Prepared for

The Los Angeles Regional Water Quality Control Board

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Santa Susana Field Laboratory

Surface Water Expert Panel Annual Report

2025/26 Reporting Year

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Abbreviations

AIBP	Area I Burn Pit
AILF	Area I Landfill
A2LF	Area II Landfill
BMP	Best Management Practice
CDO	Cease and Desist Order
CM	Culvert Modification
COPC	Constituent of Potential Concern
DDF	Depth-Duration-Frequency
DL	Detection Limit
DMR	Discharge Monitoring Report
DNQ	Detected Not Quantified
DOE	U.S. Department of Energy
DTSC	California Department of Toxic Substances Control
ELV	Expendable Launch Vehicle
ETEC	Energy Technology Engineering Center
GAC	Granular Activated Carbon
HHRA	Human Health Risk Assessment
IDF	Intensity-Duration-Frequency
ISE	Imminent and Substantial Endangerment
ISRA	Interim Source Removal Action
LADWP	Los Angeles Department of Water and Power
LARWQCB	Los Angeles Regional Water Quality Control Board

LLBF	Lower Lot Biofilter
LOE	Line of Evidence
LOX	Liquid Oxygen Plant
MCL	Maximum Contaminant Level
mg/L	milligrams per liter
MOU	Memorandum of Understanding
MWD	Metropolitan Water District
NASA	National Aeronautics and Space Administration
ND	Not Detected
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
PCB	Polychlorinated Biphenyls
PFAS	Per- and Polyfluoroalkyl Substances
PFDS	Precipitation Frequency Data Server
PSD	Particle-Size Distribution
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RMMP	Restoration, Mitigation, and Monitoring Plan
SAP	Sampling and Analysis Plan
S-GAC	Sulfur-Impregnated Granular Activated Carbon
SRAM	Standardized Risk Assessment Methodology
SSFL	Santa Susana Field Laboratory
SWEP	Surface Water Expert Panel
SWPPP	Stormwater Pollution Prevention Plan
SWTS	Stormwater Treatment System
TCDD	2,3,7,8-Tetrachlorodibenzo-p-dioxin
TEQ	Toxic Equivalency
TMDL	Total Maximum Daily Load
TPH	Total Petroleum Hydrocarbons
TSS	Total Suspended Solids
µg/L	micrograms per liter

Executive Summary

Stormwater discharges from the Santa Susana Field Laboratory (SSFL) are regulated under NPDES Permit No. CA0001309, Order No. R4-2023-0359 (Permit) issued by the Los Angeles Regional Water Quality Control Board (LARWQCB). Surface Water Expert Panel (SWEP) activities during the 2025/26 reporting year (July 1, 2025 through June 30, 2026) included review of stormwater monitoring results and implementation activities performed by site operators, evaluation of treatment control performance, investigation of sources of Permit limit exceedances, review of post-interim cleanup stabilization controls, and public engagement on stormwater topics. This Annual Report documents the SWEP's recent activities, conclusions, and recommendations, and is being submitted as required by the Permit (section 6.3.3.b[1]). During the reporting year, SSFL received 27.81 inches of rainfall, representing approximately 157% of the average annual rainfall (Table ES-1). Ten qualifying storm events occurred, with the most intense being a storm in December 2025 that had a 25-year, 12-hour and 10-year, 24-hour recurrence interval.

A total of seven outfalls discharged during the reporting year. Monitoring results were evaluated against Permit limits for 1197 constituent-outfall combinations, of which 1,180 (98.6%) met Permit limits (Table ES-1). Of the 17 Permit limit exceedances observed during the reporting year, 13 exceedances were very likely attributable to naturally occurring background soils (aluminum and manganese). The remaining four exceedances were for mercury and TCDD TEQ (no DNQ), representing approximately 0.33% of the constituent-outfall combinations compared against Permit limits.

The only exceedances at Outfalls 011 and 018 occurred during the December 2025 storm, which had a 10-year, 24-hour recurrence interval, substantially exceeding the SWEP site-specific design storm (1-year, 24-hour event) and resulting in bypasses around the SWTSs. Despite these bypasses, only aluminum and manganese exceeded Permit limits, both of which were very likely attributable to naturally occurring background soils; no constituents associated with legacy impacted surface soils exceeded Permit limits during the SWTS bypass. The December 2025 storm also produced the only discharge from Outfall 004 during the reporting year, when runoff exceeded the capacity of the storage and pumping system that normally conveys flows to the Outfall 018 SWTS; bypass flows received partial treatment through the media filter. No discharges occurred at the other small northern outfalls (003, 005, 006, 007, and 010) during the reporting year. Collectively, these observations indicate that the site's storage, pumping, and active treatment systems generally provide capacity substantially beyond the SWEP site-specific design storm.

[1] This section reads: "With input from the Surface Water Expert Panel, the Discharger shall submit annual reports that describe the previous year's monitoring results and include an evaluation of existing BMP performance and submit a workplan that includes recommendations for modified and/or new stormwater controls and monitoring that will address exceedances of limitations at any Discharge Point addressed by this permit. The Discharger shall also support the Surface Water Expert Panel in organizing periodic public interaction events and encouraging public communication and involvement."

Table ES-1. 2025/26 Reporting Year Key Metrics Summary

Key Metrics	2025/26 Reporting Year Result
Annual Rainfall	27.81 inches
Percent of Average Long-Term Rainfall	157%
Qualifying Rain Events	10
Outfalls with Discharge	001, 002, 004, 008, 009, 011, 018
Number of Outfall Samples Collected	31
Number of constituent-outfall combinations subject to Permit limits	1197
Constituent-Outfall Combinations Meeting Permit Limits	98.6% (1180 of 1197)
Permit Limit Exceedances	17 (1.4%)
Parameters with Exceedances	Aluminum, Manganese, Mercury, TCDD TEQ (no DNQ)
Percent of Constituent-Outfall Combinations Remaining After Excluding Background-Related Aluminum and Manganese Exceedances*	0.33% (4 of 1197)

*Weight-of-evidence evaluations indicated that 13 of the 17 exceedances were very likely attributable to naturally occurring background concentrations of aluminum and manganese.

Key outcomes from the SWEP's 2025/26 evaluations include:

- **Weight-of-evidence forensic investigations identified contributing sources for all Permit limit exceedances**:
    - Aluminum and manganese exceedances were very likely attributable to naturally occurring background soils.
    - The Outfall 004 mercury exceedance was very likely attributable to legacy impacted surface soils.
    - The Outfall 009 mercury exceedance was likely attributable to legacy impacted surface soils, with contributions from naturally occurring background soils.
    - The Outfall 002 TCDD TEQ (no DNQ) exceedance was likely attributable to legacy impacted surface soils and contributions from treated wood poles.
- Performance evaluations **confirmed the continued effectiveness of the Site's stormwater treatment controls** including during the December 2025 storm, when several systems experienced flows substantially greater than the SWEP site-specific design storm.
- **Effective stabilization** following the SWEP's recommendations was **confirmed at the Former Shooting Range and Area I Burn Pit** following completion of all excavation activities.
- Review of 2025/26 monitoring results confirmed previous Human Health Risk Assessment (HHRA) conclusions that recreational **exposure to SSFL stormwater does not pose elevated human health risks** through evaluated exposure pathways.
- The ultimate result of the SWEP's 2025/26 evaluations is a set of **"recommendations for modified and/or new stormwater controls and monitoring that will address exceedances of limitations"**

(per Permit section 6.3.3.b), with an emphasis on those exceedances for which legacy impacted surface soils and/or other controllable anthropogenic sources were identified as likely or very likely contributing sources.

During the reporting year, Boeing continued implementation of recommendations from prior SWEP evaluations. Key accomplishments included:

- **Reconstruction of the B-1 Media Filter** with sulfur-impregnated granular activated carbon media to improve mercury treatment performance.
- **Completion of excavation and stabilization activities at the Former Shooting Range and Area I Burn Pit** interim cleanup areas, as well as continued revegetation monitoring following stabilization activities.
- **Implementation of Coca Road stormwater control modification** (to reduce untreated road runoff to Outfall 001).

In summary, the 2025/26 monitoring program demonstrated continued water quality mitigation from SSFL stormwater controls, and no new monitoring results altered previous conclusions that recreational exposure to SSFL stormwater does not pose elevated human health risks. Based on these findings, the SWEP's 2026/27 recommendations focus on continued evaluation of stormwater controls and on actionable sources of mercury and TCDD TEQ (no DNQ), while maintaining monitoring needed to characterize naturally occurring background conditions. The SWEP's recommendations to address mercury and TCDD TEQ (no DNQ) exceedances are:

- **Source Removal:** Evaluate ISRA or similar removal of mercury- and dioxin-impacted surface soils in the Outfall 001, 002, 004, and 009 watersheds .
- **Erosion and Sediment Control:** Install and maintain erosion and sediment controls at and downstream of identified mercury and dioxin source areas, including riprap check structures and removal of accumulated impacted sediment. Replace filter fabric on Outfall 004 upland areas.
- **Treatment Control Improvements:** Evaluate additional stormwater capture capacity at Outfall 004, and continue inspection and maintenance of existing treatment controls.
- **Utility Pole Soil Source Control:** Continue inspection and replacement of wattles downgradient of utility poles
- **Targeted Monitoring:** Conduct targeted stormwater monitoring of hotspot areas with elevated mercury in surface soils and at old subarea stormwater samples with high mercury (that were based on older analytical methods), including upstream and downstream of the Area II Landfill in the Northern Drainage to further evaluate mercury from identified hillside source areas.
- **Particle Size Monitoring:** Conduct particle size fractionation monitoring to evaluate the transport of mercury, TCDD TEQ (no DNQ), and other constituents to support exceedance source evaluations.

Additionally, the SWEP continues to work closely with LARWQCB staff and Geosyntec on fulfilling the responsibilities outlined in the 2022 Memorandum of Understanding (MOU). Current efforts are focused on development and calibration of the site-wide post-cleanup stormwater model, which will provide a preview of stormwater quality following cleanup. The first draft calibration report, addressing hydrology, TSS, lead, copper, and mercury, was submitted to LARWQCB in October 2026, with calibration of the remaining constituents ongoing. The MOU also includes additional SWEP responsibilities related to modeling post-cleanup stormwater quality, background threshold development, post-cleanup

confirmation monitoring design, and oversight of an updated stormwater Human Health Risk Assessment (HHRA). These activities remain ongoing but are not the focus of this Annual Report.

1 Introduction

The Santa Susana Field Laboratory (SSFL) occupies approximately 2,850 acres in the Simi Hills of Ventura County, California. Stormwater discharges from the Site are regulated by the Los Angeles Regional Water Quality Control Board (LARWQCB) under National Pollutant Discharge Elimination System (NPDES) Permit No. CA0001309, Order No. R4-2023-0359 (2023 Permit), which became effective January 1, 2024.

The 2023 Permit requires Boeing to maintain an independent Surface Water Expert Panel (SWEP) to evaluate stormwater monitoring results, assess the effectiveness of stormwater controls, recommend improvements where warranted, and support public engagement regarding stormwater management at SSFL. Consistent with these requirements, this Annual Report summarizes monitoring activities and results from the 2025/26 reporting year (July 1, 2025 through June 30, 2026), evaluates stormwater control performance, and presents recommendations intended to improve water quality.

In August 2022, the LARWQCB approved a Memorandum of Understanding (MOU) establishing a framework for post-cleanup stormwater compliance and eventual Permit termination. The MOU includes additional SWEP responsibilities related to modeling post-cleanup stormwater quality, background threshold development, post-cleanup confirmation monitoring design, and oversight of an updated stormwater Human Health Risk Assessment (HHRA). These activities remain ongoing but are not the focus of this Annual Report.

1.1 Background

The SSFL site (the "Site") is jointly owned by the Boeing Company (Boeing) and the federal government. The National Aeronautics and Space Administration (NASA) administers the portion of the property owned by the federal government. As shown in Figure 1-1, the Site is divided into four administrative areas (Areas I, II, III, and IV), and additional undeveloped land areas surrounding the Site to the north and south. Administrative Areas I and III are operated by Boeing, which owns the majority of Area I and all of Area III. The federal government owns a 40-acre portion of Area I and the entirety of Area II, both administered by NASA. While Area IV land is Boeing-owned, the Department of Energy (DOE) is responsible for its cleanup. Boeing no longer serves as a DOE contractor; however, Boeing and preceding contractors performed work at the DOE Energy Technology Engineering Center (ETEC) site in Area IV prior to the 1998 Department of Energy remediation contract with Boeing. The DOE owns specific facilities located within an approximately 90-acre portion of Area IV. Industrial operations at the Site have ceased, and current activities include environmental monitoring and sampling, demolition, remediation, and ongoing remedial planning. Undeveloped land and open space at the Site also provide additional wildlife habitat and natural area.

The SWEP[2] consists of Dr. Robert Pitt, University of Alabama, emeritus; Dr. Robert Gearheart, California State Polytechnic University, Humboldt; Dr. Michael Stenstrom, University of California, Los Angeles; Mr. Jonathan Jones, Wright Water Engineers; and Dr. Gregory Pasternack, University of California, Davis. The SWEP continues to oversee stormwater planning and design work at SSFL, providing key input on monitoring and source removal activities, as well as a variety of NPDES Permit topics. The SWEP oversees scientific studies related to SSFL stormwater quality and stormwater control design considerations, reviews the stormwater HHRA, and engages with the public regarding stormwater activities at SSFL. The original SWEP objective to improve stormwater at NPDES Outfalls 008 and 009 was expanded in 2015 to

[2] Emeritus member of the SWEP is Dr. Michael Josselyn (formerly WRA Environmental Consultants)

include all NPDES Outfalls, as required by the 2015 Permit, and remains their charge in the current 2023 Permit. The SWEP also reviews the Quarterly Discharge Monitoring Reports (DMRs) and site-wide construction Stormwater Pollution Prevention Plans (SWPPPs) for demolition and interim source removal projects.

1.2 Site Overview and Stormwater Management Framework

Outfalls regulated under the 2023 Permit are listed in Table 1-1 and depicted in Figure 1-1. The NPDES Permit states that 60% of the annual stormwater discharge from SSFL exits the property via two southerly discharge points (Outfalls 001 and 002) to Bell Creek, a tributary to the Los Angeles River. Upstream Outfalls 011 and 018 contribute discharge to Outfalls 001 and 002, respectively. Outfalls 019 and 020 (which were intended for surface discharge of treated groundwater, if needed) are no longer included in the 2023 Permit, unlike in the previous 2015 Permit.

Groundwater considerations are not included in the scope of the SWEP, except for naturally occurring seeps and springs where groundwater is known to comingle with stormwater and could potentially contribute constituents of potential concern (COPCs) to stormwater discharges at the NPDES Outfalls. A separate Groundwater Expert Panel at SSFL advises on groundwater matters, including groundwater treatment and assessment of naturally occurring seeps and springs.

Stormwater runoff from northern areas of the Site (Outfalls 003 through 007 and 010) is captured and pumped to Silvernale Pond for treatment prior to discharge at Outfall 018. Runoff in excess of the storage and transfer system capacity is treated by flow-through media filters and discharges at Outfalls 003 through 007 and Outfall 010[3], which discharge to the Calleguas Creek watershed. SWTSs have been in place at Outfalls 011 and 018 since 2012. The SWTSs provide advanced stormwater treatment using ActiFlo coagulation and filtration systems, with stormwater ponds upstream for flow equalization and pretreatment by sedimentation. The SWTS at Outfall 011 has experienced lapses in operation throughout its lifetime, but it has been operational since December 2019. Both Outfall 011 and 018 SWTSs were operational throughout the 2025/26 reporting year.

Stormwater runoff from the Outfall 008 and 009 Watersheds is not captured and treated by a central SWTS[4], given the location, size, and adverse terrain of these watersheds, coupled with the inability to store large volumes of stormwater near the outfalls. As described in the 2010 BMP Plan, due to topographical constraints, distributed stormwater treatment and an iterative, adaptive management-based approach are applied within both the Outfall 008 and 009 Watersheds. Stormwater runoff that discharges at Outfall 009 naturally flows to Arroyo Simi and subsequently to Calleguas Creek. Stormwater runoff from Happy Valley at Outfall 008 flows via Dayton Canyon Creek to Chatsworth Creek, which flows south to join Bell Creek southwest of the intersection of Shoup Avenue and Sherman Way. Bell Creek then continues southeast toward its confluence with the Los Angeles River.

[3] There have been five discharges at Outfall 004, seven discharges at Outfall 006, and four discharges at Outfall 010, and none at Outfall 003, 005, and 007 since the pumps and conveyance lines were installed in 2010/11. Outfalls 005 and 007 do not have media filters.

[4] An exception to this is where a portion of runoff from the Helipad in Area II of the Outfall 009 Watershed is captured and piped to Silvernale Pond for treatment by the Outfall 018 SWTS.

Table 1-1. NPDES Outfall Descriptions

NPDES Outfall[1]	Watershed Area (acres)	Description
001	293 (+303 above Outfall 011)	Downstream of Outfall 011; discharges to Bell Creek
002	360 (+539 above Outfall 018)	Downstream of Outfall 018; discharges to Bell Creek
003	12	Runoff transferred to Silvernale for treatment prior to discharge at Outfall 018[2]
004	6	Runoff transferred to Silvernale for treatment prior to discharge at Outfall 018[2]
005	<1	Runoff transferred to Silvernale for treatment prior to discharge at Outfall 018
006	12	Runoff transferred to Silvernale for treatment prior to discharge at Outfall 018[2]
007	3.0	Runoff transferred to Silvernale for treatment prior to discharge at Outfall 018
008	62	Stormwater from Happy Valley; discharges to Dayton Creek
009	536	Stormwater from Northern Drainage; discharges to Arroyo Simi
010	5	Runoff transferred to Silvernale for treatment prior to discharge at Outfall 018[2]
011	303	Stormwater and perimeter pond treated by SWTS; discharges to Outfall 001
018	539	Stormwater and R-2 pond, treated by SWTS; discharges to Outfall 002

[1] Outfalls 012 through 017 are not included in the 2015 or 2023 Permit. Outfalls 019 and 020 (unused outfalls intended for treated groundwater) were removed in the 2023 Permit.
[2] Stormwater runoff exceeding storage and transfer capacities is treated by media filters at individual outfalls before discharging to tributaries of Calleguas Creek.

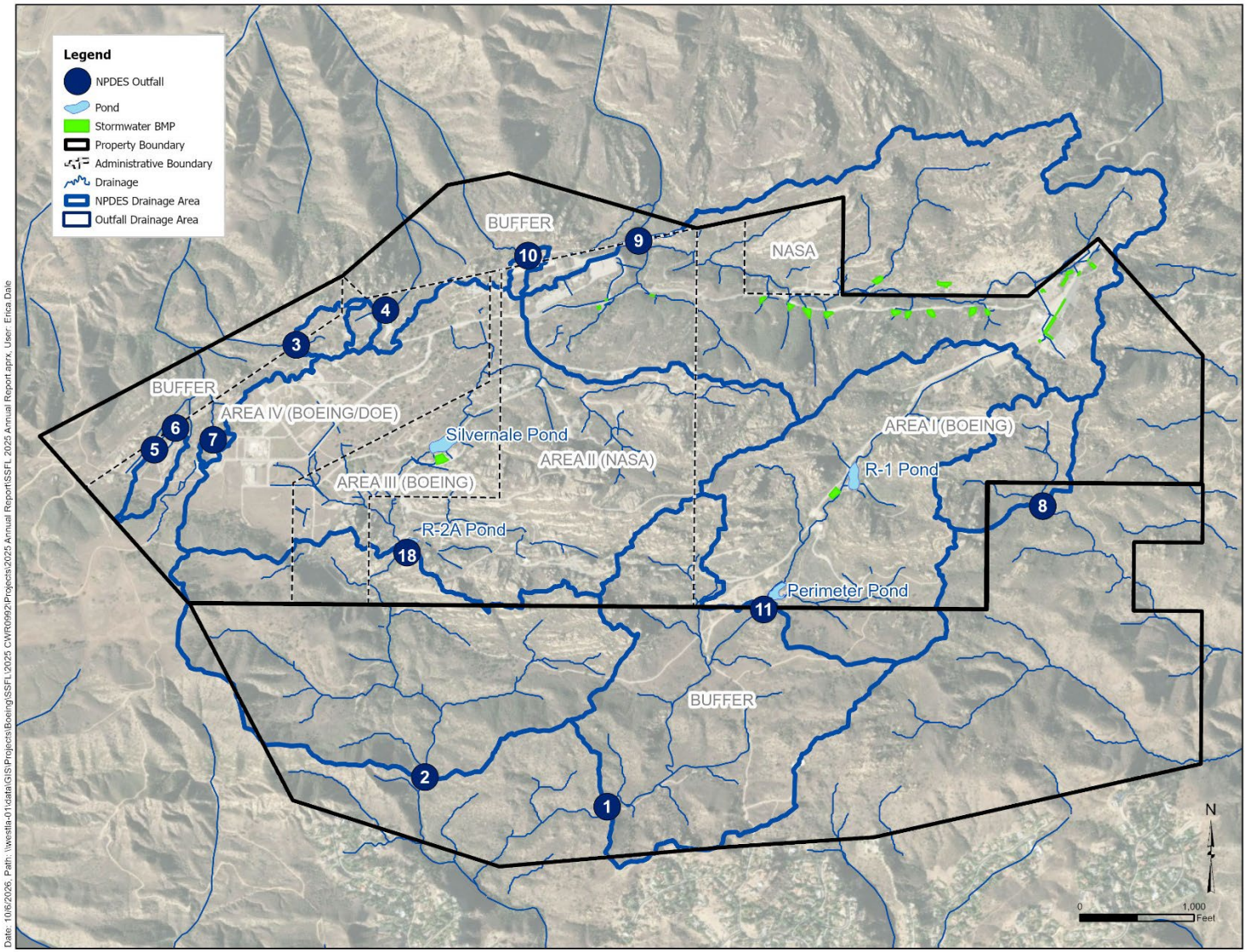

Figure 1-1. Site Map with Drainages, Drainage Areas, Outfalls, and Stormwater Treatment Controls

1.3 Existing Stormwater Control Summary

SSFL uses a combination of centralized treatment systems, distributed structural stormwater controls, runoff diversions, source-control measures, and site-wide erosion and sediment controls to manage stormwater and improve stormwater quality before discharging at the outfalls. Table 1-2 summarizes the principal control types and their locations. Additional information, including the stormwater control inventory, implementation history, current status, and representative photographs, is provided in Appendix B.

Table 1-2. Summary of Stormwater Controls Utilized Onsite

Treatment control Type	Primary Locations	Function and Examples
Centralized active treatment systems	Watersheds 011 and 018	Ponds provide storage, settling, and flow equalization before treatment by the Stormwater Treatment Systems (SWTSs). Treated water discharges through Outfalls 011 and 018 and continues to Outfalls 001 and 002, respectively.
Runoff capture and transfer	Outfalls 003 through 007 and 010; helipad in Outfall 009 watershed.	Pumps and conveyance systems transfer runoff to Silvernale Pond for treatment by the Outfall 018 SWTS.
Distributed passive treatment controls	Primarily Outfall 009 watershed	Sedimentation basins, media filters, biofilters, bioswales, culvert modifications, check structures, and localized detention controls treat runoff within the watershed.
Diversion and conveyance controls	Outfall 001, 009, and 011 watersheds	Berms, pumps, slope drains, roadway diversions, stabilized channels, and the western Area I Burn Pit (AIBP) diversion route runoff to treatment or controlled discharge locations.
Erosion and sediment controls	Site-wide, including interim cleanup areas and the Northern Drainage	Fiber rolls, wattles, riprap, check structures, inlet controls, temporary covers, and stabilized slopes reduce erosion and sediment transport.
Source-control and interim cleanup measures	Outfall 008 and 009 watersheds, Former Shooting Range, and AIBP	Soil removal, stabilization, revegetation, and cleanup-related controls reduce contact between stormwater and legacy impacted surface soils.
Road and impervious-area controls	Site-wide	Road stabilization, pavement removal, soil scarification, building removal, and revegetation reduce runoff and erosion from disturbed or impervious areas.
Utility-pole controls	Site-wide, but mostly in Outfall 009 watershed and the Southern Buffer Zone	Wattles and soil stabilization around treated wood utility poles reduce transport of associated constituents.
Inspection and adaptive maintenance	Site-wide, including the Northern Drainage	Monitoring and inspections identify sediment-removal, repair, stabilization, and stormwater control-modification needs.

1.4 Permit History

Table 1-3 provides an overview of past SSFL stormwater Permits, SWEP involvement, and notable milestones.

Table 1-3. Key Stormwater Regulatory and Site Milestones

Year	Milestone	Significance
1998	Initial NPDES Permit Issued	Established regulatory requirements for wastewater and stormwater discharges from SSFL.
2004	NPDES Permit Update	Added California Toxics Rule-based limits and 11 new compliance monitoring locations.
2005	Topanga Wildfire	Approximately 97% of SSFL burned, contributing to elevated runoff and exceedances during the subsequent storm seasons.
2006	NPDES Permit Revision	Added waste load allocations associated with downstream TMDLs.
2007	Cease and Desist Order (CDO)	Required formation of the Surface Water Expert Panel (SWEP) and expanded stormwater-control evaluation, planning, and reporting requirements.
2009–2013	Outfall 008 Interim Source Removal Action	Removed soil affected by copper, lead, and dioxins within the Outfall 008 watershed to reduce potential stormwater pollutant sources.
2009–2013	Outfall 009 Interim Source Removal Action	Removed soil affected by cadmium, copper, lead, mercury, and dioxins within the Outfall 009 watershed to reduce potential stormwater pollutant sources. ISRA soil removals were completed in 2013.
2010	NPDES Permit Renewal	Continued SWEP oversight and stormwater-control implementation within the Outfall 008 and 009 watersheds.
2011	Outfall 011 and 018 Stormwater Treatment Systems Operational	Reduced site-wide discharges by routing runoff from multiple outfalls for treatment before discharge.
2015	NPDES Permit Renewal	Expanded SWEP responsibilities to all regulated SSFL outfalls and implemented site-wide exceedance review and stormwater-control recommendations.
2018	Woolsey Wildfire	Approximately 80% of the Site burned. Subsequent storms produced elevated runoff volumes and exceedances associated with vegetation loss and post-fire watershed conditions.
2022–2025	Former Shooting Range Imminent and Substantial Endangerment (ISE) Cleanup	The ISE Order was issued on March 25, 2022. Remediation began in May 2023, and excavation and stabilization were completed in 2025 within the Outfall 009 watershed.
2022–2026	Area I Burn Pit ISE Cleanup	The ISE Order was issued on May 9, 2022. The Removal Action Workplan was approved in December 2023, excavation began in March 2024, and excavation was completed in September 2026.
2023	NPDES Permit Renewal	Revised several constituent limits and converted the Outfall 001 and 002 benchmarks to enforceable effluent limitations.

2 Key Findings

The following findings summarize the analyses and activities described in the following sections.

2.1 Rainfall

The Site experienced above-average annual rainfall (157% of the annual average) in 2025/26.

The 2025/26 reporting year was wetter than average, with 27.81 inches of rainfall (157% of the long-term average) and ten qualifying storm events. Two large storm events in November and December 2025 accounted for approximately 58% of the annual rainfall, and the December 23–27, 2025 storm included a 24-hour rainfall depth corresponding to the 10-year recurrence interval (and the 12-hour rainfall depth exceeded the 25-year recurrence interval depth).

2.2 Sources of Exceedances

During the 2025/26 reporting year, stormwater monitoring results were evaluated against Permit limits for **1,197 constituent-outfall combinations, of which 1,180 (98.6%) met Permit limits**. The remaining **17 Permit limit exceedances** were observed at Outfalls 001, 002, 004, 009, 011, and 018. Exceedances were limited to aluminum (11 exceedances), manganese (2 exceedances), mercury (2 exceedances), and TCDD TEQ (no DNQ) (2 exceedances). A weight-of-evidence evaluation was performed using soil concentration mapping, spatial analyses, particulate-strength comparisons, dissolved-phase evaluations, and chemical fingerprinting to identify potential and/or likely contributing sources of all Permit limit exceedances.

- **Aluminum:** Weight-of-evidence analyses indicate that aluminum exceedances at Outfalls 001, 002, 009, 011, and 018 were very likely attributable to **natural background soils.**
- **Manganese:** Weight-of-evidence analyses indicate that manganese exceedances at Outfalls 001 and 011 were very likely attributable to **natural background soils .**
- **Mercury:** Mercury exceedances at Outfalls 004 and 009 could not be fully explained by background conditions. Weight-of-evidence analyses identified **legacy impacted surface soils** as a very likely contributor at both outfalls.
- **TCDD TEQ (no DNQ):** TCDD TEQ (no DNQ) exceedances at Outfall 002 could not be explained by background conditions. Weight-of-evidence analyses identified **legacy impacted surface soils and treated wood poles** as likely contributing sources.

Overall, weight-of-evidence analyses indicate that 13 of the 17 Permit limit exceedances were attributable to natural background soils, leaving four exceedances associated with mercury and TCDD TEQ (no DNQ). Based on these findings, additional monitoring, treatment control, and source-control **recommendations were developed for exceedances (n=4) where industrial material and legacy impacted surface soils or other controllable anthropogenic sources were identified as potential and/or likely contributing sources**.

2.3 ISE Order Activities

Former Shooting Range areas are undergoing revegetation after the interim contaminated soil remediation action was completed, while Area I Burn Pit contaminated soil removal was completed in September 2026 and stabilization activities remain ongoing. Inspections noted that erosion controls and stabilization measures were in place at both cleanup areas during the reporting period.

2.4 Stormwater Human Health Risk Analysis (HHRA)

Outfall sampling results for 2025/26 continue to confirm results from the 2017 SSFL stormwater HHRA[5] that cumulative cancer risk and noncancer hazard estimates for recreational exposure to SSFL stormwater are well below regulatory thresholds at all assessed outfalls, confirming there is no elevated human health risk from recreational exposure to SSFL creek flows.

Although a few samples exceeded primary drinking water standards for aluminum, these were particle-associated in SSFL stormwater and therefore they are unlikely to travel with infiltrating creek flows downstream offsite and infiltrate to groundwater that is used for drinking due to natural soil filtration processes.

2.5 009 Subarea Prioritization for Mercury

Mercury concentrations in surface soils and stormwater samples from subareas in the 009 watershed were evaluated to identify potential source areas for mercury. Results were then used to issue new stormwater control and monitoring recommendations to help address the mercury exceedances.

Appendix E (Subarea Prioritization Analysis for Mercury in the Outfall 009 Watershed) yielded several top-ranked locations for mercury to focus targeted sampling to evaluate treatment control performance and potential contributions from impacted surface soils – Area 2 Landfill, Area 2 Road, B-1 Media Filter, the Northern Detention Bioswale, and the Lower Lot Biofilter.

As source removal is the preferred mitigation strategy to reduce stormwater exceedances, the SWEP recommends that Boeing and NASA prioritize the removal of mercury impacted surface soils throughout the 004 and 009 watersheds, as soon as feasible and allowed by the regulators. For example, in 2008, in response to NPDES Permit limit exceedances at Outfalls 008 and 009, the LARWQCB issued an Interim Source Removal Action (ISRA) order to Boeing and NASA to address surface soils elevated for NPDES exceeding parameters; since the mercury limit was lowered in the 2023 NPDES Permit for certain outfalls resulting in new mercury exceedances, it could be sensible to pursue a collaborative solution like this with the regulator once again.

2.6 Sandy Fire Stabilization Activities

Although the **May 2026 Sandy Fire did not burn within SSFL or watersheds draining to regulated NPDES outfalls, post-fire stabilization measures were implemented to address localized disturbances associated with firefighting access to nearby property and response activities.** Disturbed roadway and access areas were evaluated by the SWEP and stabilization recommendation provided by the SWEP were implemented by the operator, as needed, to minimize erosion potential, maintain stormwater controls, and prepare the Site for the 2026/27 rainy season.

2.7 Background Thresholds Development Update

Offsite stormwater monitoring continued at two background and one ambient (non-industrial, partly developed) watersheds to collect additional data to refine the background stormwater threshold

[5] https://www.waterboards.ca.gov/losangeles/public_notices/Boeing/2017/16.FinalHHRAforSurfaceWaterRunoffExitingSSFLviatheSouthernOutfalls-October30,20017.pdf

values, many of which were found to be above 2023 NPDES Permit limits in both ambient and natural background watersheds. Results indicate additional samples are needed to improve reliability of background threshold values, which provide important context for interpreting stormwater concentrations observed at SSFL. An update to the background stormwater thresholds based on data collected through 2025/26 is included in Appendix F.

3 Monitoring Activities

Characteristics of the 2025/26 rainfall record are presented below, alongside a summary of stormwater sample results from NPDES Permit outfalls, the Outfall 009 Watershed stormwater controls, and offsite background monitoring locations specified in the 2025/26 reporting year Sampling and Analysis Plan (Appendix A). Observations from the Northern Drainage assessment are also summarized below.

3.1 2025/26 Rainfall Summary

The long-term average annual rainfall at SSFL from 1959 to 2026 is 17.8 inches[6], occurring primarily in winter storms from October through April. Highly variable periods of above or below-average rainfall are common. Little rainfall typically occurs during the May through September dry season. A total of 27.81 inches of rainfall was measured in the 2025/26 reporting year, more than twice the total rainfall received in the prior reporting year (2024/25 had 10.8 inches of rain). A total of ten qualifying rain events occurred in 2025/26, where a "rain event" is defined by the NPDES Permit as 0.1 inch of rainfall or greater in a 24-hour period preceded by at least 72 hours of dry weather. Of the ten rain events, eight produced runoff discharges at one or more NPDES outfalls.

Table 3-1 summarizes historical rainfall totals observed since the submittal of the Surface Water Expert Panel Work Plan in 2010. Nine of the last 17 reporting years have had above-average rainfall (bolded in the table below), and there was a five-year drought from 2011/12 to 2015/16.

[6] Data from the Simi Hills – Rocketdyne Lab gauge (Ventura County Watershed Protection District site 249) were used to determine annual rainfall from 1958/59 through 1977/78 and from 1984/85 through 2000/01. Rainfall data from 2001/02 through 2025/26 were recorded at the Area 4 gauge, which was relocated to Area 1 on January 1, 2013), resulting in a combined period of record of 62 years.

Table 3-1. Historical Rainfall at SSFL, since 2010 Surface Water Expert Panel Work Plan

Reporting Year	Annual Rainfall (in)	Percent of Average Annual Rainfall	Number of Qualifying Rain Events
2025/26	**27.81**	157%	10
2024/25	10.8	61%	8
2023/24	**37.8**	213%	14
2022/23	**45.9**	259%	16
2021/22	**18.2**	103%	8
2020/21	4.5	26%	5
2019/20	**20.5**	115%	9
2018/19	**26.3**	148%	12
2017/18	9.8	55%	4
2016/17	**23.4**	132%	14
2015/16	12.0	68%	13
2014/15	11.2	64%	9
2013/14	6.1	34%	5
2012/13	8.1	46%	9
2011/12	11.3	64%	10
2010/11	**23.4**	132%	14
2009/10	**19.4**	109%	11

Note: Above-average annual rainfall totals are **bolded**.

Figure 3-1 illustrates the cumulative rainfall recorded in 2025/26 compared to the previous eight years and the long-term average annual rainfall.

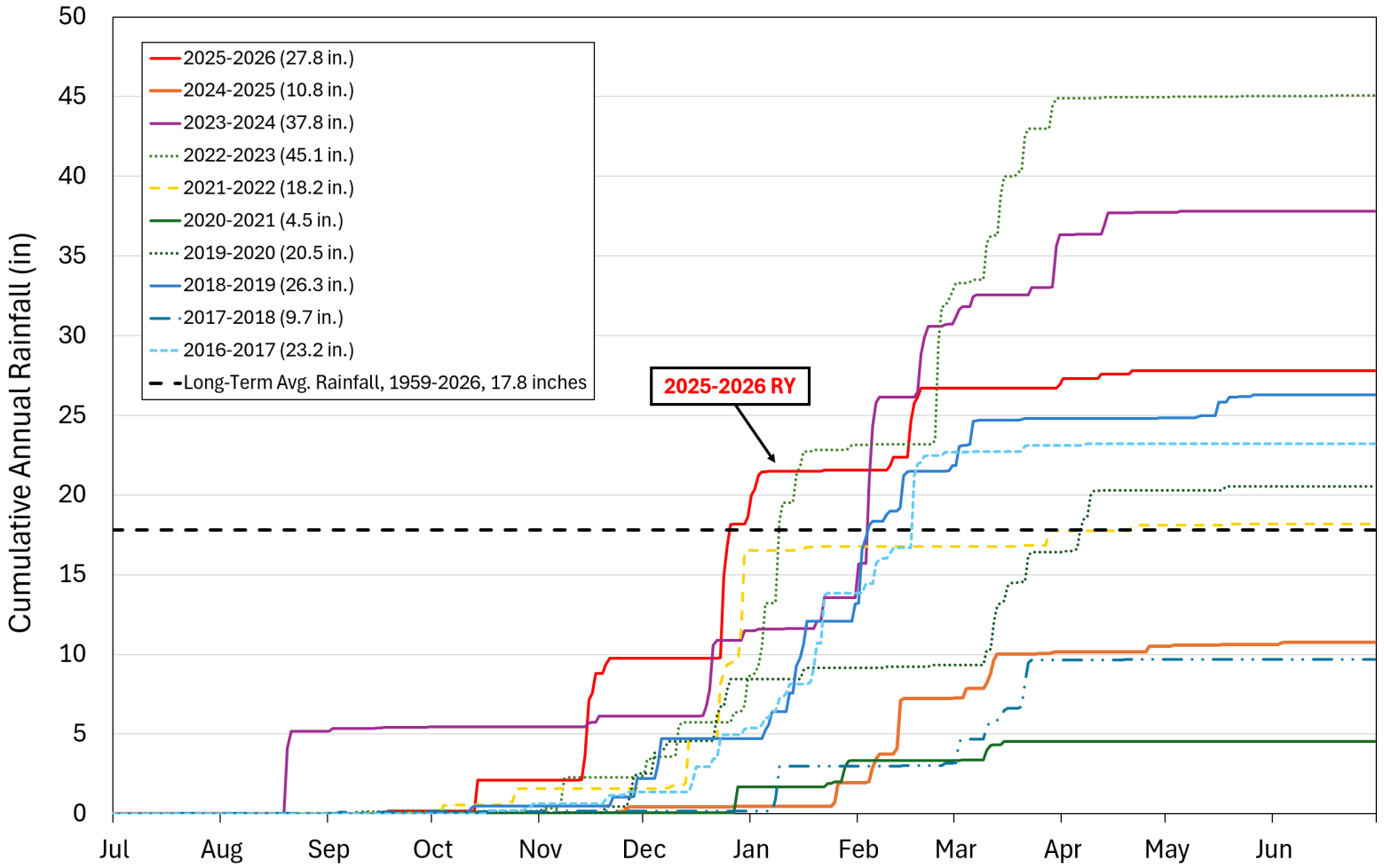

Figure 3-1. Annual Cumulative Rainfall, 2016-2026

Table 3-2 summarizes the depth, intensity, and recurrence interval of rain events in 2025/26. The largest rain event of 2025/26 occurred December 23-27, 2025, with a total of 8.42 inches. The maximum 12-hour and 24-hour rainfall depths also occurred during the same storm, which had a recurrence interval of 25-year (12-hr) and 10-year (24-hr) based on the point precipitation depth duration frequency estimates for SSFL shown in Table 3-3 (NOAA, 2026). The next largest rain event of 2025/26 occurred November 13-21, 2025, with a total of 7.64 inches. The maximum 24-hour rainfall depth observed for this storm, 3.49 inches, corresponds with a 2-year recurrence interval (NOAA, 2026). Combined, these two storms produced 16.06 inches of rainfall, which was over half of the 2025/26 total annual rainfall.

Table 3-2. 2025/26 Rain Event Summary

Rain Event[1]	Total Rainfall (in)	Rain Event Duration (hours)	Average Rainfall Intensity During Hours with Rainfall (in/hr)	Maximum 1-hr Rainfall Intensity (in/hr)	Maximum 24-hr Rainfall Depth (in)	Recurrence Interval[2]	Antecedent Dry Period[3] (days)
9/18/2025-9/18/2025	0.15	5	0.03	0.06	0.15	< 1-year	106
10/14/2025-10/15/2025	1.93	33	0.11	0.40	1.93	1-year, 6-hour	26
11/13/2025-11/21/2025	7.64	180	0.09	0.5	3.49	2-year, 24-hour	30
12/23/2025-12/27/2025	8.42	87	0.13	0.75	5.14	25-year, 12-hour; 10-year, 6 and 24-hour	32
12/31/2025-1/6/2026	3.32	137	0.06	0.33	1.79	< 1-year	4
2/10/2026-2/11/2026	0.82	14	0.12	0.28	0.82	< 1-year	36
2/16/2026-2/19/2026	4.35	80	0.11	0.59	2.29	2-year, 6-hour; 1-year, 12-hour, <1-year, 24-hour	5
3/31/2026-4/1/2026	0.59	6	0.10	0.22	0.59	< 1-year	40
4/12/2026-4/12/2026	0.27	2	0.04	0.06	0.27	< 1-year	11
4/21/2026-4/21/2026	0.20	4	0.03	0.07	0.2	< 1-year	9
Non-Event Total[4]	0.12	--	--	--	--	--	--
Total	27.81	--	--	--	--	--	--

[1] Total rainfall, event duration, rainfall duration, average rainfall intensity, and maximum 1-hour rainfall intensity were assessed from rainfall data recorded at a calibrated and maintained weather station within Area I.

[2] Recurrence interval is based on the point precipitation depth duration frequency estimates for SSFL shown in Table 3-3 (NOAA, 2026). Depths for durations of 1, 3, 6, 12, and 24 hours were evaluated and the largest recurrence intervals are summarized in the table. If no depths were greater than the 1-year recurrence interval <1-year is shown.

[3] Antecedent dry period represents the number of days between the start of the rain event and the last recorded rainfall, regardless of whether it qualified as a rain event.

[4] Non-Qualifying Event Total. The following rainfall measured in 2025/26 did not meet the definition of a qualifying rain event per the NPDES Permit: September 26, 2025 (0.03 in), January 22, 2026 (0.06 in), May 3, 2026 (0.02 in), and May 26, 2026 (0.01 in).

Table 3-3. NOAA Point Precipitation Depths (inches), Durations, and Frequencies at SSFL

Duration	Average Recurrence Interval[1]						
	1-yr	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
1-hour	0.51	0.67	0.87	1.03	1.24	1.40	1.57
3-hour	0.95	1.24	1.62	1.92	2.32	2.62	2.92
6-hour	1.38	1.80	2.34	2.78	3.36	3.79	4.22
12-hour	1.89	2.47	3.21	3.81	4.59	5.18	5.76
24-hour (1 day)	2.53	3.33	4.34	5.14	6.20	6.98	7.76
48-hour (2 day)	3.14	4.20	5.55	6.63	8.07	9.16	10.20
72-hour (3 day)	3.45	4.69	6.32	7.65	9.46	10.90	12.30
96-hour (4 day)	3.74	5.14	7.00	8.54	10.70	12.30	14.00

[1] Source: Long-term precipitation depth duration frequency (DDF) data, NOAA Precipitation Frequency Data Server (PFDS). NOAA Atlas 14, Volume 6, Version 2. Simi Hills-Rocketdyne Lab, Latitude: 34.2353°, Longitude: -118.6759°. Accessed on August 14, 2026.

Table 3-3 presents observed rainfall intensities throughout the 2025/26 reporting year compared to NOAA point precipitation frequency estimates (NOAA, 2026). The 1-hour and 3-hour rainfall intensities were generally below the 10-year recurrence interval depth. The 6-hour and 12-hour rainfall intensities were generally below the 25-year recurrence interval depth, with one 12-hour rainfall intensity between the 25-year and 50-year interval depths. The remaining greater duration intensities were below the 25-year recurrence interval depth. Note that peak runoff occurs when the rainfall duration is equal to the time of concentration of the drainage area. Small drainage areas can, therefore, have peak runoff rates during relatively short rain durations, while large drainage areas require longer rain durations to produce peak runoff rates.

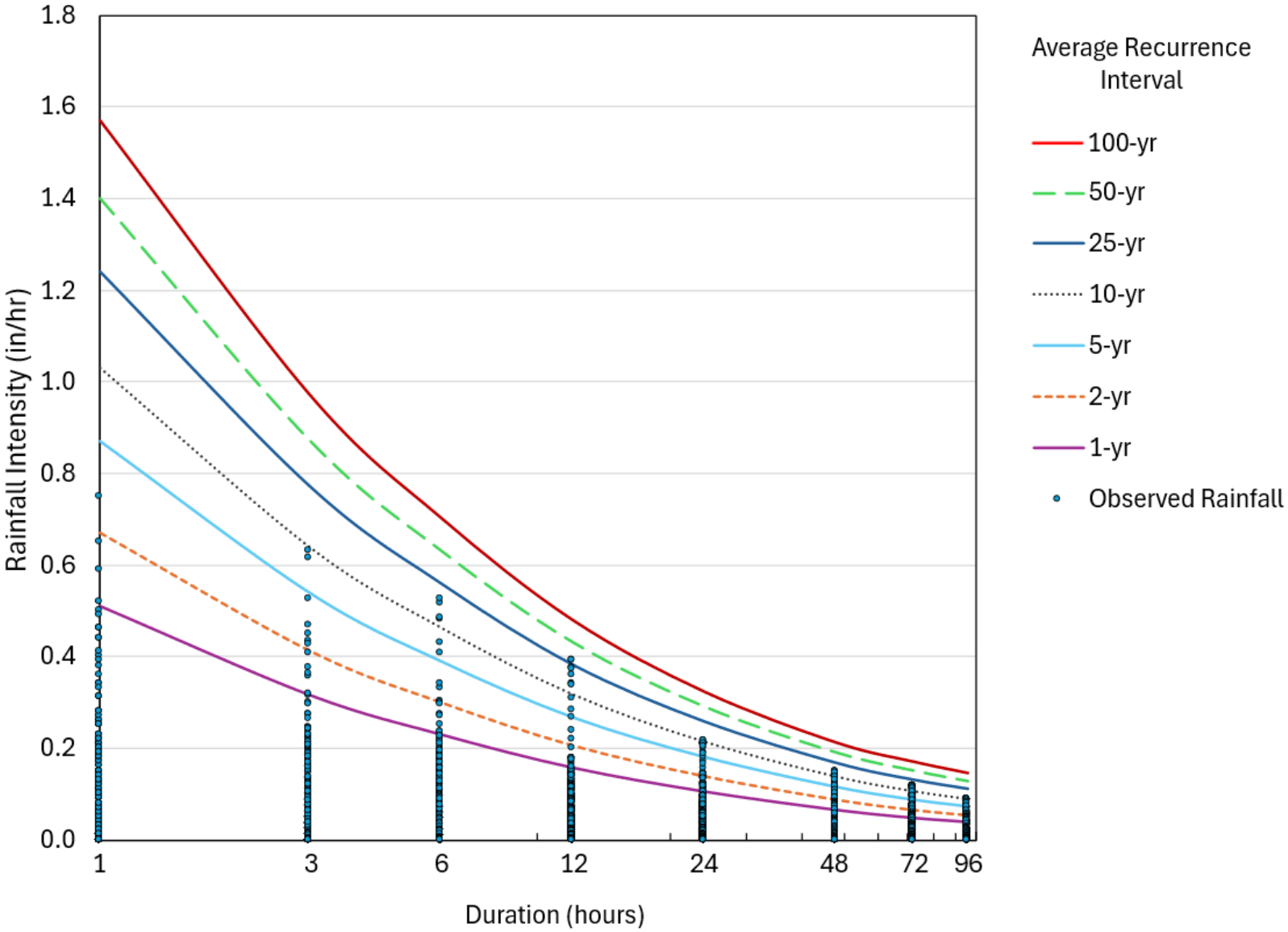

Figure 3-2. SSFL IDF Curves and Observed 2025/26 Rainfall Intensities

3.2 2025/26 Discharge Sampling Summary

During the 2025/26 reporting year, a total of 31 samples were collected from NPDES Outfalls 001, 002, 004, 008, 009, 011 and 018. In addition to the compliance samples, 35 stormwater control performance monitoring samples were collected in Outfall 009 Watershed, representing 15 influent and effluent sample pairs (where an influent might be a weighted composite of multiple influent points), and two subarea samples were collected in the Area I Burn Pit (AIBP) vicinity. Additionally, seven background and four ambient offsite samples were collected to refine the background stormwater thresholds. A full list of sampling locations and monitoring suites can be found in Appendix A (2025/26 Reporting Year Sampling and Analysis Plan); sampling results are discussed in the following sections.

3.2.1 NPDES Outfalls

During the 2025/26 reporting year, stormwater and SWTS discharges were monitored at Outfalls 001, 002, 004, 008, 009, 011, and 018 in accordance with the Permit. Of the 1,197 constituent-outfall combinations evaluated, 1,180 (98.6%) met Permit limits. Seventeen exceedances were observed at Outfalls 001, 002, 004, 009, 011, and 018 and were limited to aluminum (11), manganese (2), mercury (2), and TCDD TEQ (no DNQ) (2). Outfall 008 was monitored during three storm events with no Permit limit exceedances. Table 3-4 summarizes discharge-producing events, the NPDES outfalls that discharged, and the Permit limit exceedances observed during each event.

No sampleable discharges occurred at Outfalls 003, 005, 006, 007, and 010. Runoff from these watersheds was routed to the Silvernale Pond treatment system and subsequently monitored at Outfall 018, precluding direct sampling at the upstream outfalls. Outfalls 011 and 018 were monitored during the reporting year, including during storm events with SWTS bypass conditions. An additional SWTS-only discharge was collected at Outfall 018 and Outfall 002 in January 2026, following restart of the treatment system after the preceding storm.

The wet season was characterized by several large storm events, including the November 2025 and December 2025 storms. The December 23-27, 2025 storm was the largest event of the reporting year, producing 8.42 inches of rainfall and resulting in the highest number of Permit limit exceedances observed during the reporting year.

Table 3-4. NPDES Outfalls – 2025/26 Stormwater Discharges and Exceedances

Outfall	Dates of Discharge-Producing Storm Events or SWTS Discharge	Exceedance Summary				
		Sample Date	Exceeding Parameter	Unit	Result	2023 Permit Limit
001	12/23-27/2025 12/31/2025-1/6/2026 2/16-19/2026	12/27/2025	Aluminum	mg/L	3.3	1.0
		1/2/2026	Aluminum	mg/L	1.1	1.0
		2/18/2026	Aluminum	mg/L	6.4	1.0
		2/18/2026	Manganese	µg/L	110	50
002	11/13-21/2025 12/23-27/2025 12/31/2025-1/6/2026 1/19-21/2026 (018 SWTS only) 2/10-11/2026 2/16-19/2026 3/31-4/1/2026 4/12/2026 4/21/2026	11/16/2025	Aluminum	mg/L	4.5	1.0
		12/25/2025	Aluminum	mg/L	4.1	1.0
		2/17/2026	Aluminum	mg/L	3.5	1.0
		11/16/2025	TCDD TEQ (no DNQ)	µg/L	3.419E-08	2.8E-08
		12/25/2025	TCDD TEQ (no DNQ)	µg/L	7.17E-08	2.8E-08
004	12/23-27/2025	12/26/2025	Mercury	µg/L	0.046	0.024
008	12/23-27/2025 12/31/2025-1/6/2026 2/16-19/2026	*No exceedances in 2025/26*				
009	10/31/2025 (water main break)[1] 11/13-21/2025 12/23-27/2025 12/31/2025-1/6/2026 2/16-19/2026	12/25/2025	Aluminum	mg/L	1.1	1.0
		1/2/2026	Aluminum	mg/L	1.3	1.0
		2/17/2026	Aluminum	mg/L	1.2	1.0
		12/25/2025	Mercury	µg/L	0.025	0.024
011	12/23-27/2025 (SWTS bypass) 12/31/2025-1/6/2026 2/16-19/2026	12/26/2025	Aluminum	mg/L	2.6	1.0
		12/26/2025	Manganese	µg/L	52	50
018	11/13-21/2025 12/23-27/2025 (SWTS bypass) 12/31/2025-1/6/2026 1/19-21/2026 (SWTS only)[2] 2/16-19/2026 3/31-4/1/2026	12/26/2025	Aluminum	mg/L	1.2	1.0

[1]The October 31, 2025 discharge was caused by a drinking water main break in the upper Outfall 009 watershed and was not associated with a rain event.
[2]The January 19–21, 2026 event reflects an additional SWTS discharge following restart of the treatment system after the preceding storm, rather than a separate storm event.

Stormwater Treatment System Bypass Observations

This section reviews overflow and bypass events at the Outfall 011 and Outfall 018 SWTSs during the 2025/26 reporting year, to determine whether such events are associated with any observed Permit limit exceedances. Overflow events are important to track because they can result in stormwater being only partially treated through pond storage and sedimentation rather than fully treated by the advanced SWTS. Historically, overflows have mainly occurred during storms exceeding the 1-year, 24-hour design storm (2.5 inches) or during consecutive large events.

During the 2025/26 reporting year, overflow or bypass conditions occurred at both the Outfall 011 and Outfall 018 SWTSs during the December 23-27, 2025 storm event, which produced 8.42 inches of rainfall. During this storm event, overflow from the R-2A Pond bypassed the Outfall 018 SWTS and discharged untreated stormwater via Outfall 018. Likewise, the Outfall 011 Media Filter and the Outfall 011 SWTS had bypass and discharged untreated stormwater via Outfall 011. Aside from this event, stormwater captured in the Outfall 011 and Outfall 018 ponds was treated at the respective SWTSs as designed. Review of the 2025/26 monitoring results indicated overflow and bypass conditions during the extreme December 2025 storm very likely contributed to the exceedances at Outfalls 011 and 018; however, the Outfall 011 and Outfall 018 SWTSs generally provided effective treatment throughout the reporting year.

Sources of Exceedances

A weight-of-evidence evaluation was conducted to identify potential and/or likely contributing sources of Permit limit exceedances observed during the 2025/26 reporting year. The evaluation incorporated multiple lines of evidence (LOE): surface-soil concentration mapping, stormwater and solid-source comparisons, spatial analyses, particulate-strength and dissolved-phase evaluations, and chemical fingerprinting.

Potential source contributors identified through the LOE evaluations generally fall within three source categories that differ in source characteristics and controllability: (1) naturally occurring background sources, (2) industrial materials and legacy impacted surface soils, and (3) other controllable anthropogenic sources. These source categories are used throughout this report and Appendix D to describe and communicate exceedance source evaluations. Table 3-5 summarizes the source categories evaluated and their general characteristics.

Table 3-5. Description of Exceedance Source Categories Evaluated

Source Category	Description	Example Sources	Controllability
Naturally Occurring Background Sources	Constituent concentrations attributable to ambient geologic or environmental conditions that are often ubiquitous	Natural background soils	Generally not controllable, some reductions possible through erosion and sediment control or treatment
Industrial Material and Legacy Impacted Surface Soils	Constituents suspected to be associated with historical site industrial activities and potentially subject to cleanup	Surface soils elevated for mercury in RCRA Facility Investigation (RFI) areas	Usually controllable through source removal, stabilization, or treatment
Other Controllable Anthropogenic Sources	Non-industrial materials or site features that may contribute constituents but are not impacted by legacy industrial activities	Treated wood poles; pavement	Potentially controllable through source control measures or treatment

Table 3-6 summarizes the source conclusions, while detailed supporting analyses are provided in Appendix D, 2025/26 Exceeding Constituent Source Investigation.

Key Findings:

- **Aluminum and manganese:** The combined LOEs indicate that the aluminum and manganese exceedances were very likely attributable to naturally occurring background soils.
- **TCDD TEQ (no DNQ):** The combined LOEs indicate that the Outfall 002 exceedance was likely attributable to legacy impacted surface soils and contributions from treated wood poles. Notably, no TCDD TEQ (no DNQ) Permit limit exceedances occurred at Outfall 018 during the December 2025 SWTS bypass, despite elevated TCDD TEQ concentrations in watershed surface soils, providing additional support for focusing source evaluation and control measures within the Outfall 002 watershed.
- **Mercury:** At Outfall 004, the combined LOEs indicate that the mercury exceedance was very likely attributable to legacy impacted surface soils. At Outfall 009, the combined LOEs indicate that the mercury exceedance was likely attributable to legacy impacted surface soils, with contributions from natural background soils. Dissolved-phase concentrations were evaluated as an additional line of evidence because mercury had a mean dissolved fraction of 64%, compared with 0 to 19% for the other constituents with exceedances.

Based on the exceedance source conclusions summarized in Table 3-6, the Section 5 recommendations focus on watersheds where industrial materials, legacy impacted surface soils, or other controllable anthropogenic sources were identified as potential or likely contributors and can be addressed through source control, treatment, removal, or other mitigation measures.

Table 3-6. Summary of Exceedance Source Evaluations

Outfall	Aluminum (1.0 mg/L)	Manganese (50 µg/L)	Mercury (0.1/0.024 µg/L*)	TCDD TEQ (no DNQ) (2.8E-08 µg/L)
001	Natural background soils	Natural background soils	No exceedance	No exceedance
002	Natural background soils	No exceedance	No exceedance	Legacy impacted surface soils; Treated wood poles
004	No exceedance	Not applicable, no Permit limit	Legacy impacted surface soils	No exceedance
009	Natural background soils	Not applicable, no Permit limit	Legacy impacted surface soils; Natural background soils	No exceedance
011	Natural background soils	Natural background soils	No exceedance	No exceedance
018	Natural background soils	No exceedance	No exceedance	No exceedance

Notes:
No exceedance = No Permit limit exceedance was observed for the constituent at the designated outfall during the 2025/26 reporting year.
Not applicable, no Permit limit = The constituent does not have an applicable Permit limit at that outfall.
* The mercury Permit limit is 0.1 µg/L at Outfalls 001, 002, 011, and 018 and 0.024 µg/L at all other regulated outfalls.
Highlighted Orange = Outfall exceedance source(s) likely included legacy impacted surface soils, among other sources
Highlighted Blue = Outfall exceedance source was identified as likely solely natural background soils

3.2.2 Stormwater Treatment Control Performance Monitoring

The 2023 NPDES Permit requires the Discharger, with input from the SWEP, to evaluate the performance of existing stormwater treatment controls and recommend modified and/or new controls and monitoring to address Permit limit exceedances. To support this required evaluation, the monitoring program uses paired influent and effluent samples collected during storm events to assess the performance of individual passive and active treatment systems. The program evaluates treatment performance for recently exceeding constituents, including lead, mercury, aluminum, and TCDD TEQ (no DNQ), using statistical analyses where sufficient data are available. TSS is also monitored as a general indicator of treatment performance, although the 2023 NPDES Permit does not establish a stormwater Permit limit for TSS.

During the 2025/26 reporting year, performance monitoring was completed at B-1 Media Filter, CM-1, CM-9, Upper Lot Media Filter, the Southern Detention Bioswale, the ELV Treatment stormwater control, and the Outfall 011 and 018 Stormwater Treatment Systems (SWTSs). In addition, the B-1 Media Filter was reconstructed and fitted with new treatment media in January 2026, and post-construction monitoring was restarted to assess performance improvements. No samples were collected at the Lower Lot Biofilter or CM-12 during the 2025/26 reporting year due to monitoring prioritization of Permit-required sampling locations by the field team. Routine post-storm inspections were also completed to evaluate ponding, sediment accumulation, bypass conditions, and maintenance needs.

Table 3-7. Summary of 2025/26 Stormwater Control Monitoring Activities

Stormwater Control/System	Number of Paired Samples Collected in 2025/26
CM-1 and CM-9	2
Upper Lot Media Filter	2
B-1 Media Filter	1 (after reconstruction in January 2026)
Southern Detention Bioswale	2
ELV Treatment Stormwater Control	2
Outfall 011 SWTS	2
Outfall 018 SWTS	4

Key Performance Findings

Monitoring results indicate that the Site's treatment stormwater control network continues to provide measurable stormwater quality and runoff reduction benefits while supporting compliance objectives at Outfall 009.

Table 3-8. Summary of 2025/26 Stormwater Control Performance Key Findings

Stormwater Control Category	Statistically Significant Reductions Observed For:
CMs and Media Filters	**TSS**, **dioxins**, and **lead** (insufficient data for mercury and aluminum)
Detention Bioswales	**TSS**, **dioxins**, and **lead** (insufficient data for mercury and aluminum)
ELV Treatment Stormwater Control	**Dioxins** and **lead** (insufficient data for mercury and aluminum)
Outfall 011 and 018 SWTSs	**TSS**, **lead**, and **mercury** (insufficient data for dioxins and aluminum)

Overall, effluent concentrations generally exceeded Permit limits less frequently than corresponding influent concentrations, demonstrating that the treatment stormwater control network continues to improve stormwater quality prior to discharge. The most consistent treatment benefits were observed for **TSS, dioxins, and lead**.

In addition to water quality improvements, the **Lower Lot Biofilter** continued to provide runoff reduction benefits by reducing discharges to the Northern Drainage. Based on long-term performance monitoring through 2025/26, the biofilter reduced discharge during approximately **55% of storms less than 1 inch of rainfall** and **15% of storms between 1 and 2 inches of rainfall**, while providing limited runoff reduction benefits during larger storm events. Together, these findings demonstrate that the stormwater control network remains an effective component of the Site's stormwater management strategy, providing both pollutant reduction and runoff volume management benefits.

Maintenance Evaluation

No significant non-routine maintenance actions are currently recommended based on stormwater control performance results; however, several maintenance observations warrant continued monitoring and routine upkeep.

Additional inspection and maintenance activities, including sediment removal, vegetation management, erosion control, and observation of underdrain functionality, will continue as part of routine stormwater control operation and maintenance. CM-9 remains the highest-priority stormwater control for future media replacement planning based on sediment loading analyses. Initial post-media changeout monitoring results at the B-1 Media Filter showed a potentially small reduction in mercury concentrations, but more paired samples are needed to confirm.

Table 3-9. Summary of 2025/26 Maintenance Findings

Stormwater Control/System	Observation	Recommended Action
CM-9	Reached estimated sediment loading capacity based on cumulative TSS loading analysis. Ponding greater than 1 ft and sediment accumulation observed during inspections.	Continue sediment removal and routine maintenance to maintain drainage capacity. Plan for media replacement once persistent ponding is confirmed or next year after mercury performance results from B-1 Media Filter are available.
CM-2, CM-3, CM-4, CM-5, CM-11	Ponding greater than 1 ft and sediment accumulation observed during inspections.	Continue sediment removal and routine maintenance to maintain drainage capacity and confirm through improved[7] post-storm inspections whether media are draining (if not, changeout media next year).

Overall Stormwater Control Performance Conclusion

The treatment stormwater control network continues to provide measurable stormwater quality and runoff reduction benefits and remains an important component of the Site's stormwater management strategy. Monitoring results demonstrate continued reductions in TSS, dioxins, and lead across multiple stormwater control types, while supporting long-term compliance efforts at downstream NPDES outfalls. Routine maintenance remains effective for most systems, with future attention focused primarily on sediment management and continued inspection of ponding conditions. Stormwater controls will continue to be assessed for extended post-storm ponding and indications of increasing effluent COPC concentrations, suggesting chemical breakthroughs are occurring through the media, to support media replacement evaluations.

3.2.3 Onsite Subarea Stormwater Monitoring

Subarea stormwater sampling is a voluntary activity performed by Boeing and NASA at the SWEP's recommendation to identify stormwater "hotspots" in watersheds without outfall treatment, to inform targeted placement of distributed controls. Many of these sampled subareas include RCRA Facility Investigation (RFI) areas, or areas with former site activities and expected soil contamination.

[7]Certain 72-hour post-storm ponding inspection forms were not dated or timed so observation data could not be confirmed. Improvements to observation documentation have been included in SWEP recommendations for 2026/27.

Historical Summary of Subarea Sampling

Subarea stormwater monitoring has been conducted at SSFL since 2010 to support source identification, treatment control evaluation, stormwater control siting, and special studies. Early efforts focused on the Outfall 008 and 009 watersheds, where monitoring results were incorporated into a SWEP-developed stormwater control prioritization framework used to identify locations for new treatment controls and evaluate treatment control performance. The prioritization methodology informed implementation of numerous treatment controls throughout the Outfall 009 watershed, originally focusing on dioxins and lead as the most frequently exceeding constituents, and resulting in the placement of distributed media filters treating stormwater runoff from paved and RFI hotspot areas.

Following implementation of treatment controls and observed improvements in water quality, the watershed-scale subarea sampling program that began in the Outfall 008 and 009 watersheds was expanded by the SWEP in 2019/20 into the Outfall 001 and 002 southern buffer zone watersheds to evaluate contributions from legacy impacted surface soils, dirt and paved roads, and background areas to constituent exceedances observed following the Woolsey Fire. Six monitoring locations were established within the Outfall 001 and 002 watersheds, including sampling locations capturing runoff from the Area I Burn Pit (A1BP), STL-IV, and Coca RFI areas. Initial results indicated that exceeding constituent concentrations generally tracked suspended sediment concentrations and that particulate-strengths were consistent with naturally occurring soil sources, supporting the conclusion that erosion of natural background soils was a primary contributor to elevated concentrations observed at these buffer zone outfalls, perhaps with the exception of dioxins where legacy impacted surface soils/sediments and treated wood poles also contributed.

Beginning in the 2021/22 reporting year, monitoring was further refined to support characterization of runoff from the AIBP, while monitoring within the Outfall 009 watershed shifted toward targeted evaluations of the Northern Drainage and Former Shooting Range ISE cleanup area. Most recently, the historical subarea prioritization methodology was reactivated for the 2024/25 reporting year and applied specifically to mercury (following implementation of the lower mercury Permit limit and beginning of associated mercury exceedances) within the Outfall 009 watershed to identify potential source areas and evaluate opportunities for new or modified controls.

2025/26 Reporting Year Subarea Sampling

Subarea monitoring during the 2025/26 reporting year focused on supporting active source investigations, evaluating ISE order cleanup areas, and informing treatment control recommendations. Monitoring the Outfall 001 subarea location (EPSW001IE01) was conducted to characterize stormwater from the drainage west of the AIBP (where soil data indicated elevated dioxin levels in surface soils and/or drainage sediments), following the diversion of previously contributing stormwater from the Western AIBP and Coca Road to above Outfall 011 (for pumping to the SWTS). This was done to evaluate potential upper watershed and drainage contributions to exceedances at Outfall 001. The subarea at the eastern edge of the AIBP (A1BPSW0001), which drains to Outfall 011 and the SWTS, was also sampled in one storm event. Table 3-11 summarizes constituents with concentrations above the applicable Outfall 001 and 011 Permit limits at these locations during the 2025/26 reporting year.

Table 3-10. Summary of Area I Burn Pit Subarea Monitoring

Analyte	2023 Permit Limit at Outfalls 001 and 011	A1BPSW0001 (Eastern AIBP, in 011 Watershed)	EPSW001IE01 (Drainage West of AIBP, in 001 Watershed)
		12/25/2025 11:00	12/25/2025 12:10
Aluminum	1000 µg/L	**6,500**	**33,000**
Gross Alpha	15 pCi/L	**17.4**	**56.2**
Lead	5.2 µg/L	4.5	**16**
Manganese	50 µg/L	**140**	**950**
TCDD TEQ (No DNQ)	2.8E-08 µg/L	Not detected	**7.61E-07**
Zinc	159 µg/L	34	**160**
Total Suspended Solids (TSS)	No limit	210	1,400

Bolded results indicate concentrations above the applicable 2023 Permit Limits for the corresponding downstream outfall (Outfall 001 or 011).

Subarea results identified elevated concentrations of several constituents, including gross alpha, lead, and TCDD TEQ in the drainage west of the AIBP. Elevated concentrations were likely due in part to high TSS. Despite these elevated subarea results, only aluminum and manganese exceeded limits at the downstream outfalls (001 and 011) this year. Even so, recommendations for the drainage west of the AIBP were developed to address these localized elevated concentrations (the eastern AIBP sample location normally is pumped to the 011 SWTS and discharged at Outfall 011). Check structures are recommended to be added to the drainage to reduce sediment transport and particulate-associated constituents and an interim soil removal is recommended in the areas where impacted soils have been observed.

In addition, SWEP completed a mercury-focused subarea prioritization analysis for the Outfall 009 watershed (Appendix E). This analysis identified locations with elevated mercury concentrations relative to Permit thresholds and background conditions and was used to develop recommendations for additional monitoring, source investigation, and treatment control enhancements.

3.2.4 Offsite Background Stormwater Monitoring

The MOU previously tasked the SWEP with establishing background stormwater thresholds for priority[8] COPCs, so a regional screening was conducted to identify offsite monitoring locations for establishing stormwater-based thresholds. Attachment E (Santa Susana Field Laboratory Background Stormwater Sampling Memo) of Exhibit D (Santa Susana Field Laboratory Background Stormwater Thresholds) of the MOU (Santa Susana Surface Water Expert Panel and Geosyntec Consultants, 2022a) identified three offsite locations for monitoring background stormwater – two undeveloped natural background locations, and one ambient residential/non-industrial location.

During the 2025/26 season, four additional samples were collected at the ambient watershed location and a total of seven additional samples were collected at the two background watershed locations. Table 3-11 summarizes the total number of samples collected at these locations during 2025/26 and since the start of the program.

[8] Priority COPCs for the background thresholds are defined in Appendix F of this report.

Table 3-11. Summary of Offsite Background Stormwater Monitoring

Watershed Category	Sample Location	Number of Samples Collected in 2025/26	Total Number of Samples Collected Through 2025/26
Offsite Background Stormwater	EPOSBKGRLC	4	26
Offsite Background Stormwater	EPOSBKGRMC	3	19
Offsite Ambient Stormwater	EPOSBKGRBC	4	25

Results from the 2025/26 monitoring program continue to demonstrate that some constituents frequently have concentrations above Permit limits at offsite background and/or ambient offsite monitoring locations. The ambient background watershed (Box Canyon) exhibited the most constituents with concentrations above Permit limits, including metals, radionuclides, and TCDD TEQ (No DNQ). The undeveloped natural background watersheds typically had sulfate, metals, and gross alpha concentrations above Permit limits.

Table 3-12. Preliminary Background Stormwater Thresholds for 2025/26 Exceeding Constituents

Constituent		Aluminum	Manganese	Mercury	TCDD TEQ (no DNQ)
Units		µg/L	µg/L	µg/L	µg/L
2023 NPDES Permit Limit[1]		1,000	50	0.0240	2.80e-08
Offsite Background Stormwater	Number of Samples	31	66	66	34
	Number of Detections	31	65	36	0
	Background Stormwater Threshold[3]	128,436	5,021	0.114	ND
	Threshold Basis[2,3]	Lognormal 99th percentile	Lognormal 99th percentile	Lognormal 99th percentile	no detected results
Offsite Ambient Stormwater	Number of Samples	16	19	19	19
	Number of Detections	16	19	19	13
	Ambient Stormwater Threshold[3]	229,657	4,342	0.280	4.26e-06
	Threshold Basis[2,3]	Lognormal 99th percentile	Lognormal 99th percentile	Lognormal 99th percentile	Deltalognormal 99th percentile

1. Where there are multiple Permit limits for different outfalls, the lowest one is shown here.
2. 99th percentile calculated following Appendix E of the US EPA Technical Support Document (TSD) for Water Quality-based Toxics Control. EPA/505/2-90-001. The calculation assumes a lognormal distribution for results that are detected 100% of the time or a deltalognormal distribution if there are any nondetects. If the data fail the Anderson-Darling test for lognormality, then the nonparametric 99th percentile is calculated.
3. The threshold is based on the 99th percentile if sufficient data is available, otherwise, the max result is used.
ND = no detected results; a threshold could not be calculated.
The threshold values presented here remain preliminary and subject to change as additional samples are collected.

These results demonstrate that even completely undeveloped natural background watersheds can have stormwater concentrations above SSFL Permit limits. These offsite background and ambient monitoring data provide important context for interpreting concentrations and exceedances in stormwater observed at SSFL. Updated background stormwater thresholds are calculated in Appendix F of this Annual Report. These thresholds will be used for comparison with post-cleanup modeling and monitoring results, as established by the MOU.

3.3 Northern Drainage Assessment

Recurring geomorphic inspections were performed annually along the Northern Drainage during the 5 years from 2011/12 to 2016/17, as described in the *Northern Drainage Restoration, Mitigation, and Monitoring Plan* (RMMP) (Haley & Aldrich, Inc., 2011).

Although the RMMP expired in 2017, the voluntary annual stream walk and inspection of in-channel erosion risk areas and sediment control conditions in the lower portions of the Outfall 009 Watershed is recommended annually by the SWEP. This year's inspection was conducted on April 14, 2026. During this inspection, 11 locations were identified for priority maintenance recommendations, seven of which were identified as critical maintenance priorities (Table 3-13). Priority recommendations included sediment removal, culvert repair/removal, and/or riprap reinforcement to maintain capacity and efficacy of control measures within the Northern Drainage.

Table 3-13. 2026 Priority Maintenance Recommendations for the Northern Drainage

Station	Description	2025/26 Northern Drainage Assessment Observations	Maintenance Recommendation
22+75 to 23+00	Bank scour	Bank scour and undercutting on north bank.	**Add riprap bank toe reinforcement that connects to check structure at 23+00 and possible coco-mat on bank above riprap reinforcement, or upstream check structure.**
26+50	Sediment Buildup	Sediment deposits in channel.	Remove accumulated sediment.
28+00 to 28+75	Sediment Buildup	Sediment deposited due to upstream check dam failure.	**Fortify low point of check structure with riprap and remove and/or stabilize sediment.**
28+50	Riprap Check Structure Compromised	Structure is compromised, sediment deposition observed immediately downstream.	**Repair check structure.**
32+25	Rill Erosion	Runoff conveyed across the gravel road is concentrating along a low point, resulting in incision of the adjacent bank slope and formation of a gully.	**Fill in low point with geocell to reroute water to existing slope drain. Consider refurbishing existing slope drain.**
39+98	Riprap Check Structure Compromised	Structure is compromised.	**Repair check structure.**
47+75	Rill Erosion	Runoff conveyed across the gravel lot near LOX is concentrating at a low point, resulting in incision of the bank slope and formation of a gully.	**Fill in low point with riprap and geocell and consider addition of slope drain/gravel berm.**
50+00 to 50+25	Sediment Buildup	Sediment deposits in channel.	Remove accumulated sediment.
58+00 to 58+75	Rill Erosion	Runoff conveyed across the gravel access road near CM-5 is concentrating at a low point, resulting in incision of the bank slope and formation of a gully	**Fill in low point with riprap and geocell and consider addition of slope drain/gravel berm.**
Sage Ranch Tributary above CM12	Sediment Buildup	Sediment buildup downstream of riprap near CM-12.	Remove accumulated sediment. Repair or supplement existing check structure for western tributary.
Sage Ranch Tributary above CM12	Riprap check structure	Sediment buildup observed behind check dam	Remove sediment from behind check dam.

Bolded recommendations were identified with critical maintenance urgency. The remaining recommendations were recommended/non-critical.

3.4 Human Health Risk Analysis

Concentrations measured in 2025/26 do not change prior stormwater HHRA conclusions that there are no elevated human health risks from exposure to SSFL stormwater discharge.

[9]The exposure pathways, flow days and corresponding exposure frequencies (based on a slightly above average year), risk-based concentrations, and other assumptions from the final HHRA (Geosyntec Consultants, 2017) were retained for this analysis. The same list of COPCs[10] was also evaluated. The 2025/26 outfall monitoring results were compared to exposure point concentrations from the 2017 HHRA to assess the cumulative cancer risk and noncancer hazard index associated with the potential exposure of recreators to Site COPCs via surface water discharges.[11] As shown in Table 3-14, the cumulative cancer risk estimates[12] for recreators are less than the *de minimis* cancer risk level of 1E-0^{-6} and the cumulative hazard index estimates are less than the target noncancer hazard of 1 at all assessed outfalls based on the maximum concentrations detected in the 2025/26 monitoring results. Thus, the HHRA conclusions still hold true, that exposure to SSFL stormwater today does not represent an elevated risk to human health through the exposure pathways that were evaluated, which included incidental ingestion but not drinking stormwater as a potable water source.

[10] Antimony (metallic); arsenic, inorganic; barium; benzene; bis (2-ethylhexyl) phthalate; boron; bromodichloromethane; butyl benzyl phthalate; cadmium (water); chloroform; chromium(VI); chromium, total; cobalt; copper; dibromochloromethane; 1,2-dichloroethane; diethyl phthalate; fluoride; manganese (non-diet); mercury (elemental); methylene chloride; nickel; nitrate; nitrate + nitrite (as N); nitrite; selenium; TCDD, 2,3,7,8- TEQ; thallium; vanadium; zinc; hydrogen-3 (tritium); radium-226; radium-228; strontium-90; and uranium-235.

[10] Antimony (metallic); arsenic, inorganic; barium; benzene; bis (2-ethylhexyl) phthalate; boron; bromodichloromethane; butyl benzyl phthalate; cadmium (water); chloroform; chromium(VI); chromium, total; cobalt; copper; dibromochloromethane; 1,2-dichloroethane; diethyl phthalate; fluoride; manganese (non-diet); mercury (elemental); methylene chloride; nickel; nitrate; nitrate + nitrite (as N); nitrite; selenium; TCDD, 2,3,7,8- TEQ; thallium; vanadium; zinc; hydrogen-3 (tritium); radium-226; radium-228; strontium-90; and uranium-235.

[11] Outfalls 004, 006, and 010 were not assessed in the final HHRA (Geosyntec Consultants, 2017) due to a lack of flow data.

[12] Cal-EPA, 2015. Preliminary Endangerment Assessment Guidance Manual. Interim Final. Revised October 2015 (First Printing, January 1994).

Table 3-14. Cumulative Incremental Cancer Risk and Hazard Estimates by Outfall, 2025/26

	Units	Outfall					
		001	002	008	009	011	018
Lower Bound	Cancer Risk	5E-08	4E-08	4E-10	1E-08	1E-08	1E-08
Upper Bound	Cancer Risk	1E-07	8E-08	9E-10	3E-08	2E-08	3E-08
Lower Bound	Hazard	9E-03	9E-03	3E-04	7E-04	2E-03	3E-03
Upper Bound	Hazard	2E-02	2E-02	6E-04	1E-03	5E-03	6E-03

All values are below the *de minimis* cancer risk level of one in a million (1E-06) and noncancer hazard index of 1. Note that for exponential numbers, a larger negative exponent indicates a smaller amount, so 1E-08 is one hundred times smaller than 1E-06.

An additional evaluation was performed to assess human health risks through a drinking water pathway assuming the surface water could be a potable water source. While SSFL stormwater is not directly used for drinking water, some of its downstream surface receiving waters may be designated for municipal supply use (or *potential* municipal supply use) or for recharge to groundwater that may be designated for municipal supply use (which would receive soil aquifer treatment, the process of natural contaminant attenuation that occurs as water passes through the vadose zone). Therefore, many of SSFL's Permit limits are based on drinking water-based objectives, i.e., California primary and secondary Maximum Contaminant Levels (MCLs) and copper and lead Action Levels. MCL values are based on a lifetime of drinking water daily at that concentration, while Action Levels protect public health by minimizing copper and lead in drinking water. This comparison compares short-duration storm event concentrations to long-term MCLs and Action Levels[13]. Aluminum (Outfalls 001, 002, 004, 008, 009, 011, and 018), manganese (Outfalls 001 and 011), and iron (Outfalls 001, 004, 008, 009, and 011) exceeded the secondary MCLs, which are based on aesthetic drinking water conditions, such as taste, color, and odor. Aluminum also has a primary MCL, which is based on human health risks. **In 2025/26, aluminum concentrations at Outfalls 001, 002, 009, 011, and 018 exceeded the primary MCL. All other 2025/26 concentrations for dozens of constituents at each outfall met drinking water standards. All MCL-exceeding parameters (aluminum, iron, and manganese) are highly particle-associated, and attributed solely to naturally occurring background soils. Particulates have limited mobility and are subject to filtration removal through the soil vadose zone during infiltration in downstream creek beds and, therefore, have a low potential to reach groundwater at concentrations observed at the surface. These constituents would also be naturally present in groundwater already since they are of geologic origin.**

The Site is upstream of communities served by water systems that use imported water, groundwater, and recycled water. The community downstream of Outfall 009 is served by Ventura County Waterworks District No. 8, which relies primarily on imported water from the Calleguas Municipal District. Treated groundwater from the alluvial Gillibrand Groundwater Subbasin has historically supplemented supply during summer months, and recycled water has historically been used for dust control and landscape

[13] Primary MCLs: aluminum (1000 µg/L). Secondary MCLs: aluminum (200 µg/L), manganese (50 µg/L), iron (300 µg/L). Action Levels: lead (15 µg/L).

irrigation at the Simi Valley Landfill (Kennedy Jenks, 2020). The Simi Groundwater Basin is approximately 2 miles downstream of Outfall 009, and the closest water supply wells are over 6 miles to the north.

The community downstream of Outfalls 002 and 008 is served by the Los Angeles Department of Water and Power (LADWP), which relies primarily on imported water from the Metropolitan Water District and the Los Angeles Aqueduct. Groundwater, primarily from the San Fernando Basin, and recycled water are also used (LADWP, 2020). The San Fernando Basin is approximately 2 miles downstream of Outfall 008, and the closest wellfield, the Tujunga Wellfield, is over 14 miles to the east. Given the water-supply sources and the distances to the identified wells and wellfield, any contribution of water originating at the Site to these supplies, if present, would be expected to be very small.

4 Treatment Control Activities

This section summarizes reporting year interim soil removal, stormwater control implementation, inspection, and maintenance activities.

4.1 ISE Order Interim Soil Removal Activities

The following sections discuss interim soil removal activities completed during the reporting year related to the Former Shooting Range and AIBP ISE projects.

4.1.1 Former Shooting Range ISE Order

Under the March 2022 ISE Order, Boeing removed approximately 31,000 cubic yards of lead-impacted soil from the Former Shooting Range in the Outfall 009 watershed. Excavation and stabilization were completed in 2025, and a June 2025 SWEP inspection confirmed that erosion controls were in place (Figure 4-1 A). Since then, the area was revisited by the SWEP in July 2026 and natural revegetation was observed (Figure 4-1 B). **No lead exceedances occurred at Outfall 009 during the 2025/26 reporting year despite the higher rainfall amounts and storm intensities.**



Figure 4-1. A) Former Shooting Range in March 2025 with Erosion Controls and B) Vegetation regrowth observed in October 2026

4.1.2 Area I Burn Pit ISE Order

Under the May 2022 ISE Order, approximately 26,580 cubic yards of contaminated soil were removed from the Area I Burn Pit (AIBP). Excavation was prioritized during dry weather, and the western AIBP diversion continued to successfully route runoff to Perimeter Pond for treatment at the SWTS. During a July 2026 site visit, SWEP observed that stabilization measures were in place at completed excavation areas, while final excavation and stockpiling wrapped up elsewhere. Excavation was completed in September 2026, and stabilization efforts are now complete in preparation for the upcoming storm season (Figure 4-2). The SWEP will revisit the area in early December 2026, and will reassess stabilization status again then. Inspections and as-needed maintenance of all stabilization controls will occur throughout the 2026/27 season. **No exceedances of constituents potentially associated with impacted surface soils occurred at Outfall 001 or Outfall 011 during the 2025/26 reporting year despite the higher rainfall amounts and storm intensities, and ongoing excavation and stockpiling.**



Figure 4-2. Post-excavation stabilization (hydromulch) of the AIBP in October 2026

4.2 Sandy Fire Response and Stabilization Activities

The Sandy Fire burned approximately 2,183 acres offsite between May 18 and May 27, 2026. No burned areas were located within the SSFL property or within watersheds draining to SSFL outfalls. However, SSFL roadways were used to support firefighting operations, resulting in increased vehicle traffic, localized soil disturbance, and widening of some unpaved access roads for fire breaks and access to remote location during firefighting activities. Following fire response activities, disturbed areas were evaluated and stabilized, as needed, to minimize erosion during the 2026/27 rainy season.



Figure 4-3. Erosion controls installed in fire break and response vehicle access route

4.3 B-1 Media Filter Rebuild and Media Replacement

In the 2024/25 Annual Report, the B-1 Media Filter drainage area was identified as a priority subarea based on evaluation of mercury concentrations in stormwater and surface soils. Additionally, the treatment control was largely overgrown. Therefore, the SWEP recommended replacing the B-1 filter media with a mixture containing 20% sulfur-impregnated GAC to target mercury specifically. Reconstruction was completed in January 2026. The single paired sample collected following the media changeout showed a potentially small reduction in mercury concentration and an effluent concentration below the applicable Permit limit. However, additional paired samples are needed to evaluate treatment performance and determine whether the media changeout provides a consistent reduction in mercury concentrations.



Figure 4-4. Reconstructed B-1 Media Filter with Sulfur-Impregnated GAC

4.4 Other Activities and Maintenance

Maintenance and other activities conducted at SSFL outfalls and stormwater controls in the 2025/26 reporting year included stormwater control repairs and replacements, removal of sediment and debris from outfalls following large storm events, and inspections of existing erosion and sediment controls and vegetation across the Site and repairing or supplementing where needed.

During 2026, JHA performed maintenance at Culvert Modification (CM) locations along Area 2 Road. Before sediment removal, each location was inspected and photographed to support estimates of the accumulated sediment volume. Sediment and debris were removed with a vacuum truck and Super Vac equipment, and weed abatement was performed at CM-2, CM-3, CM-4, CM-5, CM-6, CM-8, CM-9, CM-11, and CM-12. Additional erosion-control improvements included placement of rock and installation of riprap at CM-4 and installation of riprap at CM-8 and CM-11. No maintenance needs at CM-1, CM-7, or CM-10 were identified in the 2026 maintenance submissions.

These and other reporting-year maintenance activities are incorporated by reference through the following quarterly NPDES DMRs[14]:

- The Boeing Company, 2025a. *Third Quarter 2025 NPDES Discharge Monitoring Report, Compliance File CI-6027 and NPDES No. CA0001309, Santa Susana Field Laboratory, Ventura County, California.* November 15.

[14] Quarterly NPDES reports are posted on the Boeing website SSFL Surface Water Monitoring Reports page: https://www.boeing.com/innovation/sustainability/santa-susana-field-laboratory/surface-water-monitoring-reports

- The Boeing Company, 2026a. *Fourth Quarter 2025 NPDES Discharge Monitoring Report, Compliance File CI-6027 and NPDES No. CA0001309, Santa Susana Field Laboratory, Ventura County, California.* February 15.
- The Boeing Company, 2026b. *First Quarter 2026 NPDES Discharge Monitoring Report, Compliance File CI-6027 and NPDES No. CA0001309, Santa Susana Field Laboratory, Ventura County, California.* May 15.
- The Boeing Company, 2026c. *Second Quarter 2026 NPDES Discharge Monitoring Report, Compliance File CI-6027 and NPDES No. CA0001309, Santa Susana Field Laboratory, Ventura County, California.* August 15.

Stormwater control recommendations from the 2024/25 SSFL Site-wide Stormwater Annual Report (Surface Water Expert Panel and Geosyntec, 2025), and the resulting stormwater control maintenance, improvement, and monitoring actions taken this past season are summarized in Section 5.1.

5 Recommendations

5.1 Status of Recommendations from 2024/25 Annual Report

As described in Sections 1.3 and 3.2, recommendations from the SWEP continue to be implemented at the Site in order to continue to improve stormwater quality. A summary of recommendations organized by outfall from the 2024/25 Annual Report and their status to date are provided in Table 5-1, Table 5-2 and Table 5-3.

Table 5-1. Status of 2024/25 SWEP Stormwater Control Recommendations for Outfall 001 and 011 Watersheds

Recommendation	2026 Status	Addressed Exceeding Constituents from Non-background Sources	
		Lead (5.2 µg/L)	TCDD TEQ (no DNQ) (2.8E-08 µg/L)
Erosion and sediment controls and stormwater capture/conveyance at the AIBP	**Complete.** Hydroseeding, wattles, and sandbag/burlap berms were installed; inspection and maintenance are ongoing.	X	X
Continue to capture and pump AIBP stormwater from 001 watershed to Perimeter Pond until the area is stabilized as evidenced by stormwater monitoring results for industrial COPCs	**Complete.** The diversion system was installed and remains in operation.	X	X
Divert road runoff from Coca Road away from 001 Watershed to the Perimeter Pond and 011 SWTS	**Complete.** Sandbags and inlet covers were installed along Coca Road.	X	X
Install riprap check structures in drainages west of A1BP (south of Coca Road, north of dirt road) and implement routine sediment removal above them	**In Progress.** Regulatory authorization is pending; applications are in progress.		X
Refurbish pole wattles and relocate 10 ft radius from pole base where feasible	**In progress.** Wattles are in place at many locations, not all are currently 10 ft radius from pole and should be adjusted.		X

Table 5-2. Status of 2024/25 SWEP Stormwater Control Recommendations for Outfall 002 Watershed

Recommendation	2026 Status	Addressed Exceeding Constituents from Non-background Sources
		TCDD TEQ (no DNQ) (2.8E-08 µg/L)
Implement erosion controls at STL-IV RFI area and riprap check structures in downstream channel	**In Progress.** Erosion controls at the RFI area are complete; downstream check structures are pending regulatory authorization, and applications are in progress.	**X**
Refurbish pole wattles and relocate 10 ft radius from pole base where feasible	**In Progress.** Wattles are in place at many locations, not all are currently 10 ft radius from pole and should be adjusted.	**X**

Table 5-3. Status of 2024/25 SWEP Stormwater Control Recommendations for Outfall 009 Watershed

Recommendation	2026 Status	Addressed Exceeding Constituents from Non-background Sources		
		Lead	Mercury	TCDD TEQ (no DNQ)
		(5.2 µg/L)	(0.024 µg/L)	(2.8E-08 µg/L)
Continued inspection and necessary maintenance of riprap check structures, removal of newly accumulated sediment, and sampling and analysis of lead in removed sediment along the Northern Drainage below the ISE cleanup area.	**Complete.** 2025/26 inspection and maintenance were completed; recurring inspection and maintenance will continue.	X	X	X
Removal of sediment accumulated in front of CMs, continued inspection (especially for lack of post-storm ponding), and necessary maintenance at all CMs and other treatment stormwater controls across the watershed*	**Complete.** 2025/26 inspection and maintenance were completed; recurring inspection and maintenance will continue.	X	X	X
Sage Ranch gravel road enhancement (increasing road height to reduce pooling at the low point, armoring road and adding water bars, or culvert)	**Complete.**	X		
Continue inspection and as needed maintenance/support of natural revegetation of Shooting Range	**Complete.** Inspection and as-needed maintenance of revegetation will continue.	X		
Replace B-1 filter media mix with 20% sulfur-impregnated GAC. If infeasible, top dress with S-GAC and till in	**Complete.**		X	
Confirm that the Lower Lot Biofilter (LLBF) bank edge berm has a greater elevation than the top of the LLBF overflow spillway. Otherwise, raise and/or supplement the existing edge berm along the northwestern fence-line to prevent bypass	**Complete.** Continue inspection during the 2026/27 wet season and improve if evidence of bypass is observed.	X	X	X
Refurbish pole wattles and relocate 10 ft radius from pole base where feasible	**In Progress.** Wattles are in place at many locations, not all are currently 10 ft radius from pole and should be adjusted.			X
Confirm erosion controls are in place, as feasible, along the road on southern edge of Area II Landfill (A2LF) and along the road to Outfall 009	**In Progress.** Inspection and as-needed maintenance of erosion controls are ongoing.			X

Table 5-4. Summary of 2024/25 Surface Water Expert Panel Monitoring Recommendations

Monitoring Domain	Recommendation	Status
NPDES Outfalls	Add PFAS sampling at SWTS pond influent locations during the first two storms of the wet season.	Complete
	Discontinue non-required SRAM sampling.	Complete
Stormwater Control Performance Sampling	Continue influent/effluent sampling at Outfall 009 stormwater control locations twice annually.	Ongoing
	Add influent/effluent sampling at the B-1 Media Filter twice annually.	Ongoing
	Revise the analyte suite to include exceedance history and diagnostic analytes.	Complete
	Remove analysis of particulate size fractions.	Complete
	Improve stormwater control observation protocols, including documentation of overflow and bypass conditions.	Ongoing
	Prioritize completion of post-storm ponding documentation.	Ongoing
Onsite Subarea Sampling	Continue subarea sampling twice annually at designated locations.	Ongoing
	Monitor for dioxins, metals (including mercury), and TSS.	Ongoing
Offsite Background Sampling	Continue sampling during runoff events.	Complete
	Continue PFAS and PCB congener analyses.	Complete
	Remove TPH, PCB Aroclors, and volatile constituents from the analyte suite.	Complete
	Remove SRAM constituents not analyzed at NPDES outfalls.	Complete
Methods and Training	Emphasize field staff training and signage.	Ongoing
	Update the NASA mercury analytical method to achieve lower detection limits consistent with Boeing's laboratory methods.	Complete

5.2 Stormwater Control Recommendations Following Reporting Year 2025/26

5.2.1 Recommendations for Watersheds with Non-Background Exceedances in 2025/26

The following recommendations focus on watersheds where the weight-of-evidence evaluation identified industrial materials and legacy impacted surface soils and/or other controllable anthropogenic sources as potential and/or likely contributors to Permit limit exceedances observed in reporting year 2025/26. Consistent with its charge under the Permit, SWEP recommends modified or new stormwater controls

and monitoring, as appropriate, to address these exceedances through treatment, source removal, maintenance, or other mitigation measures.

Table 5-5. SWEP Recommendations for Modified or New Stormwater Controls for TCDD TEQ (no DNQ) in the Outfall 002 Watershed

Recommended Action
Complete installation of planned riprap check structures in drainages below STL IV (carryover from 2024/25, delayed by permitting). Remove dioxin-impacted surface sediment and soil upstream of check structures as an ongoing maintenance activity to maintain capacity for sediment capture.
Install additional riprap check structures in drainage below Outfall 018 near the boundary of Area II and III, where surface soil data show dioxin-impacted sediments, and perform routine sediment removal maintenance.

Table 5-6. SWEP Recommendations for Modified or New Stormwater Controls for Mercury in the Outfall 004 Watershed

Recommended Action
Discuss with applicable regulators whether an Interim Source Removal Action (ISRA) or similar regulatory mechanism could be used to authorize removal of mercury-impacted surface soils in the Outfall 004 watershed, and implement the removal if required or otherwise approved. Conduct excavation during the dry season, stabilize disturbed areas before the wet season, and use the existing pond for sediment capture following stabilization.
Remove and replace existing filter fabric with new, comparable filter fabric.
Evaluate feasibility of adding additional Adler tanks and/or pumping capacity to increase stormwater capture (for transfer to Silvernale Pond for treatment) and reduce frequency of discharge at Outfall 004 during large storms.

Table 5-7. SWEP Recommendations for Modified or New Stormwater Controls for Mercury in the Outfall 009 Watershed

Recommended Action
Discuss with applicable regulators whether an ISRA or similar regulatory mechanism could be used to authorize removal of mercury-impacted surface soils in the Outfall 009 watershed and implement the removal if required or otherwise approved. Conduct excavation during the dry season, stabilize disturbed areas before the wet season, and use the existing pond for sediment capture following stabilization.

5.2.2 Other Site-wide and Ongoing Recommendations

In addition to the targeted recommendations presented above, SWEP recommends continued implementation of applicable site-wide stormwater treatment and source-control measures identified in previous reporting years. These ongoing recommendations address constituents with a history of permit limit exceedances and include modified and/or new stormwater controls and monitoring intended to further evaluate or reduce constituent loading. Table 5-8 summarizes the ongoing recommendations.

Besides the already initiated permitting for check structures, the SWEP also recommends the operator discuss with applicable regulators whether an ISRA or similar regulatory mechanism could be used to authorize removal of impacted surface soils. In addition to the areas of Outfall 004 and Outfall 009 listed above, the SWEP recommends soil removal in the drainage above EPSW001IE01. If implemented, the SWEP also recommends that excavation take place during the dry season and disturbed areas are stabilized before the wet season.

Table 5-8. Ongoing SWEP-Recommended Site-wide Stormwater Control and Source-Control Actions

Recommended Action	Watershed
Continued inspection and maintenance of riprap check structures, removal of accumulated sediment, and lab analysis of removed sediment from the Northern Drainage below the ISE cleanup area.	009
Continued inspection of all treatment controls in 009 watershed (including post-storm visits to confirm media is properly draining), perform sediment removal and other maintenance as needed.	009
Continue inspection and as-needed replacement of wattles installed 10 ft downgradient of all utility poles (including non-wood), to reduce mobilization of dioxin-containing soils. Begin in 002 watershed where 2025/26 dioxin exceedance occurred.	Site-wide
Continue inspection, maintenance, and replacement of existing erosion controls and identification of areas requiring additional erosion controls, particularly in cleanup areas and areas containing surface soil contamination.	Site-wide
Provide enforceable site-wide guidance on "advanced" construction stormwater control BMPs for all future high risk soil cleanup projects, to ensure implementation of BMPs similar to those recommended by the SWEP and Geosyntec during the Former Shooting Range ISE project. The SWEP can provide instruction on which RFI areas fit this "high risk" category, but they primarily consist of those projects that are: 1. steep (i.e., high erosion risk), 2. above and adjacent to drainages or paved roads (i.e., efficient conveyance of stormwater), and 3. upstream of outfalls without ponds or SWTSs (i.e., no downstream treatment). Examples include the Area I Landfill (AILF), A2LF, portions of LOX, and Happy Valley within the Outfall 008 and 009 watersheds. For these higher-risk areas, the guidance should establish minimum erosion and sediment controls and enhanced construction stormwater practices, including, to the extent feasible: • Performing work outside the rainy season; • Phasing excavation to limit the extent of disturbed or devegetated areas at any one time, including completing excavation, temporary erosion control, confirmation sampling, and final stabilization within manageable work areas before proceeding to subsequent areas; • Providing for SWEP review and input on SWPPPs and stormwater controls before, during, and following construction, with direct coordination between the SWEP and the responsible SWPPP consultant; • Conducting periodic inspections by construction stormwater professionals experienced with enhanced controls at higher-risk sites; and • Providing qualified inspectors with stop-work authority when conditions warrant corrective action.	Site-wide

5.3 Monitoring Recommendations Following Reporting Year 2025/26

Informed by the data analyses contained in this report and its appendices, the Expert Panel recommended changes to the 2025/26 Sampling and Analysis Plan (SAP) (Haley & Aldrich, Inc., 2025) for the 2026/27 stormwater monitoring season. Details are provided in the subsections below and summarized in Table 5-9. These recommendations are designed to focus resources on parameters and locations with demonstrated relevance to improving stormwater quality and risk management.

Table 5-9. Summary of SWEP Monitoring Recommendations Following 2025/26 Reporting Year

Monitoring Domain	Monitoring Recommendation	Watershed	Status
Particle Size Distribution and Particle Size Fractionation Sampling	**Conduct particle-size fractionation monitoring** to evaluate particle-size contributions to transport of mercury, TCDD TEQ, aluminum, and manganese and support exceedance-source evaluations (see Section 5.3.1).	001, 002, and 009, influent SWTS, and offsite locations	New (2026/27)
Subarea Sampling	Reinstate stormwater monitoring at **EPSW002IE01 and EPSW002IE02 in Outfall 002** Watershed to evaluate dioxin source areas and assess the effectiveness of recently implemented source-control measures (see Section 5.3.3)	002	New (2026/27)
Subarea Sampling	Conduct stormwater monitoring in the Northern Drainage immediately **upstream and downstream of Area II Landfill** to evaluate whether elevated mercury concentrations remain present in runoff from identified NASA hillside source areas (see Section 5.3.3).	009	New (2026/27)

Monitoring Domain	Monitoring Recommendation	Watershed	Status
Subarea Sampling	Conduct targeted stormwater monitoring at **Well 13 Road (A2BMP0009)** to determine whether historically elevated mercury concentrations in stormwater runoff remain elevated under current conditions (see Section 5.3.3).	009	New (2026/27)
Subarea Sampling	Continue stormwater monitoring at the **Area I Landfill (A1BMP0002, ILBMP0002, and A1BMP0003)** to provide updated mercury data for stormwater runoff (see Section 5.3.3).	009	Ongoing
Subarea Sampling	Conduct targeted stormwater monitoring of the **NASA Sewage Treatment Plant/Ash Pile area (APBMP0001-A)**, relocating the monitoring location to immediately upstream of the ELV effluent location to better evaluate potential contributions from elevated mercury in surface soils (see Section 5.3.3).	009	New (2026/27)
Stormwater Control Performance Sampling	**Prioritize** targeted performance monitoring treatment controls identified through the mercury subarea prioritization analysis, specifically at the **Northern Detention Bioswale, Lower Lot Biofilter and B1 Media Filter** (see Section 5.3.2).	009	New (2026/27)
Stormwater Control Performance Sampling	Continue treatment control performance monitoring and enhanced performance monitoring at stormwater treatment controls listed in Section 5.3.2.	009	Ongoing
Stormwater Control Performance Sampling	Continue documenting observations and/or indications of overflow, bypass, and/or post-storm ponding conditions all applicable stormwater treatment controls (see Section 5.3.2).	009	Ongoing
Offsite Watersheds	Continue monitoring selected offsite background and ambient locations to support establishment and refinement of background thresholds and PSD comparisons (see Section 5.3.4)	Site-wide	Ongoing

5.3.1 Particle size distribution and particle size fractionation sampling

Continue monitoring in accordance with the NPDES Permit, including recommended additions summarized in Table 5-9 and detailed here.

To improve understanding of constituent transport mechanisms and support exceedance-source evaluations, **conduct particle-size fractionation (PSD) analyses on selected stormwater samples**. The objective of this monitoring is to evaluate the particle-size ranges responsible for transport of mercury, TCDD TEQ, aluminum, and manganese and to further assess PSD-based explanations used in exceedance-source evaluations. Comparable PSD analyses should also be conducted for selected offsite background and ambient samples to facilitate comparison of onsite and offsite runoff characteristics.

Locations:

- Outfalls 001, 002, and 009
- Influent locations to Outfalls 011 and 018
- Offsite background and ambient monitoring locations

Parameters:

- Mercury
- TCDD TEQ (no DNQ)
- Aluminum
- Manganese
- TSS
- Particle size distribution

Fractions:

- <0.45 µm (standard “dissolved” fraction)
- 0.45-2 µm (clay fraction)
- 2-64 µm (silt fraction)
- >64 µm (sand and larger fraction)
- Total (unfractionated sample)

Data Evaluation

- Sample collection: For each parameter, collect sufficient sample volume to support particle-size fractionation analysis. Aluminum and manganese may be combined where appropriate.
- Sample splitting and filtering: In the laboratory, use a decaport splitter to divide the sample into five representative subsamples. One subsample is for total analysis; filter other subsamples using 0.45, 2, and 64 um stainless steel filters to characterize the following fractions: <0.45 µm, 0.45–2 µm, 2–64 µm, and >64 µm.
- Analyze each subsample
- Determine constituent concentrations within each particle-size fraction by subtracting subsamples
    - i.e., (concentration in total sample – concentration in 64 um filtered sample) / (TSS concentration in total sample – TSS concentration in 64 um filtered sample) = constituent particulate strength of >64 um suspended solid size fraction. Similarly, 64

um – 2 um subtraction = particulate strength of 2-64 um size fraction. Then again for 0.45-2 um size fraction.

5.3.2 Stormwater Control Performance Sampling

Continue treatment-control performance sampling twice per year (where runoff conditions are suitable) to evaluate treatment effectiveness, assess the performance of recently modified controls, and support future treatment-control and source-control decisions.

Priority Control Performance Sampling

Based on the 2025/26 mercury subarea prioritization evaluation, the following treatment controls should be **prioritized** for performance monitoring **before other treatment controls** because they are associated with higher-priority mercury source areas:

- B-1 Media Filter (B1BMP0005, B1BMP0004-5, B1SW0011, B1SW0013, B1SW0014-C, B1BMP0006, B1BMP0003, B1BMP0002, B1BMP0004, B1BMP0004-5, B1SW0015)
- Lower Lot Biofilter (ILBMP0001)
- North Detention Bioswale (ILBMP0006, ILBMP0007)

Routine Control Performance Sampling

Continue treatment-control performance monitoring at:

- CM-1
- CM-3
- CM-9
- CM-12
- Upper Lot Media Filter
- ELV Treatment Stormwater Control
- Outfall 011 SWTS influent
- Outfall 018 SWTS influent

Analytical Suite

Analyze samples for recently exceeding constituents, historically exceeding constituents, and diagnostic parameters used to evaluate treatment performance, which are:

- Aluminum (dissolved and total)
- Copper (dissolved and total)
- Lead (dissolved and total)
- Mercury (dissolved and total)
- Manganese (dissolved and total)
- TCDD TEQ (no DNQ)
- TSS
- Gross alpha
- Particle-size fractions (Outfall 011 SWTS influent and Outfall 018 SWTS influent)

Documentation

- Document overflow and bypass conditions when performance samples are collected.

- Document ponding observations during 72-hour post-storm inspections.
- Record observation dates and times on all field forms.
- Maintain backup copies of field forms and photographs following each storm event.

5.3.3 Onsite Subarea Sampling

Continue subarea sampling at priority locations twice per year to support source evaluations and assess the effectiveness of source control and stormwater control measures.

Current Priority Monitoring Locations

- **Northern Drainage:** Immediately upstream and downstream of the Area II Landfill. These locations are intended to evaluate whether elevated mercury concentrations associated with identified hillside source areas remain present in runoff where direct sampling of hillside runoff has been difficult.
- **Area I Landfill:** A1BMP0002, ILBMP0002, and A1BMP0003
- **Area II Landfill (A2BMP0001 and A2BMP0008):** Conduct targeted stormwater monitoring to evaluate whether mercury concentrations remain elevated in stormwater from hillside areas associated with upgradient mercury-impacted soils in the vicinity of the Area II Landfill. To evaluate these subareas, it is recommended to conduct targeted stormwater monitoring upstream and downstream of the Area II Landfill in the Northern Drainage to determine the influence the Area II Landfill may have on Outfall 009 stormwater quality for mercury.
- **Well 13 Road:** A2BMP0009.
- **NASA Sewage Treatment Plan (STP) & Ash Pile (adjacent to ELV Treatment Control): (APBMP0002):** To focus on potential impacts from elevated soil concentrations it is recommended to relocate the APBMP0001-A monitoring location to just upstream of the ELV effluent location (APBMP0002**)**.
- **Outfall 002 watershed:** EPSW002IE01 and EPSW002IE02. Continue monitoring to evaluate TCDD TEQ (no DNQ) source areas and the effectiveness of recently implemented source control measures.

Analytical Suite:

Focus is on analytes that have exceeded in the past 10 years, particularly at Outfall 009 where distributed controls are placed to target priority subareas that most contribute to downstream exceedances at the outfall:

- TCDD TEQ (no DNQ)
- Aluminum (dissolved and total)
- Copper (dissolved and total)
- Lead (dissolved and total)
- Mercury (dissolved and total)
- Manganese (dissolved and total)
- Total Suspended Solids (TSS)

5.3.4 Offsite Background and Ambient Sampling

Continue sampling offsite background stormwater subareas (Las Llajas Canyon, Box Canyon, Montgomery Canyon) during each storm event with observed runoff.

Analytical Suite:

- Continue PFAS and PCB congeners analyses at all offsite background and ambient monitoring sites, as these datasets have not met the SWEP's background threshold sample count target yet.
- Continue to monitor the same parameters collected at NPDES Outfalls.
- Conduct PSD analyses
- Periodically reevaluate monitoring parameter results and discontinue analyses where sufficient data are available to establish representative background and ambient conditions or where additional monitoring is not expected to materially refine the background and ambient thresholds.

5.3.5 Methods and Training

- **Field Procedures:** Prioritize field staff training and confirm that clear signage is posted to minimize missed or incorrect sample collection.
- **Field Forms:** All field forms must have date and times that reflect the time of observation.

6 Key Dates and Activities

6.1 Public Involvement

Numerous stakeholder groups and members of the public have expressed interest in stormwater topics at SSFL during past public engagements and LARWQCB hearings. To provide progress updates as well as opportunities for obtaining feedback from the public, public forum meetings and site tours with the SWEP have been held periodically from 2011 through the currently ongoing duration of the 2015 Work Plan. The next public meeting and tour will be held in December 2026. Project reports and documents are posted on the Boeing project website following completion of major project milestones and public outreach meetings. Table 6-1 summarizes public engagement activities since the development of the 2010 BMP Plan (MWH et al., 2010).

Table 6-1. Surface Water Expert Panel Public Involvement Activities, 2011-Present

Date	Activity
December 5, 2026	Planned public meeting and SSFL tour
November 4, 2025	Public meeting and SSFL tour
November 29, 2023	Public meeting and SSFL tour
November 17, 2022	Public meeting and SSFL tour
August 19, 2021	Public meeting (virtual)
August 11, 2020	Public meeting (virtual)
July 17 2019	Public meeting and SSFL tour
May 9, 2019	Presentation to LARWQCB

Date	Activity
July 25, 2018	Public meeting and SSFL tour
August 17, 2017	DIPCON LA Conference SSFL tour
March 21, 2017	Public meeting and SSFL tour
November 19, 2014	Community Action Group meeting
March 20, 2013	Public meeting and SSFL tour
October 6, 2013	Public meeting and SSFL tour
August 25, 2011	Public meeting
January 22, 2011	Public meeting and SSFL tour

6.2 SWEP Membership Changes

Following coordination with the LARWQCB, Dr. Gregory Pasternack joined the SWEP in 2025. Dr. Pasternack remained an active member throughout the 2025/26 reporting period and contributed to the development of this Annual Report. No changes to SWEP membership occurred during the reporting period. Future SWEP activities will be conducted as needed in accordance with the 2023 Permit, MOU, and LARWQCB and Boeing requests for SWEP involvement.

6.3 Memorandum of Understanding (MOU) and Cleanup Activities

The SWEP continues to work closely with LARWQCB staff and Geosyntec to develop a site-wide stormwater model as described in Exhibit C (Post-Cleanup Stormwater Quality Modeling Work Plan) of the MOU (Santa Susana Surface Water Expert Panel and Geosyntec Consultants, 2022b). Dozens of progress report meetings have been held with LARWQCB staff over the last 4+ years to collect feedback throughout the calibration process. This modeling effort will develop, calibrate, and apply a hydrologic and water quality model to predict stormwater pollutant concentrations from Boeing soil cleanup areas under post-cleanup conditions. The model will estimate future stormwater quality and predicted concentrations will be compared to Permit limits and background thresholds. The model is intended to provide a preview of post-cleanup water quality within the broader multi-line-of-evidence framework that includes post-cleanup stormwater modeling, post-cleanup confirmation stormwater monitoring, and a post-cleanup stormwater human health risk assessment (HHRA). The first draft model calibration report (Part 1 of 2) was submitted to the LARWQCB in mid-October 2026, and it covered hydrology, TSS, and three COPCs (lead, copper, and mercury). Calibration of the remaining Work Plan COPCs is approximately 75% complete as of October 2026, and these results will be captured in a Part 2 report that also addresses LARWQCB comments on the draft Part 1 report.

During and after cleanup, the SWEP will assist through recommendation of erosion control and stabilization of disturbed areas and review of stormwater monitoring results.

7 References

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Appendix A: 2025/26 Reporting Year Sampling and Analysis Plan

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December 10, 2025
File No. 0129095-040

Mr. Peter Zorba
National Aeronautics and Space Administration
Santa Susana Field Laboratory
5800 Woolsey Canyon Road
Canoga Park, California 91304

Mr. Jeffrey Wokurka
The Boeing Company
Santa Susana Field Laboratory
5800 Woolsey Canyon Road
Canoga Park, California 91304

Subject: 2025/2026 Rainy Season Sampling and Analysis Plan (SAP) Updates,
Best Management Practice (BMP) Monitoring Program
Santa Susana Field Laboratory
Canoga Park, California

Dear Mr. Zorba and Mr. Wokurka:

This letter presents the Sampling and Analysis Plan (SAP) updates to the Best Management Practice (BMP) subarea and performance monitoring programs near or within the Outfalls 001, 002, 008, 009, and 011 watersheds at the Santa Susana Field Laboratory (Santa Susana) for the 2025/2026 rainy season, and serves as an addendum to the 2015/2016 and 2016/2017 rainy season SAPs (MWH Americas, Inc. [MWH], 2015; 2016) and the 2017/2018, 2018/2019, 2019/2020, 2020/2021, 2021/2022, 2022/2023, 2023/2024, and 2024/2025 SAPs (Haley & Aldrich, Inc. 2018a; 2018b; 2019; 2020; 2021; 2023; 2024a; 2024b). BMP subarea monitoring is conducted at locations receiving runoff from potential pollutant source areas and other infrastructure (e.g., roads, buildings, parking areas) to evaluate the potential for constituents of concern from these areas to stormwater runoff and to identify locations for new BMPs. BMP performance monitoring is conducted at selected structural BMPs (e.g., Lower Lot BMP, B1436 detention bioswales) to assess the effectiveness of the BMPs at promoting sediment settling and improving surface water quality to comply with limits at Outfalls 001, 002, 008, 009, and 011.

The updates to the BMP monitoring program SAP for the 2025/2026 rainy season account for field observations of monitoring locations during the 2024/2025 rainy season and an evaluation of surface water sampling data collected to date. These updates are described below. In addition, attached to this letter are 2025/2026 rainy season versions of the SAP tables, figures, and standardized BMP inspection forms. The changes described in this letter were developed with input from, and in accordance with, the recommendations from the Santa Susana Surface Water Expert Panel (Expert Panel) and Geosyntec Consultants (Geosyntec), initially presented in the 2024/2025 Site-wide Stormwater Annual Report

(Geosyntec Consultants and Surface Water Expert Panel, 2025), and revised via email communications with Geosyntec in November 2025.

BMP Monitoring Updates

ANALYTICAL PROGRAM

The BMP performance sample locations and parameters established for the 2025/2026 rainy season are summarized in Table IA.

During the 2025/2026 rainy season, Boeing will perform the following procedures as a part of the analytical quality assurance/quality control (QA/QC) program:

- Collect and submit field duplicate samples at a rate of one field duplicate sample per 10 primary samples.
- Review sample container sets and Chain-of-Custody forms to confirm that all required analyses are performed at each sample location.

NASA SUBAREAS

Subarea monitoring of Area II Road, Area II Landfill, and Well 13 Road will be reinstated at a frequency of twice per year during the 2025/2026 rainy season. Sample locations will include APBMP0002, A2BMP0001, and A2BMP0009.

AREA 1 BURN PIT

Subarea monitoring of Area 1 Burn Pit (A1BP) will continue at a frequency of every rain event during 2025/2026 rainy season. Drainage west of A1BP will be characterized by EPSW001IE01 and drainage east of A1BP will be characterized by A1BPSW0001. Sampling will be conducted at these locations regardless of whether Outfalls 001 or 011 flow.

B-1 MEDIA FILTER

BMP performance sampling of the B-1 Media Filter will be reinstated at a frequency of twice per year during the 2025/2026 rainy season. Sample locations will include B1BMP0004, B1BMP0005, and B1BMP0006.

FORMER SHOOTING RANGE CLEANUP AREA

Subarea monitoring of locations EPNDSW07 and EPNDSW04 will continue at a frequency of twice per year during the 2025/2026 rainy season to capture runoff upstream and downstream of the Former Shooting Range Cleanup Area (Shooting Range) and to evaluate the effectiveness of erosion and sediment controls. BMP performance samples collected from CM-12 will also be utilized to characterize runoff from the Shooting Range.

BACKGROUND MONITORING LOCATIONS

The Santa Susana Background Stormwater Sampling Plan, included as an attachment to this document, details the background sampling program initiated during the 2020/2021 rainy season. The offsite and ambient background sample locations and parameters for the 2025/2026 rainy season are summarized in Table IB.

BMP PERFORMANCE SAMPLING CONTINUING FROM THE 2024/2025 SAP

BMP performance sites within the Outfall 009 watershed will continue to be sampled twice a year during the 2025/2026 rainy season, and where feasible:

- One sample will be collected during the first discharge-producing rain event.
- The second sample will not be collected until Outfall 009 also flows.

BMP performance sampling will continue at the following locations within the Outfall 009 watershed:

- CM-1;
- CM-9;
- CM-12;
- Upper Lot Media Filter;
- Lower Lot BMPs (Sedimentation Basin and Biofilter);
- Southern Detention Bioswale; and
- Expendable Launch Vehicle (ELV) Treatment BMP.

Regular observations of flow/no flow will be made in lieu of sampling the overflow location EVBMP0001, including when its upstream location (EVBMP0007) is sampled.

Not all BMP sites need to be sampled during the same rain event, but influent and effluent samples from a single BMP site must be collected during the same event. Additionally, when effluent samples are collected, a record of overflow/bypass will be maintained where applicable.

The lower lot totalizer reading will be recorded in the post-rain BMP conveyance report.

BMP INSPECTIONS AND FORMS

For BMP sites with active sampling locations, regardless of their assigned sampling frequency, the BMP Performance Inspection Checklists and/or BMP Visual Inspections will continue to be completed for every rain event exceeding 0.75 inches of rainfall, and once after the rainy season.

For BMP sites without active sampling locations, the BMP Performance Inspection Checklists and/or BMP Visual Inspections can be reduced to two large storms per year and after significant rain events exceeding 2.5 inches of rainfall. A ‘large storm’ event will be classified by exceeding 1.0 inch of rainfall in

a 24-hour period. If no 'large storms' occur, then inspections are to be conducted during any two rain events exceeding 0.75 inches of rainfall, with at least one inspection by the end of January and one inspection by the end of April.

The BMP inspection forms attached to this SAP will be used to document the inspections; these forms include visual observations, maintenance needs, and corrective actions. As specified on each form, a standardized framed photo should be taken at the same location, facing the same direction, during each inspection.

Seventy-two hours after the end of each rain event exceeding 0.75 inches of rainfall, field crews will inspect and record maximum ponding levels at specified locations listed in the 72-Hours After Rain Event Ponding Inspection Forms. The ponding inspection may occur at a time slightly before or after the 72-hour period.

Inspection forms for Boeing and NASA BMP sites are updated for the 2025/2026 rainy season year and are included as attachments to this SAP.

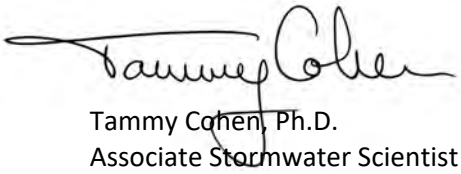
Other Monitoring Recommendations

Updates to BMP performance sampling at both OF011 and OF018 Stormwater Treatment Systems (SWTS) are not included in the SAP, but are reflected in their corresponding NPDES permit sampling suite.

Sincerely yours,
HALEY & ALDRICH, INC.



Yair Pilowsky, CPESC, QSD/QSP, QISP
Technical Specialist, Environmental Scientist



Tammy Cohen, Ph.D.
Associate Stormwater Scientist

Enclosures:

- Table IA - BMP Monitoring Locations and Analytical Plan - BMP and Subarea Locations, 2025/2026 Rainy Season
- Table IB - BMP Monitoring Locations and Analytical Plan - Background Locations, 2025/2026 Rainy Season
- Figure 1 - Outfall 009 and 011, BMP Monitoring Locations
- Figure 2 - Outfall 009, B-1 and Lower Parking Lot Areas - Boeing
- Figure 3 - Outfall 009, IEL Area - Boeing
- Figure 4 - Outfall 009, AILF Area - Boeing
- Figure 5 - Sage Ranch, Outfall 009, CMs South of LOX Area - NASA
- Figure 6 - Outfall 009, A2LF, CM-1, and Helipad Areas - NASA
- Figure 7 - Outfall 009, ELV Area - NASA
- Figure 8 - Sage Ranch, Outfall 009, CM-12
- Figure 9 - Outfalls 001 and 002, Potential BMP Monitoring Locations

Figure 10 - Outfall 011, Area 1 Burn Pit
Figure 11 - Outfall 001, Potential BMP Subarea
Figure 12 - Las Llajas Canyon Sample Location
Figure 13 - Montgomery Canyon Sample Location
Figure 14 - Box Canyon Sample Location
Attachment A - Field Forms
Attachment B - Santa Susana Field Laboratory Background Stormwater Sampling Plan 2021

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TABLES

TABLE IA
BMP MONITORING LOCATIONS AND ANALYTICAL PLAN - BMP and SUBAREA LOCATIONS
2025/2026 RAINY SEASON
SANTA SUSANA FIELD LABORATORY
CANOGA PARK, CALIFORNIA

Object ID	Sampling Responsibility	Figure Number	Location	Outfall Watershed Monitored	Areas Monitored	Purpose	Notes	Sample Frequency[1]	Al, Cd, Cu, Fe, Mn, Ni, Pb, total recoverable (Method 200.8)	Al, Cd, Cu, Fe, Mn, Ni, Pb, total dissolved (Method 200.8)	Low Level Hg, total recoverable (Method 1631E)	Low Level Hg, total dissolved (Method 1631E)	Dioxins- 17 Congeners[4] (Method 1613B/ SM 8290)	Total Suspended Solids (Method 2540D)	SVOCs- only Bis(2-ethylhexyl)Phthalate, Pentachlorophenol (Method 6251 SIM)	Turbidity (Method 180.1 / SM 2130B)	Gross Alpha, total recoverable (Method 900.0)	SVOCs - only 3,3-Dichlorobenzidine, Benzidine, Indeno(1,2,3-cd) Pyrene (Method 625.1 SIM)	Al, As, Cd, Cu, Fe, Mn, Pb, Se, Zn, total recoverable (Method 200.8)	Al, As, Cd, Cu, Fe, Mn, Pb, Se, Zn, total dissolved (Method 200.8)	Sulfate [SO4] (Method 300)	Tritium (Method 906.0)	Gross Alpha, Gross Beta (E900.0), K-40, CS-137 (E901.1), Uranium (HASL-300 U-02 or A-01 R), Total Combined Rad 226 & 228 (E903, E904)	Gross Alpha, Gross Beta (E900.0), K-40, CS-137 (E901.1), Uranium (HASL-300 U-02 or A-01 R), Total Combined Rad 226 & 228 (E903, E904) -- Total Dissolved	Pesticides/PCBs- only 4,4-DDE, alpha-BHC, Heptachlor (Method 608)	PCBs - 44 Congeners only (1688C)
Sampled by Boeing																										
A1BPSW0001	Boeing	9, 10	A1BP	OF001, OF011	Impacted Soils Evaluation (A1BP)	Potential BMP Location, AIBP east side draining toward Outfall 011	At edge of A1BP and access road to Outfall 011	Every Storm[3]			X	X	X	X				X	X	X	X	X	X	X	X	X
EPSW001IE01	Boeing	9, 11	A1BP, OF001 Watershed	OF001	Impacted Soils Evaluation (A1BP, CTL-V)	Potential BMP Location, AIBP west side draining toward Outfall 001	At the bottom of the hill to the north of the intersection of the Southern Buffer Zone Road and Outfall 001 Road.	Every Storm[3]			X	X	X	X				X	X	X	X	X	X	X	X	X
EPNDSW07 (BGBMP0005)	Boeing	2	Sage Ranch	OF009	FSR, ND	US, Former Shooting Range Cleanup Area Monitoring	Access near the front gate, along a small branch of the Northern Drainage.	Twice a year[2]	X	X	X	X	X	X	X		X										
EPNDSW04	Boeing	5	Sage Ranch	OF009	FSR, ND	DS, Former Shooting Range Cleanup Area Monitoring	Sage Ranch location along the Northern Drainage; east of LOX.	Twice a year[2]	X	X	X	X	X	X	X		X										
CM12INF	Boeing	8	Sage Ranch	OF009	CM-12, ND	Former Shooting Range Cleanup Area Monitoring	Influent to CM-12, prior to the weir board stationed in front of the culvert	Twice a year[2]	X	X	X	X	X	X	X		X										
CM12EFF	Boeing	8	Sage Ranch	OF009	CM-12, ND	Former Shooting Range Cleanup Area Monitoring	Effluent of CM-12, underdrains (directly behind the weir board in front of the culvert)	Twice a year[2]	X	X	X	X	X	X	X		X										
A1BMP0002	Boeing	4	A1LF	OF009	CM-9, A1LF	US South, Treatment BMP Performance Monitoring	Influent to CM-9, A1LF tributary drainage	Twice a year[2]	X	X	X	X	X	X	X		X										
A1BMP0003	Boeing	4	A1LF	OF009	CM-9, A1LF, IEL, Area II Road	DS, Treatment BMP Performance Monitoring	Effluent of CM-9, underdrains	Twice a year[2]	X	X	X	X	X	X	X		X										

TABLE IA
BMP MONITORING LOCATIONS AND ANALYTICAL PLAN - BMP and SUBAREA LOCATIONS
2025/2026 RAINY SEASON
SANTA SUSANA FIELD LABORATORY
CANOGA PARK, CALIFORNIA

Object ID	Sampling Responsibility	Figure Number	Location	Outfall Watershed Monitored	Areas Monitored	Purpose	Notes	Sample Frequency[1]	Al, Cd, Cu, Fe, Mn, Ni, Pb, total recoverable (Method 200.8)	Al, Cd, Cu, Fe, Mn, Ni, Pb, total dissolved (Method 200.8)	Low Level Hg, total recoverable (Method 1631E)	Low Level Hg, total dissolved (Method 1631E)	Dioxins- 17 Congeners[4] (Method 1613B/ SM 8290)	Total Suspended Solids (Method 2540D)	SVOCs- only Bis(2-ethylhexyl)Phthalate, Pentachlorophenol (Method 6251 SIM)	Turbidity (Method 180.1 / SM 2130B)	Gross Alpha, total recoverable (Method 900.0)	SVOCs - only 3,3-Dichlorobenzidine, Benzidine, Indeno(1,2,3-cd) Pyrene (Method 625.1 SIM)	Al, As, Cd, Cu, Fe, Mn, Pb, Se, Zn, total recoverable (Method 200.8)	Al, As, Cd, Cu, Fe, Mn, Pb, Se, Zn, total dissolved (Method 200.8)	Sulfate [SO4] (Method 300)	Tritium (Method 906.0)	Gross Alpha, Gross Beta (E900.0), K-40, Cs-137 (E901.1), Uranium (HASL-300 U-02 or A-01 R), Total Combined Rad 226 & 228 (E903, E904) Total Recoverable	Gross Alpha, Gross Beta (E900.0), K-40, Cs-137 (E901.1), Uranium (HASL-300 U-02 or A-01 R), Total Combined Rad 226 & 228 (E903, E904) -- Total Dissolved	Pesticides/PCBs- only 4,4-DDE, alpha-BHC, Heptachlor (Method 608)	PCBs - 44 Congeners only (1688C)
B1BMP0004	Boeing	2	B-1	OF009	B-1 Media Filter	US North, Treatment BMP Performance Monitoring	Influent to B-1 Media Filter, tributary drainage	Twice a year[2]	X	X	X	X	X	X	X		X									
B1BMP0005	Boeing	2	B-1	OF009	B-1 Media Filter	US South, Treatment BMP Performance Monitoring	Influent to B-1 Media Filter, Asphalt swale downstream of retention basin discharge	Twice a year[2]	X	X	X	X	X	X	X		X									
B1BMP0006	Boeing	2	B-1	OF009	B-1 Media Filter	DS, Treatment BMP Performance Monitoring	Effluent of B-1 Media Filter, underdrains	Twice a year[2]	X	X	X	X	X	X	X		X									
B1BMP0009	Boeing	2	B-1	OF009	B-1 Upper Parking Lot Media Filter	US North, Treatment BMP Performance Monitoring	Influent to Upper Lot Media Filter, Gunite swale conveying road runoff	Twice a year[2]	X	X	X	X	X	X	X		X									

TABLE IA
BMP MONITORING LOCATIONS AND ANALYTICAL PLAN - BMP and SUBAREA LOCATIONS
2025/2026 RAINY SEASON
SANTA SUSANA FIELD LABORATORY
CANOGA PARK, CALIFORNIA

Object ID	Sampling Responsibility	Figure Number	Location	Outfall Watershed Monitored	Areas Monitored	Purpose	Notes	Sample Frequency[1]	Al, Cd, Cu, Fe, Mn, Ni, Pb, total recoverable (Method 200.8)	Al, Cd, Cu, Fe, Mn, Ni, Pb, total dissolved (Method 200.8)	Low Level Hg, total recoverable (Method 1631E)	Low Level Hg, total dissolved (Method 1631E)	Dioxins- 17 Congeners[4] (Method 1613B/ SM 8290)	Total Suspended Solids (Method 2540D)	SVOCs- only Bis(2-ethylhexyl)Phthalate, Pentachlorophenol (Method 6251 SIM)	Turbidity (Method 180.1 / SM 2130B)	Gross Alpha, total recoverable (Method 900.0)	SVOCs - only 3,3-Dichlorobenzidine, Benzidine, Indeno(1,2,3-cd) Pyrene (Method 625.1 SIM)	Al, As, Cd, Cu, Fe, Mn, Pb, Se, Zn, total recoverable (Method 200.8)	Al, As, Cd, Cu, Fe, Mn, Pb, Se, Zn, total dissolved (Method 200.8)	Sulfate [SO4] (Method 300)	Tritium (Method 906.0)	Gross Alpha, Gross Beta (E900.0), K-40, Cs-137 (E901.1), Uranium (HASL-300 U-02 or A-01 R), Total Combined Rad 226 & 228 (E903, E904) -- Total Recoverable	Gross Alpha, Gross Beta (E900.0), K-40, Cs-137 (E901.1), Uranium (HASL-300 U-02 or A-01 R), Total Combined Rad 226 & 228 (E903, E904) -- Total Dissolved	Pesticides/PCBs- only 4,4-DDE, alpha-BHC, Heptachlor (Method 608)	PCBs - 44 Congeners only (1688C)
Sampled by Boeing																										
B1BMP0010	Boeing	2	B-1	OF009	B-1 Upper Parking Lot Media Filter	US South, Treatment BMP Performance Monitoring	Influent to Upper Lot Media Filter, culvert outlet from upper parking lot area	Twice a year[2]	X	X	X	X	X	X	X		X								
B1BMP0011	Boeing	2	B-1	OF009	B-1 Upper Parking Lot Media Filter	DS, Treatment BMP Performance Monitoring	Effluent of Upper Lot Media Filter, underdrains (inside the Riser structure)	Twice a year[2]	X	X	X	X	X	X	X		X								
ILBMP0002	Boeing	4	A1LF	OF009	CM-9, IEL, Area II Road	US East, Treatment BMP Performance Monitoring	Influent to CM-9, Culvert inlet off Area II Road	Twice a year[2]	X	X	X	X	X	X	X		X								
ILBMP0004	Boeing	3	IEL	OF009	B1436 Southern Detention Bioswale	US, Treatment BMP Performance Monitoring	Influent to Bioswale, concrete swale (western) diverting sheetflow into rock crib	Twice a year[2]	X	X	X	X	X	X	X		X								
ILBMP0005	Boeing	3	IEL	OF009	B1436 Southern Detention Bioswale	DS, Treatment BMP Performance Monitoring	Effluent of Bioswale, underdrains (subsurface 12-inch drain connecting to existing culvert)	Twice a year[2]	X*	X*	X*	X*	X*	X	X		X								
ILBMP0008	Boeing	3	IEL	OF009	B1436 Southern Detention Bioswale	US, Treatment BMP Performance Monitoring	Influent to Bioswale, concrete swale (eastern) diverting sheetflow into rock crib	Twice a year[2]	X	X	X	X	X	X	X		X								
LPBMP0002	Boeing	2	Lower Lot	OF009	Lower Lot BMP	US, Treatment BMP Performance Monitoring	Influent to Sediment Basin, Sample port in cistern discharge pipe	Twice a year[2]	X	X	X	X	X	X	X		X								
LPBMP0003	Boeing	2	Lower Lot	OF009	Lower Lot BMP	Mid-Point, Treatment BMP Performance Monitoring	Influent to Biofilter, Sediment Basin outlet box	Twice a year[2]	X	X	X	X	X	X	X		X								
LPBMP0004	Boeing	2	Lower Lot	OF009	Lower Lot BMP	DS, Treatment BMP Performance Monitoring	Effluent of Biofilter, discharge from Biofilter effluent pipe (inside the Riser structure)	Twice a year[2]	X	X	X	X	X	X	X		X								

TABLE IA
BMP MONITORING LOCATIONS AND ANALYTICAL PLAN - BMP and SUBAREA LOCATIONS
2025/2026 RAINY SEASON
SANTA SUSANA FIELD LABORATORY
CANOGA PARK, CALIFORNIA

Object ID	Sampling Responsibility	Figure Number	Location	Outfall Watershed Monitored	Areas Monitored	Purpose	Notes	Sample Frequency[1]	Al, Cd, Cu, Fe, Mn, Ni, Pb, total recoverable (Method 200.8)	Al, Cd, Cu, Fe, Mn, Ni, Pb, total dissolved (Method 200.8)	Low Level Hg, total recoverable (Method 1631E)	Low Level Hg, total dissolved (Method 1631E)	Dioxins- 17 Congeners[4] (Method 1613B/ SM 8290)	Total Suspended Solids (Method 2540D)	SVOCs- only Bis(2-ethylhexyl)Phthalate, Pentachlorophenol (Method 6251 SIM)	Turbidity (Method 180.1 / SM 2130B)	Gross Alpha, total recoverable (Method 900.0)	SVOCs - only 3,3-Dichlorobenzidine, Benzidine, Indeno(1,2,3-cd) Pyrene (Method 625.1 SIM)	Al, As, Cd, Cu, Fe, Mn, Pb, Se, Zn, total recoverable (Method 200.8)	Al, As, Cd, Cu, Fe, Mn, Pb, Se, Zn, total dissolved (Method 200.8)	Sulfate [SO4] (Method 300)	Tritium (Method 906.0)	Gross Alpha, Gross Beta (E900.0), K-40, Cs-137 (E901.1), Uranium (HASL-300 U-02 or A-01 R), Total Combined Rad 226 & 228 (E903, E904)	Gross Alpha, Gross Beta (E900.0), K-40, Cs-137 (E901.1), Uranium (HASL-300 U-02 or A-01 R), Total Combined Rad 226 & 228 (E903, E904) --Total Dissolved	Pesticides/PCBs- only 4,4-DDE, alpha-BHC, Heptachlor (Method 608)	PCBs - 44 Congeners only (1688C)
Sampled by NASA																										
APBMP0002	NASA	7	Ash Pile	OF009	AP/STP, ELV	DS, Treatment BMP Performance Monitoring	Ash Pile drainage, surface flow immediately east (downstream) of the effluent of the ELV BMP discharge pipe	Twice a year[2]	X	X	X	X	X	X												
A2BMP0001	NASA	6	A2LF	OF009	CM-1, Area II Road	Potential BMP Location	Area II landfill tributary drainage west	Twice a year[2]	X	X	X	X	X	X												
A2BMP0006	NASA	6	CM-1	OF009	CM-1	US East, Treatment BMP Performance Monitoring	CM-1 eastern tributary drainage	Twice a year[2]	X	X	X	X	X	X												
A2BMP0007	NASA	6	CM-1	OF009	CM-1	DS, Treatment BMP Performance Monitoring	CM-1 culvert outlet	Twice a year[2]	X	X	X	X	X	X												
A2BMP0009	NASA	6	A2LF	OF009	Well 13 Road	Potential BMP Location	Well 13 road runoff east of OF009 autosamplers	Twice a year[2]	X	X	X	X	X	X												
A2BMP0012	NASA	6	CM-1	OF009	CM-1, Area II Road	US, Treatment BMP Performance Monitoring	Outlet pipe south side of road	Twice a year[2]	X	X	X	X	X	X		X										
EVBMP0003	NASA	6	CM-1	OF009	CM-1, Area II Road	US West, Treatment BMP Performance Monitoring	Sheetflow along Area II Road upstream of sandbag berm	Twice a year[2]	X	X	X	X	X	X												
EVBMP0007	NASA	7	ELV	OF009	ELV Treatment BMP	US, Treatment BMP Performance Monitoring	Sample port in BMP influent pipe prior to "T" connection	Twice a year[2]	X	X	X	X	X	X												
EVBMP0008	NASA	7	ELV	OF009	ELV Treatment BMP	DS, Treatment BMP Performance Monitoring	Discharge from media filter tank pipe	Twice a year[2]	X	X	X	X	X	X		X										

TABLE IA
BMP MONITORING LOCATIONS AND ANALYTICAL PLAN - BMP and SUBAREA LOCATIONS
2025/2026 RAINY SEASON
SANTA SUSANA FIELD LABORATORY
CANOGA PARK, CALIFORNIA

Object ID	Sampling Responsibility	Figure Number	Location	Outfall Watershed Monitored	Areas Monitored	Purpose	Notes	Sample Frequency[1]	Al, Cd, Cu, Fe, Mn, Ni, Pb, total recoverable (Method 200.8)	Al, Cd, Cu, Fe, Mn, Ni, Pb, total dissolved (Method 200.8)	Low Level Hg, total recoverable (Method 1631E)	Low Level Hg, total dissolved (Method 1631E)	Dioxins- 17 Congeners[4] (Method 1613B/ SM 8290)	Total Suspended Solids (Method 2540D)	SVOCs- only Bis(2-ethylhexyl)Phthalate, Pentachlorophenol (Method 6251 SIM)	Turbidity (Method 180.1 / SM 2130B)	Gross Alpha, total recoverable (Method 900.0)	SVOCs - only 3,3-Dichlorobenzidine, Benzidine, Indeno(1,2,3-cd) Pyrene (Method 625.1 SIM)	Al, As, Cd, Cu, Fe, Mn, Pb, Se, Zn, total recoverable (Method 200.8)	Al, As, Cd, Cu, Fe, Mn, Pb, Se, Zn, total dissolved (Method 200.8)	Sulfate [SO4] (Method 300)	Tritium (Method 906.0)	Gross Alpha, Gross Beta (E900.0), K-40, CS-137 (E901.1), Uranium (HASL-300 U-02 or A-01 R), Total Combined Rad 226 & 228 (E903, E904)	Gross Alpha, Gross Beta (E900.0), K-40, CS-137 (E901.1), Uranium (HASL-300 U-02 or A-01 R), Total Combined Rad 226 & 228 (E903, E904) -- Total Dissolved	Pesticides/PCBs- only 4,4-DDE, alpha-BHC, Heptachlor (Method 608)	PCBs - 44 Congeners only (1688C)
EVBMP0009	NASA	7	ELV	OF009	ELV Treatment BMP	Mid-Point, Treatment BMP Performance Monitoring	Composite of samples from eastern and western sample ports between settling tanks and media filter	Twice a year[2]	X	X	X	X	X	X		X										

Notes:

[1] All BMPs do not need to be sampled during the same rain event, but influent and effluent samples from a single BMP must be collected during the same event.
*[2] One sample should be collected during the **first discharge event** and then wait until OF009 flows to take , the second sample.*
[3] Sampling is required at every discharge-producing rain event, regardless of whether outfalls flow.
[4] Dioxin congeners to be analyzed are as follows:
2,3,7,8-tetrachlorodibenzo-p-dioxin
1,2,3,7,8-pentachlorodibenzo-p-dioxin
1,2,3,4,7,8-hexachlorodibenzo-p-dioxin
1,2,3,6,7,8-hexachlorodibenzo-p-dioxin
1,2,3,7,8,9- hexachlorodibenzo-p-dioxin
1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin
1,2,3,4,6,7,8,9-octachlorodibenzo-p-dioxin
2,3,7,8-tetrachlorodibenzofuran
1,2,3,7,8-pentachlorodibenzofuran
2,3,4,7,8- pentachlorodibenzofuran
1,2,3,4,7,8-hexachlorodibenzofuran
1,2,3,6,7,8-hexachlorodibenzofuran
1,2,3,7,8,9-hexachlorodibenzofuran
2,3,4,6,7,8-hexachlorodibenzofuran
1,2,3,4,6,7,8-heptachlorodibenzofuran
1,2,3,4,7,8,9-heptachlorodibenzofuran
1,2,3,4,6,7,8,9-octachlorodibenzofuran

Abbreviations:

AP = Ash Pile
A1BP = Area 1 Burn Pit
A1LF = Area 1 Landfill
A2LF = Area 2 Landfill
BG = Background
BMP = Best Management Practice
CM = Culvert Modification
CTL-V = Components Testing Laboratory V
DS = Downstream
ELV = Expendable Launch Vehicle
EP = Expert Panel
FSR = Former Shooting Range
IEL = Instrument and Equipment Laboratories
LOX = Liquid Oxygen
ND = Northern Drainage
OF = Outfall
STL-IV = Systems Test Laboratory IV
STP =
SW = Stormwater
US = Upstream
X = Collect & Analyze

* Collect one equipment blank (EB) per sampling day from the equipment used to sample the B1436 Detention Bioswales downstream monitoring location (under drains).
The EB sample ID will be based on the ID of the primary sample collected immediately before collecting the equipment blank, and will be ILQW0007_yyyymmdd.

TABLE IB
BMP MONITORING LOCATIONS AND ANALYTICAL PLAN - BACKGROUND LOCATIONS
2025/2026 RAINY SEASON
SANTA SUSANA FIELD LABORATORY
CANOGA PARK, CALIFORNIA

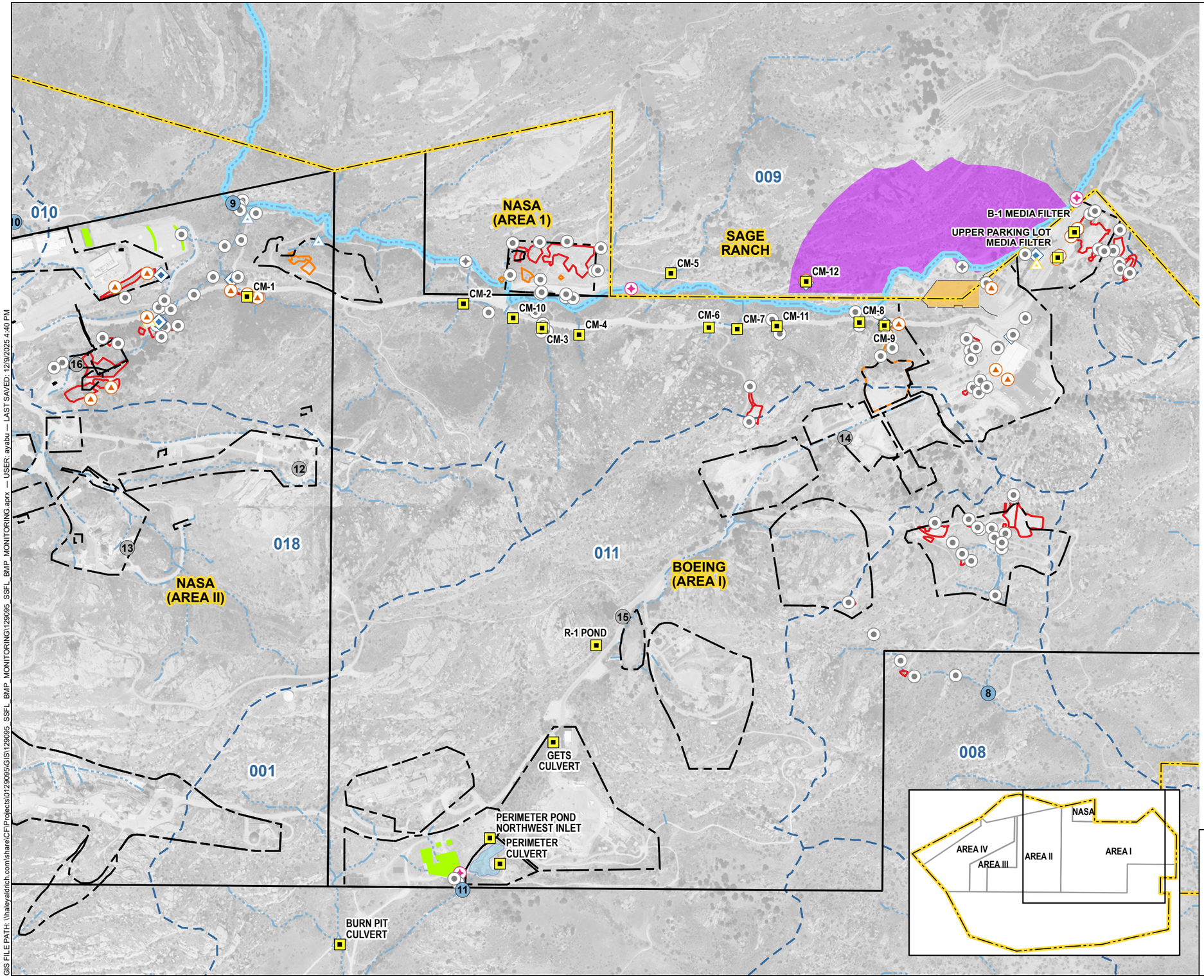
Location	Sample ID	Location Type	Sampling Responsibility	Watershed Monitored	Primary or Backup	Notes *(See Santa Susana Field Laboratory Background Stormwater Sampling Plan for detailed maps and photos of sampling locations)*	Sample Frequency[1]	Low Level Hg (E1631E) -- Total Recoverable	Low Level Hg (E1631E) -- Total Dissolved	Total Suspended Solids (SM 2540D)	Dioxins- 17 Congeners (SM 8290 / E1613B)	Particle Size Distribution (ASTM D422/D4464)	Al, Ag, As, Ba, Be, Cd, Co, Cr, Cu, Fe, Li, Mn, Mo, Ni, P, Pb, Sb, Se, Si, Sn, Sr, Ti, Tl, U, V, Zn, Zr (E200.8); B, Hardness (E200.7) -- Total Recoverable	Al, Ag, As, Ba, Be, Cd, Co, Cr, Cu, Fe, Li, Mn, Mo, Ni, P, Pb, Sb, Se, Si, Sn, Sr, Ti, Tl, U, V, Zn, Zr (E200.8); B, Hardness (E200.7) -- Total Dissolved	Cr VI (E218.6) -- Total Recoverable	Cr VI (E218.6) -- Total Dissolved	Field Parameters: Temperature, Dissolved Oxygen (DO), pH, Total Residual Chlorine	Gross Alpha, Gross Beta (E900.0); Uranium (HASL-300 U-02 or A-01-R); Potassium-40, Cesium-137 (E901.1); Strontium-90 (E905); Total Combined Radium 226 & 228 (E903, E904) -- Total Recoverable	Gross Alpha, Gross Beta (E900.0); Uranium (HASL-300 U-02 or A-01-R); Potassium-40, Cesium-137 (E901.1); Strontium-90 (E905); Total Combined Radium 226 & 228 (E903, E904) -- Total Dissolved	Tritium (E906.0)	Chloride [Cl-], Fluoride [F-], Sulfate [SO4], Nitrate-N, Nitrite-N, NO3+NO2-N (E300), Perchlorate (E314.0)	Ammonia-N (E351.1)	Cyanide (Kelada)	E. Coli (SM 9221)	Conductivity (SM 2510B / E120.1)	Turbidity (E180.1); Total Dissolved Solids [TDS] (SM 2540C)	Settleable Solids (SM 2540F / E160.5)	Biological Oxygen Demand [BOD] 5-day @ 20degC (SM 5210B / E405.1)
Las Llajas Canyon	EPBLLC	OFFSITE, Background	Boeing	Calleguas Creek	Primary	Park on Evening Sky Drive at the Las Llajas Canyon Trailhead; walk 0.3 miles north to gate on west side of trail. Walk through gate to where a creek crosses a concrete area on the dirt road.	Every Storm[1]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Montgomery Canyon	EPBMC	OFFSITE, Background	Boeing	Calleguas Creek	Primary	Park on Long Canyon Road at the Long Canyon East Trailhead (pull out with No Parking sign). Walk 0.1 miles to the sampling location where the two creeks converge and cross the dirt road.	Every Storm[1]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Box Canyon	EPBBC	OFFSITE, Non-Industrial	Boeing	Los Angeles River	Primary	Park on Valley Circle Boulevard just east of Woolsey Canyon Road. Walk <0.1 miles to the sampling location where a culvert crosses under Valley Circle Boulevard (may need sampling pole or other collection device).	Every Storm[1]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Chesebro Canyon	EPBCC	OFFSITE, Secondary Background	Boeing	Malibu Creek	Backup	Park in the parking lot at Chesebro Canyon Trailhead (closed sunset to 8 am). Walk 0.5 miles to the sampling location, just off the main trail.	Every Storm[2] (if primary location inaccessible or not flowing)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
East Las Virgenes Canyon	EPBLVC	OFFSITE, Secondary Background	Boeing	Malibu Creek	Backup	Park at the end of Las Virgenes Road at the Upper Las Virgenes Canyon Open Space Trailhead. Walk 0.4 miles to the sampling location, along a small trail just off the main trail.	Every Storm[2] (if primary location inaccessible or not flowing)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

TABLE IB
BMP MONITORING LOCATIONS AND ANALYTICAL PLAN - BACKGROUND LOCATIONS
2025/2026 RAINY SEASON
SANTA SUSANA FIELD LABORATORY
CANOGA PARK, CALIFORNIA

Location	Sample ID	Location Type	Sampling Responsibility	Watershed Monitored	Primary or Backup	Notes *(See Santa Susana Field Laboratory Background Stormwater Sampling Plan for detailed maps and photos of sampling locations)*	Sample Frequency[1]	Total Organic Carbon (SM 5310D/E415.2)	Oil & Grease (E1664A-HEM)	Asbestos (E100.2)	Surfactants (MBAS) (SM 5540C / E425.1)	1,4 Dioxane (E624 / SW8260M)	SVOCs -PP list (E625.1_SIM-PP list+6 SRAM)	Pesticides/PCBs -PP list (E608)	Monomethyl Hydrazine (SW8315M/DV-WC-0077)	Chlorpyrifos, Diazinon (E525.2)	Chronic Toxicity (EPA-821-R-02-013)	SRAM Analytes (Speical-SRAM Special 2025)	PFAS (Method 537 modified)
Las Llajas Canyon	EPBLLC	OFFSITE, Background	Boeing	Calleguas Creek	Primary	Park on Evening Sky Drive at the Las Llajas Canyon Trailhead; walk 0.3 miles north to gate on west side of trail. Walk through gate to where a creek crosses a concrete area on the dirt road.	Every Storm[1]	X	X	X	X	X	X	X	X	X	X	X	X
Montgomery Canyon	EPBMC	OFFSITE, Background	Boeing	Calleguas Creek	Primary	Park on Long Canyon Road at the Long Canyon East Trailhead (pull out with No Parking sign). Walk 0.1 miles to the sampling location where the two creeks converge and cross the dirt road.	Every Storm[1]	X	X	X	X	X	X	X	X	X	X	X	X
Box Canyon	EPBBC	OFFSITE, Non-Industrial	Boeing	Los Angeles River	Primary	Park on Valley Circle Boulevard just east of Woolsey Canyon Road. Walk <0.1 miles to the sampling location where a culvert crosses under Valley Circle Boulevard (may need sampling pole or other collection device).	Every Storm[1]	X	X	X	X	X	X	X	X	X	X	X	X
Chesebro Canyon	EPBCC	OFFSITE, Secondary Background	Boeing	Malibu Creek	Backup	Park in the parking lot at Chesebro Canyon Trailhead (closed sunset to 8 am). Walk 0.5 miles to the sampling location, just off the main trail.	Every Storm[2] (if primary location inaccessible or not flowing)	X	X	X	X	X	X	X	X	X	X	X	X
East Las Virgenes Canyon	EPBLVC	OFFSITE, Secondary Background	Boeing	Malibu Creek	Backup	Park at the end of Las Virgenes Road at the Upper Las Virgenes Canyon Open Space Trailhead. Walk 0.4 miles to the sampling location, along a small trail just off the main trail.	Every Storm[2] (if primary location inaccessible or not flowing)	X	X	X	X	X	X	X	X	X	X	X	X

Notes:
[1] Attempt to sample at every discharge-producing rain event. If sample location is inaccessible or is not flowing, attempt to sample Backup sample locations.
[2] Attempt to sample only if any primary sample location is inaccessible or not flowing.

FIGURES



LEGEND

- ACTIVE NPDES OUTFALL
- FORMER NPDES OUTFALL
- CULVERT MODIFICATION (CM)
- DOWNSTREAM BMP PERFORMANCE MONITORING LOCATION
- MIDPOINT BMP PERFORMANCE MONITORING LOCATION
- SPECIAL STUDIES AND OTHER SAMPLING LOCATIONS
- POTENTIAL BMP PERFORMANCE MONITORING LOCATION
- PREVIOUS BMP PERFORMANCE MONITORING LOCATION
- UPSTREAM BMP PERFORMANCE MONITORING LOCATION
- SSFL PROPERTY BOUNDARY
- EROSION CONTROL FABRIC/LINER
- ADMINISTRATIVE AREA BOUNDARY
- STUDY AREA
- ISRA EXCAVATION BOUNDARY
- FORMER ISRA EXCAVATION BOUNDARY
- DRAINAGE
- SURFACE WATER DIVIDE
- SURFACE WATER POND
- NORTHERN DRAINAGE
- FORMER SHOOTING RANGE CLEAN UP AREA
- FORMER SHOOTING RANGE

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. SAP = SAMPLING AND ANALYSIS PLAN
3. BMP = BEST MANAGEMENT PRACTICE
4. AERIAL IMAGERY SOURCE: CIRGIS

N

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SCALE IN FEET

HALEY ALDRICH

2025/2026 RAINY SEASON MAP
BMP MONITORING PROGRAM
THE BOEING COMPANY
VENTURA COUNTY, CALIFORNIA

OUTFALL 009 AND 011 BMP MONITORING LOCATIONS

DECEMBER 2025

FIGURE 1

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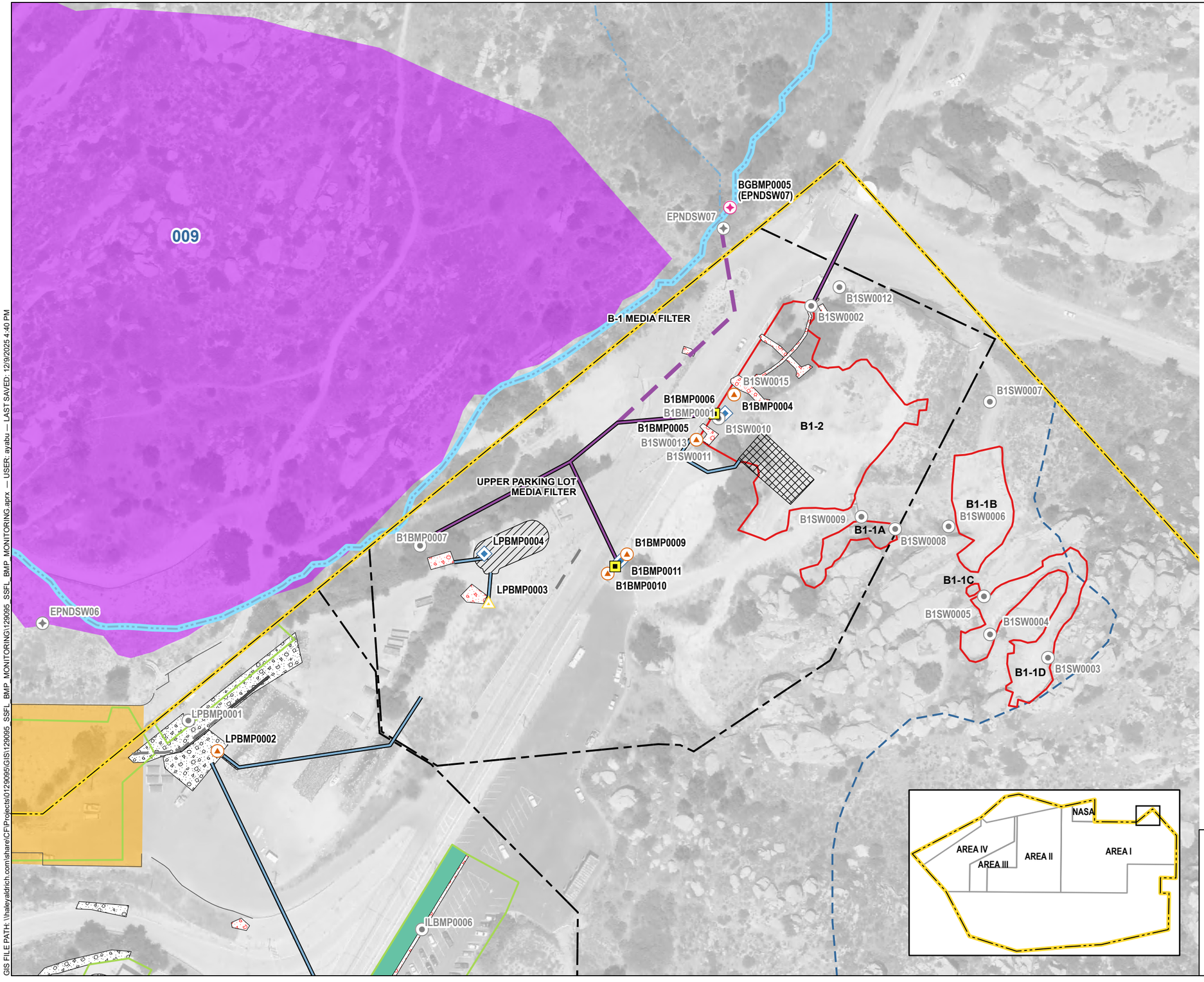

LEGEND

- CULVERT MODIFICATION (CM)
- DOWNSTREAM BMP PERFORMANCE MONITORING LOCATION
- MIDPOINT BMP PERFORMANCE MONITORING LOCATION
- SPECIAL STUDIES AND OTHER SAMPLING LOCATIONS
- PREVIOUS BMP PERFORMANCE MONITORING LOCATION
- UPSTREAM BMP PERFORMANCE MONITORING LOCATION
- SSFL PROPERTY BOUNDARY
- STORM DRAIN (ESTIMATED SUBSURFACE TRACE)
- STORM DRAIN INFERRED
- CONVEYANCE PIPELINE
- ASPHALT CURB
- ROLLING AC BERM
- ASPHALT/CONCRETE REMOVAL AREA
- DETENTION BIOSWALE
- ENGINEERED NATURAL TREATMENT SYSTEM
- GRAVEL
- RIP RAP
- SEDIMENTAION BASIN
- ADMINISTRATIVE AREA BOUNDARY
- STUDY AREA
- ISRA EXCAVATION BOUNDARY
- DRAINAGE
- SURFACE WATER DIVIDE
- NORTHERN DRAINAGE
- FORMER SHOOTING RANGE CLEAN UP AREA
- FORMER SHOOTING RANGE

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. SAP = SAMPLING AND ANALYSIS PLAN
3. BMP = BEST MANAGEMENT PRACTICE
4. AERIAL IMAGERY SOURCE: CIRGIS

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SCALE IN FEET

HALEY ALDRICH

2025/2026 RAINY SEASON MAP
BMP MONITORING PROGRAM
THE BOEING COMPANY
VENTURA COUNTY, CALIFORNIA

OUTFALL 009
B-1 AND LOWER PARKING LOT AREAS - BOEING

DECEMBER 2025

FIGURE 2

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009

ILBMP0006

ILBMP0007

ILBMP0005

ILSW0005

IEL-3

ILSW0006

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ILBMP0010

ILSW0002

IEL-1

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ILBMP0004

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ILSW0008

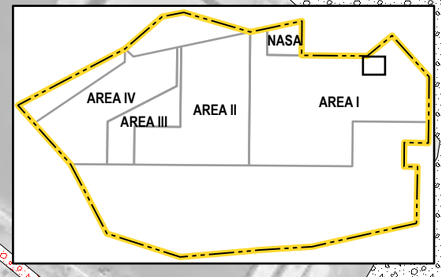
ILSW0004

IEL-2

ILSW0007

ILSW0003

IEL-2 Soil Borrow Area



LEGEND

- UPSTREAM BMP PERFORMANCE MONITORING LOCATION
- DOWNSTREAM BMP PERFORMANCE MONITORING LOCATION
- PREVIOUS BMP PERFORMANCE MONITORING LOCATION
- SURFACE WATER DIVIDE
- CONVEYANCE PIPELINE
- ROLLING AC BERM
- ASPHALT/CONCRETE REMOVAL AREA
- DETENTION BIOSWALE
- ROCK CRIB SWALE
- GRAVEL
- RIP RAP
- ISRA EXCAVATION BOUNDARY
- STUDY AREA
- ADMINISTRATIVE AREA BOUNDARY
- FORMER SHOOTING RANGE
- SSFL PROPERTY BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. SAP = SAMPLING AND ANALYSIS PLAN
3. BMP = BEST MANAGEMENT PRACTICE
4. AERIAL IMAGERY SOURCE: CIRGIS

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SCALE IN FEET

HALEY ALDRICH

2025/2026 RAINY SEASON MAP
BMP MONITORING PROGRAM
THE BOEING COMPANY
VENTURA COUNTY, CALIFORNIA

OUTFALL 009
IEL AREA - BOEING

DECEMBER 2025

FIGURE 3

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A1SW0003
A1SW0005
009
CM-8
A1SW0002
ILBMP0002-B
A1BMP0003
A1SW0009
CM-9
AILF-2
ILBMP0002
A1SW0004
A1BMP0002
ILSW0005
ILBMP0003
A1BMP0001
AILF-1
IEL-2 Soil Borrow Area
NASA
AREA IV
AREA III
AREA II
AREA I

LEGEND

- CULVERT MODIFICATION (CM)
- DOWNSTREAM BMP PERFORMANCE MONITORING LOCATION
- PREVIOUS BMP PERFORMANCE MONITORING LOCATION
- UPSTREAM BMP PERFORMANCE MONITORING LOCATION
- SSFL PROPERTY BOUNDARY
- CONVEYANCE PIPELINE
- ASPHALT/CONCRETE REMOVAL AREA
- GRAVEL
- RIP RAP
- ADMINISTRATIVE AREA BOUNDARY
- STUDY AREA
- ISRA EXCAVATION BOUNDARY
- FORMER ISRA EXCAVATION BOUNDARY
- DRAINAGE
- SURFACE WATER DIVIDE
- NORTHERN DRAINAGE
- FORMER SHOOTING RANGE CLEAN UP AREA
- FORMER SHOOTING RANGE

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. SAP = SAMPLING AND ANALYSIS PLAN
3. BMP = BEST MANAGEMENT PRACTICE
4. AERIAL IMAGERY SOURCE: CIRGIS

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SCALE IN FEET

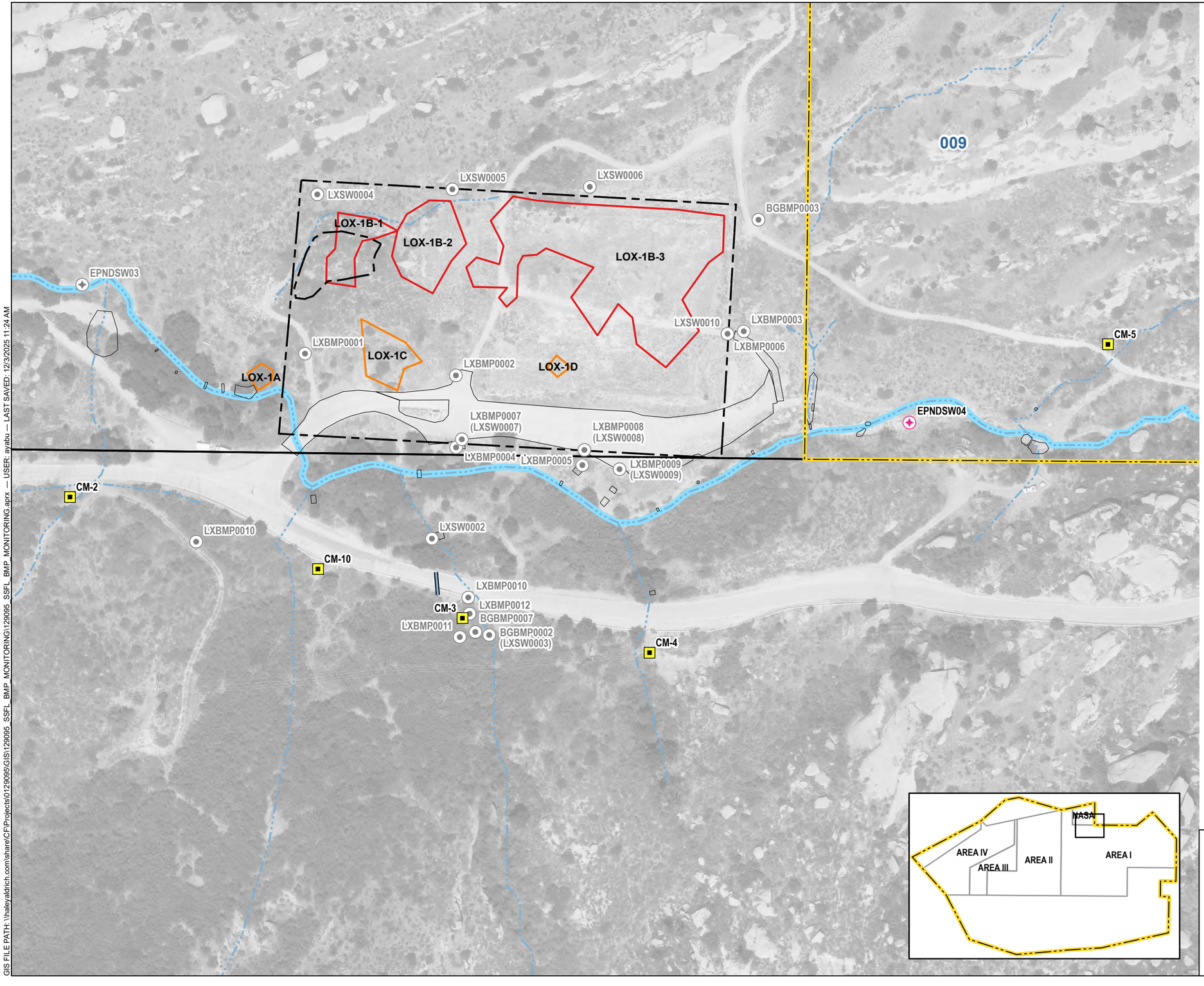
HALEY ALDRICH

2025/2026 RAINY SEASON MAP
BMP MONITORING PROGRAM
THE BOEING COMPANY
VENTURA COUNTY, CALIFORNIA

OUTFALL 009
AILF AREA - BOEING

DECEMBER 2025

FIGURE 4



LEGEND

- CULVERT MODIFICATION (CM)
- PREVIOUS BMP PERFORMANCE MONITORING LOCATION
- NORTHERN DRAINAGE
- DRAINAGE
- CONVEYANCE PIPELINE
- GRAVEL
- RIP RAP
- ISRA EXCAVATION BOUNDARY
- FORMER ISRA EXCAVATION BOUNDARY
- STUDY AREA
- ADMINISTRATIVE AREA BOUNDARY
- SSFL PROPERTY BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. SAP = SAMPLING AND ANALYSIS PLAN
3. BMP = BEST MANAGEMENT PRACTICE
4. AERIAL IMAGERY SOURCE: CIRGIS

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SCALE IN FEET

HALEY ALDRICH

2025/2026 RAINY SEASON MAP
BMP MONITORING PROGRAM
THE BOEING COMPANY
VENTURA COUNTY, CALIFORNIA

SAGE RANCH, OUTFALL 009
CMS SOUTH OF LOX AREA - NASA

DECEMBER 2025

FIGURE 5

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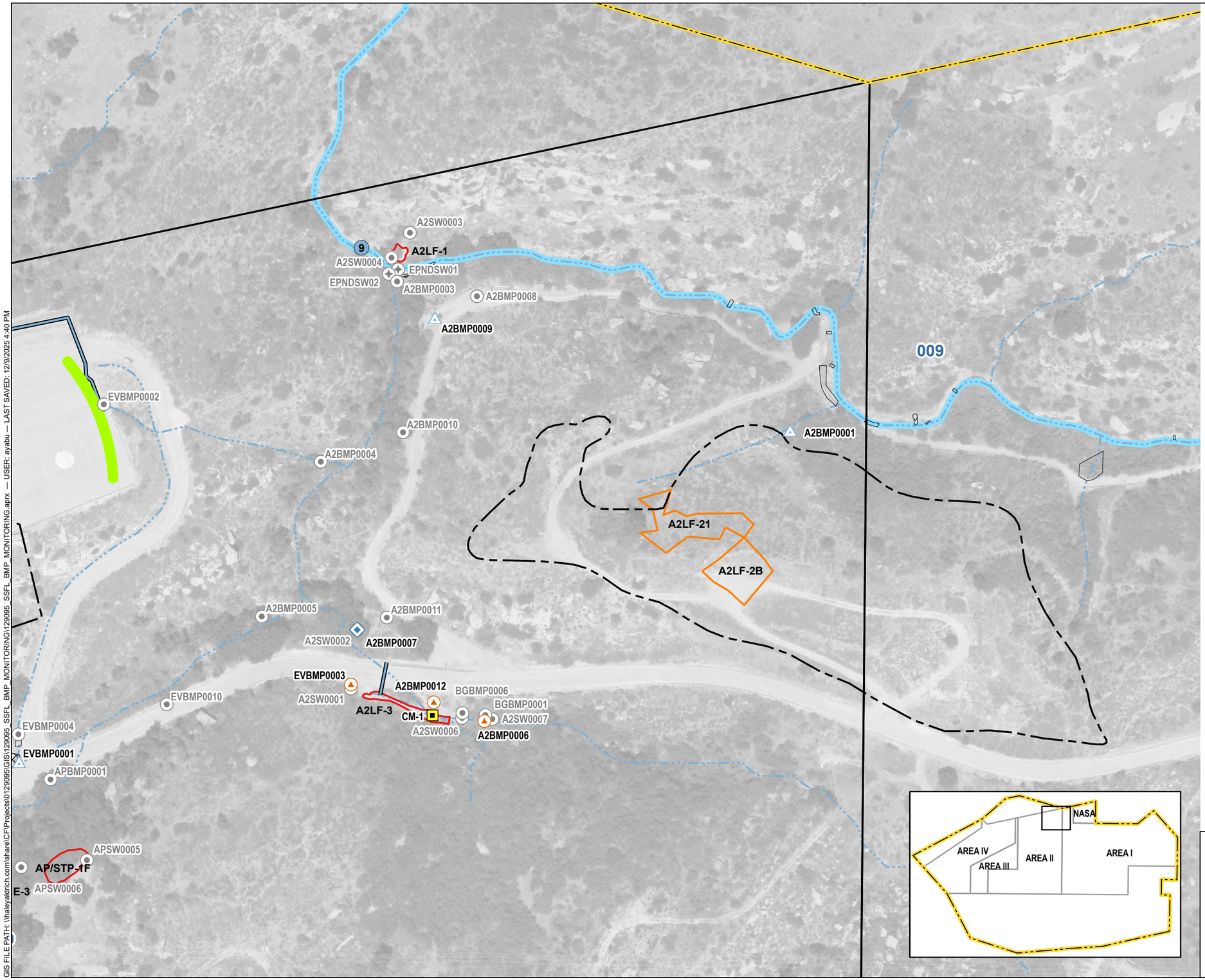

LEGEND

- ACTIVE NPDES OUTFALL
- CULVERT MODIFICATION (CM)
- DOWNSTREAM BMP PERFORMANCE MONITORING LOCATION
- POTENTIAL BMP PERFORMANCE MONITORING LOCATION
- PREVIOUS BMP PERFORMANCE MONITORING LOCATION
- UPSTREAM BMP PERFORMANCE MONITORING LOCATION
- SSFL PROPERTY BOUNDARY
- EROSION CONTROL FABRIC/LINER
- CONVEYANCE PIPELINE
- GRAVEL
- RIP RAP
- SEDIMENTAION BASIN
- ADMINISTRATIVE AREA BOUNDARY
- STUDY AREA
- ISRA EXCAVATION BOUNDARY
- FORMER ISRA EXCAVATION BOUNDARY
- DRAINAGE
- NORTHERN DRAINAGE

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. SAP = SAMPLING AND ANALYSIS PLAN
3. BMP = BEST MANAGEMENT PRACTICE
4. AERIAL IMAGERY SOURCE: CIRGIS

N

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SCALE IN FEET

HALEY ALDRICH

2025/2026 RAINY SEASON MAP
BMP MONITORING PROGRAM
THE BOEING COMPANY
VENTURA COUNTY, CALIFORNIA

OUTFALL 009
A2LF, CM-1, AND HELIPAD AREAS - NASA

DECEMBER 2025

FIGURE 6

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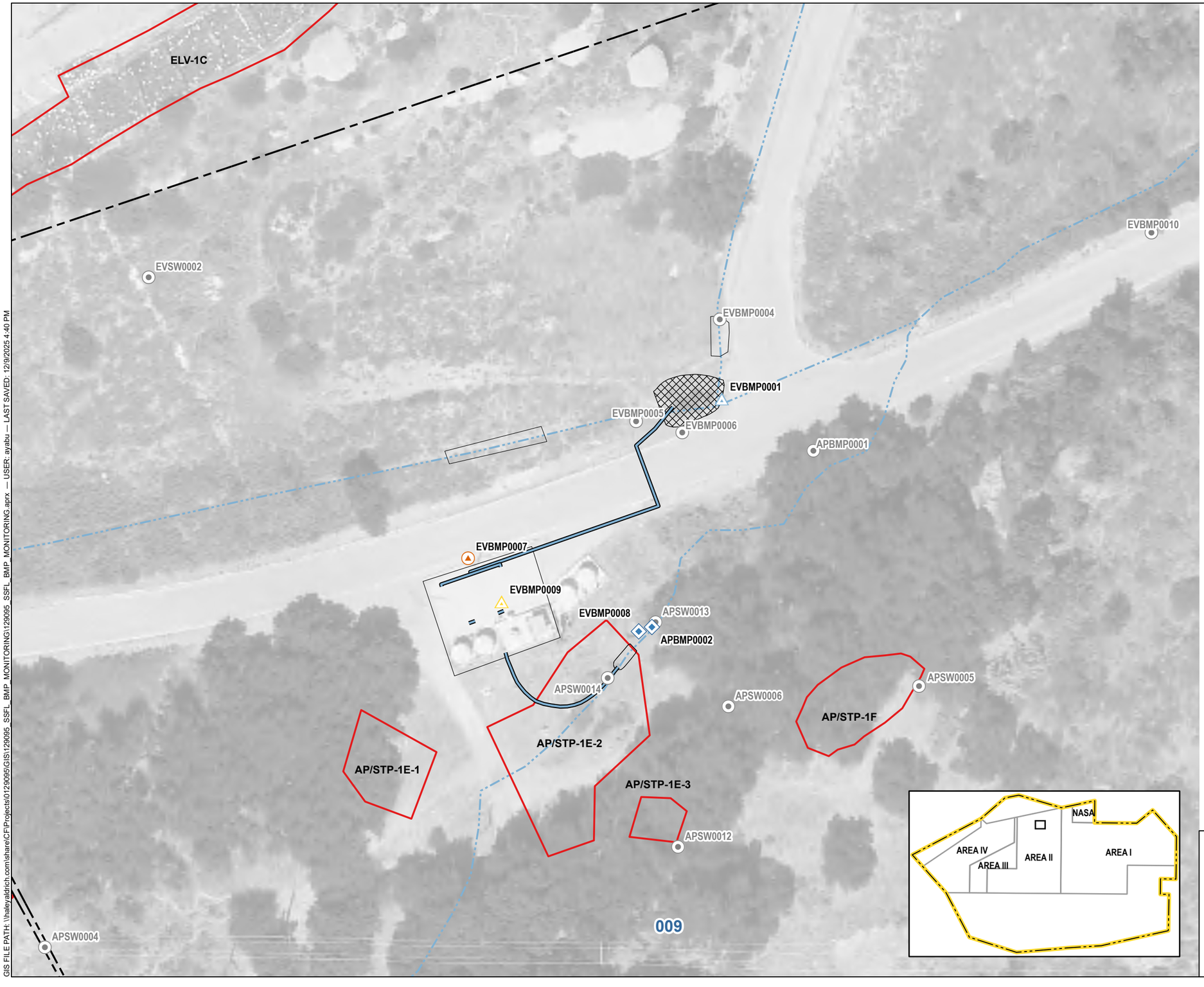

LEGEND

- DOWNSTREAM BMP PERFORMANCE MONITORING LOCATION
- MIDPOINT BMP PERFORMANCE MONITORING LOCATION
- POTENTIAL BMP PERFORMANCE MONITORING LOCATION
- PREVIOUS BMP PERFORMANCE MONITORING LOCATION
- UPSTREAM BMP PERFORMANCE MONITORING LOCATION
- SSFL PROPERTY BOUNDARY
- CONVEYANCE PIPELINE
- GRAVEL
- RIP RAP
- SEDIMENTAION BASIN
- ADMINISTRATIVE AREA BOUNDARY
- STUDY AREA
- ISRA EXCAVATION BOUNDARY
- DRAINAGE

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. SAP = SAMPLING AND ANALYSIS PLAN
3. BMP = BEST MANAGEMENT PRACTICE
4. AERIAL IMAGERY SOURCE: CIRGIS

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SCALE IN FEET

HALEY ALDRICH

2025/2026 RAINY SEASON MAP
BMP MONITORING PROGRAM
THE BOEING COMPANY
VENTURA COUNTY, CALIFORNIA

OUTFALL 009
ELV AREA - NASA

DECEMBER 2025

FIGURE 7

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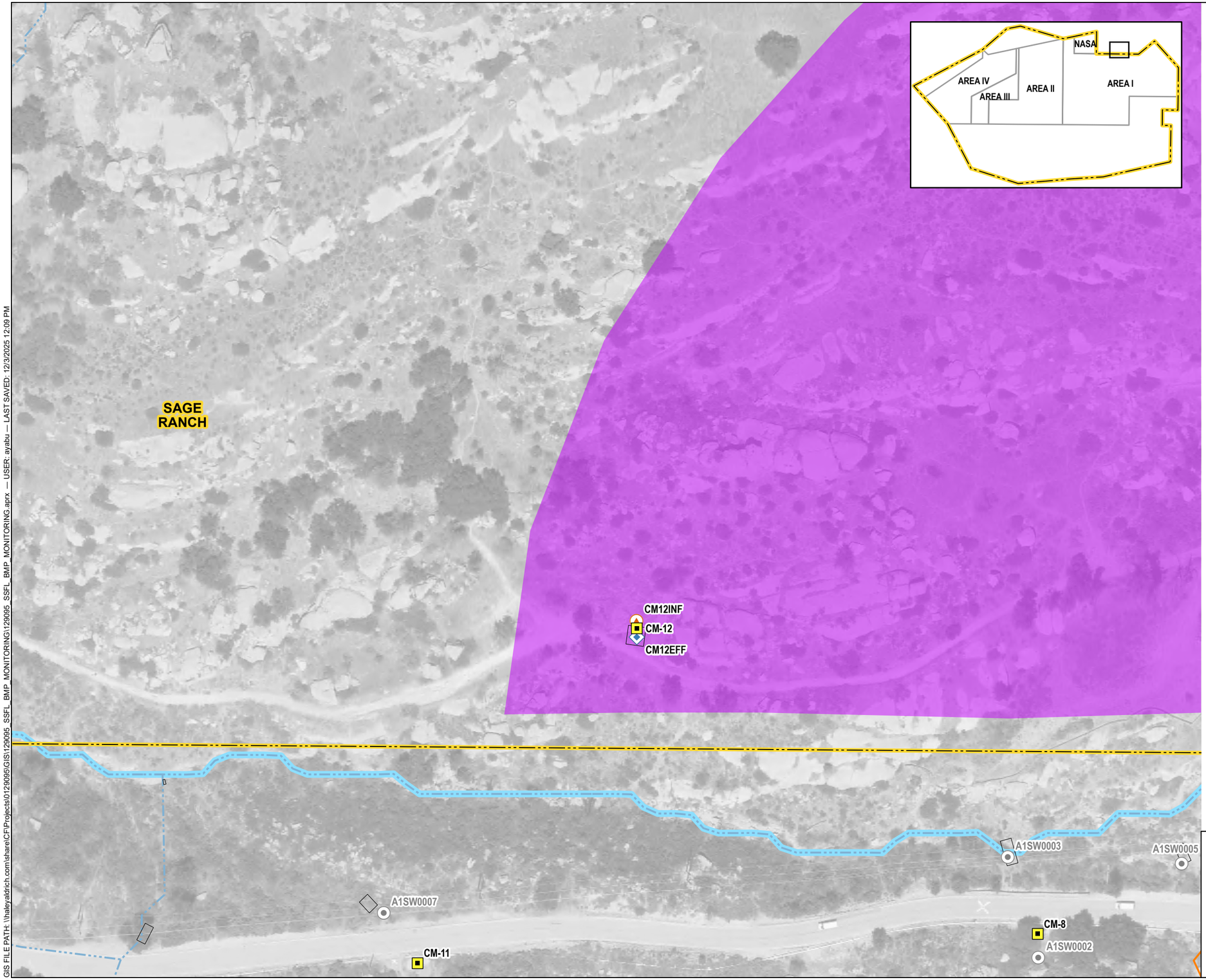

LEGEND

- CULVERT MODIFICATION (CM)
- UPSTREAM BMP PERFORMANCE MONITORING LOCATION
- DOWNSTREAM BMP PERFORMANCE MONITORING LOCATION
- NORTHERN DRAINAGE
- DRAINAGE
- RIP RAP
- FORMER ISRA EXCAVATION BOUNDARY
- ADMINISTRATIVE AREA BOUNDARY
- FORMER SHOOTING RANGE CLEAN UP AREA
- SSFL PROPERTY BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. SAP = SAMPLING AND ANALYSIS PLAN
3. BMP = BEST MANAGEMENT PRACTICE
4. AERIAL IMAGERY SOURCE: CIRGIS

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SCALE IN FEET

HALEY ALDRICH

2025/2026 RAINY SEASON MAP
BMP MONITORING PROGRAM
THE BOEING COMPANY
VENTURA COUNTY, CALIFORNIA

SAGE RANCH, OUTFALL 009
CM-12

DECEMBER 2025

FIGURE 8

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SILVERNALE POND
SILVERNALE CULVERTS
NASA (AREA II)
R-1 POND
GETS CULVERT
PERIMETER POND NORTHWEST INLET
PERIMETER CULVERT
EPSW002IE01
OUTFALL 002 ROAD NORTH CULVERT
OUTFALL 002 ROAD MIDDLE CULVERT
EPSW002IE02
BURN PIT CULVERT
EPSW001IE01
EPSW002BG01
OUTFALL 002 ROAD SOUTH CULVERT
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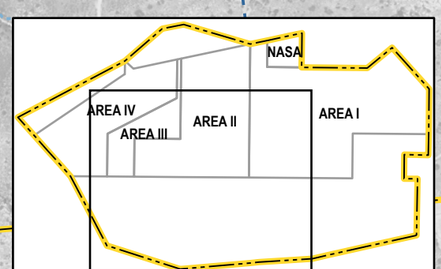

LEGEND

- CULVERT MODIFICATION (CM)
- SPECIAL STUDIES AND OTHER SAMPLING LOCATIONS
- POTENTIAL BMP PERFORMANCE MONITORING LOCATION
- PREVIOUS BMP PERFORMANCE MONITORING LOCATION
- ACTIVE NPDES OUTFALL
- FORMER NPDES OUTFALL
- DRAINAGE
- SURFACE WATER DIVIDE
- EROSION CONTROL FABRIC/LINER
- SURFACE WATER POND
- STUDY AREA
- ADMINISTRATIVE AREA BOUNDARY
- SSFL PROPERTY BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. SAP = SAMPLING AND ANALYSIS PLAN
3. BMP = BEST MANAGEMENT PRACTICE
4. AERIAL IMAGERY SOURCE: CIRGIS

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0 750 1,500
SCALE IN FEET

HALEY ALDRICH

2025/2026 RAINY SEASON MAP
BMP MONITORING PROGRAM
THE BOEING COMPANY
VENTURA COUNTY, CALIFORNIA

OUTFALLS 001 AND 002 POTENTIAL BMP MONITORING LOCATIONS

DECEMBER 2025

FIGURE 9

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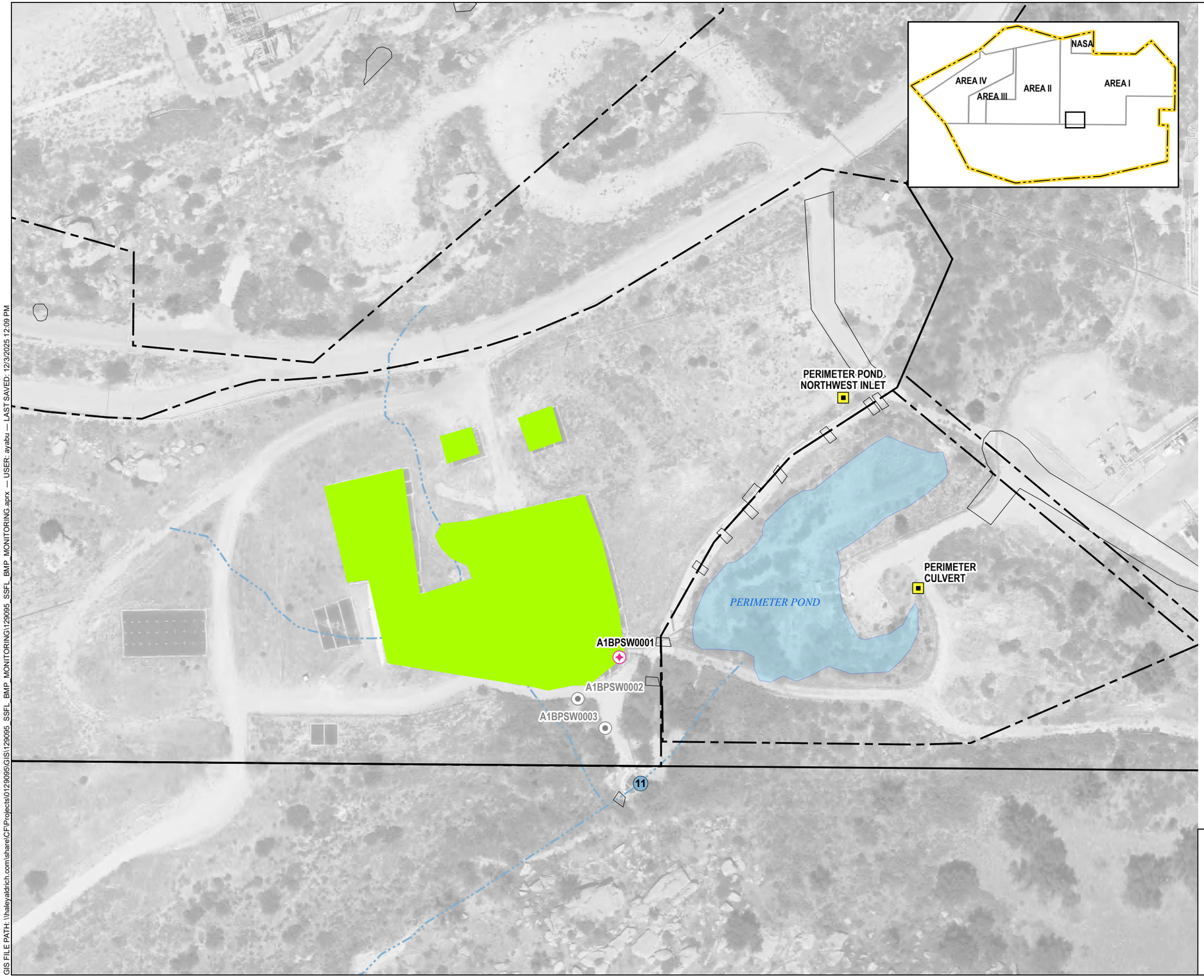

LEGEND

- CULVERT MODIFICATION (CM)
- SPECIAL STUDIES AND OTHER SAMPLING LOCATIONS
- PREVIOUS BMP PERFORMANCE MONITORING LOCATION
- ACTIVE NPDES OUTFALL
- DRAINAGE
- EROSION CONTROL FABRIC/LINER
- GRAVEL
- RIP RAP
- SURFACE WATER POND
- STUDY AREA
- ADMINISTRATIVE AREA BOUNDARY
- SSFL PROPERTY BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. SAP = SAMPLING AND ANALYSIS PLAN
3. BMP = BEST MANAGEMENT PRACTICE
4. AERIAL IMAGERY SOURCE: CIRGIS

N

0 100 200
SCALE IN FEET

HALEY ALDRICH

2025/2026 RAINY SEASON MAP
BMP MONITORING PROGRAM
THE BOEING COMPANY
VENTURA COUNTY, CALIFORNIA

OUTFALL 011
AREA 1 BURN PIT

DECEMBER 2025

FIGURE 10

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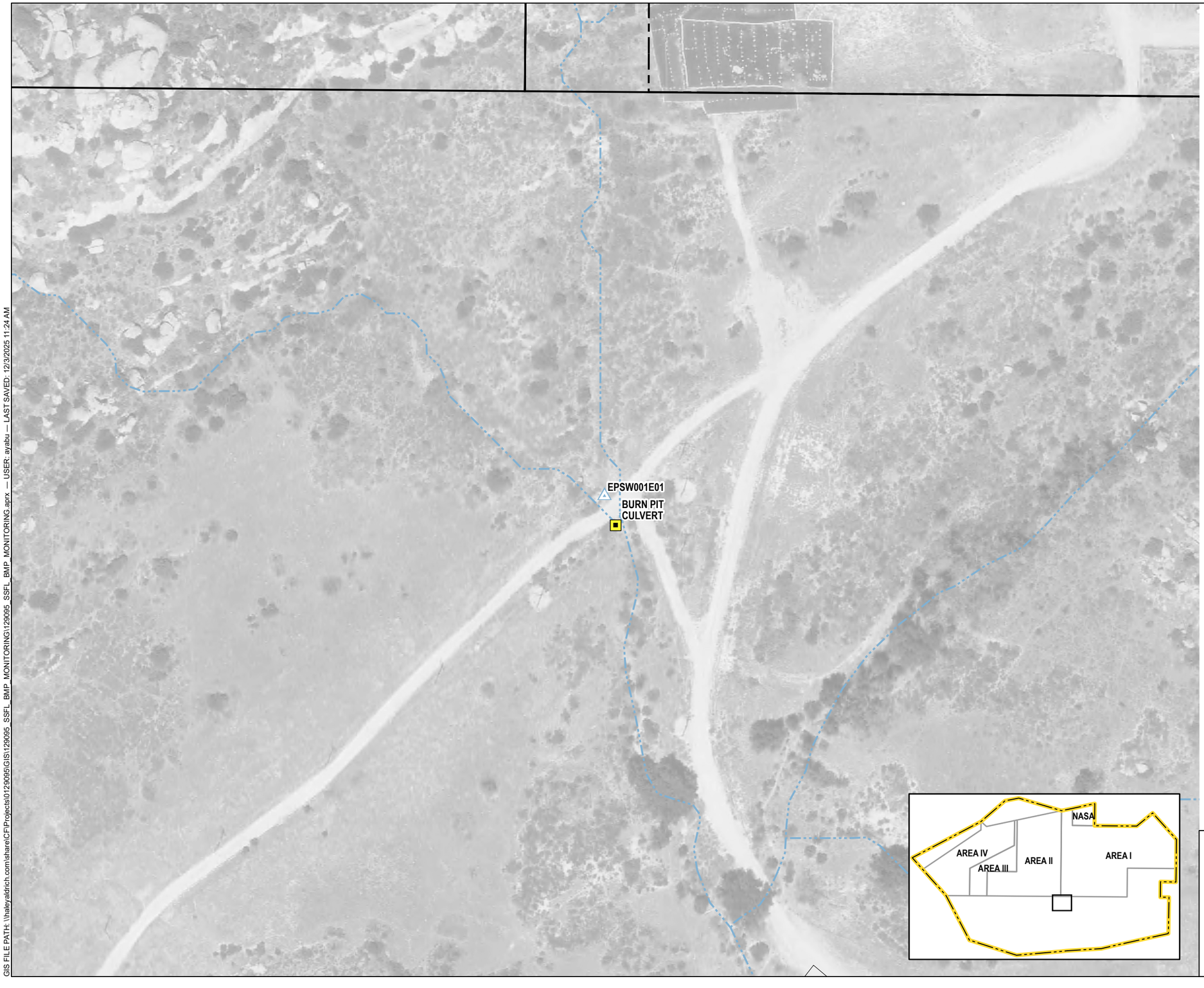

LEGEND

- CULVERT MODIFICATION (CM)
- POTENTIAL BMP PERFORMANCE MONITORING LOCATION
- DRAINAGE
- RIP RAP
- STUDY AREA
- ADMINISTRATIVE AREA BOUNDARY
- SSFL PROPERTY BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. SAP = SAMPLING AND ANALYSIS PLAN
3. BMP = BEST MANAGEMENT PRACTICE
4. AERIAL IMAGERY SOURCE: CIRGIS

N

0 100 200
SCALE IN FEET

HALEY ALDRICH

2025/2026 RAINY SEASON MAP
BMP MONITORING PROGRAM
THE BOEING COMPANY
VENTURA COUNTY, CALIFORNIA

OUTFALL 001
POTENTIAL BMP SUBAREA

DECEMBER 2025

FIGURE 11

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LEGEND

SPECIAL STUDIES AND OTHER SAMPLING LOCATIONS

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. AERIAL IMAGERY SOURCE: NEARMAP, OCTOBER 9, 2025

N

0 150 300

SCALE IN FEET

HALEY ALDRICH

2025/2026 RAINY SEASON MAP
BMP MONITORING PROGRAM
THE BOEING COMPANY
VENTURA COUNTY, CALIFORNIA

LAS LLAJAS CANYON SAMPLE LOCATION

DECEMBER 2025

FIGURE 12

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LEGEND

SPECIAL STUDIES AND OTHER SAMPLING LOCATIONS

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. AERIAL IMAGERY SOURCE: NEARMAP, OCTOBER 9, 2025

N

0 120 240

SCALE IN FEET

HALEY ALDRICH

2025/2026 RAINY SEASON MAP
BMP MONITORING PROGRAM
THE BOEING COMPANY
VENTURA COUNTY, CALIFORNIA

MONTGOMERY CANYON SAMPLE LOCATION

DECEMBER 2025

FIGURE 13

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LEGEND

SPECIAL STUDIES AND OTHER SAMPLING LOCATIONS

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. AERIAL IMAGERY SOURCE: NEARMAP, OCTOBER 9, 2025

N

0 120 240

SCALE IN FEET

HALEY ALDRICH

2025/2026 RAINY SEASON MAP
BMP MONITORING PROGRAM
THE BOEING COMPANY
VENTURA COUNTY, CALIFORNIA

BOX CANYON SAMPLE LOCATION

DECEMBER 2025

FIGURE 14

GIS FILE PATH: \\haleyaldrich.com\share\CP\Projects\0129095\GIS\129095_SSFL_BMP_MONITORING\129095_SSFL_BMP_MONITORING.aprx - USER: ayabu - LAST SAVED: 12/3/2025 4:36 PM

ATTACHMENT A
Field Forms:

BMP Performance Inspection Checklist (QNOPY Form) - Boeing

72 Hours After Rain Event Ponding Inspection Form - Boeing

Surface Water Monitoring Inspection and Sample Collection Form - Boeing

BMP Visual Inspection Form - NASA

72 Hours After Rain Event Ponding Inspection Form - NASA

Surface Water Monitoring Inspection and Sample Collection Form - NASA

Expert Panel-BMP Performance Inspection

1. General Information

Inspection Checklist Questions	Answers
Date	
Client	
Project Name	
County	
State	
Inspector Company	
Project Manager	
Inspection Type(s)	
Inspection Date	
Inspection Time	
Inspector	
Precipitation Present	
Estimated Time Since Last Storm	
Action Item	

Tasks

2. Happy Valley - Road Leading Down to Lower BMP Area

Inspection Checklist Questions	Answers
Date	
Client	
Inspection Status	
Project Name	
Is the road free of odors, suspended materials, floating materials, etc.?	
County	
Are erosion/sediment controls in good condition?	
State	
Is the road leading down to the BMP area free of ersoion?	
Inspector Company	
Are rip rap berms free of sediment/debris?	
Project Manager	
Are upstream areas free of erosion or sediment?	
Inspection Type(s)	
Corrective Actions Identified	
Inspection Date	
Inspection Time	
Photo LBMP-1: Overview of HVS Lower BMP Area (from top of road east)	
Inspector	
Photo LBMP-2: Overview of HVS Lower BMP Area (from top of road west)	
Precipitation Present	
Estimated Time Since Last Storm	
Action Item	

Tasks

3. OF008

Inspection Checklist Questions	Answers
Date	
Client	
Inspection Status	
Project Name	
Is the area free of odors, suspended materials, floating materials, etc?	
County	
Are erosion/sediment controls in good condition?	
State	
Are upstream areas free of erosion or sediment?	
Inspector Company	
Are upstream areas free of erosion or sediment?_5	
Project Manager	
Corrective Actions Identified	
Inspection Type(s)	
Inspection Date	
Photo OF008-1: HVS Drainage and Tributary Drainage Overview (looking north)	
Inspection Time	
Photo OF008-2: Outfall 008 Overview	
Inspector	
Photo OF008-3: Tributary Drainage Check Dams	
Precipitation Present	
Estimated Time Since Last Storm	
Action Item	

Tasks

4. OF009 Lower Lot

Inspection Checklist Questions	Answers
Date	
Client	
Inspection Status	
Project Name	
Is the area free of odors, suspended materials, floating materials, etc.?	
County	
Are erosion/sediment controls in good condition?	
State	
Is the area near or along the cistern drain inlet clear of unwanted sediment/debris?	
Inspector Company	
Is runoff along the 24-inch drain being diverted by the low flow diversion weir to the cistern?	
Project Manager	
Is the gravel area/gravel bag berm (north of fence) in good condition?	
Inspection Type(s)	
Is the wood retaining wall in good condition?	
Inspection Date	
Are upstream areas free of erosion or sediment?	
Inspection Time	
What is the approximate depth of water present in the low flow diversion structure?	
Inspector	
Corrective Actions Identified	
Precipitation Present	
Photo LPL-1: Cistern area	
Estimated Time Since Last Storm	

Inspection Checklist Questions	Answers
Photo LPL-2: Looking down into low flow diversion structure	
Action Item	
Photo LPL-3: Grated inlet and concrete curb	
Photo LPL-4: Wooden retaining wall	
Photo 1: LPBMP0002: Lower Lot Area, Upstream BMP; Sample Port in Cistern Discharge Pipe	
Photo 2: LPBMP0002: Lower Lot Area, Upstream BMP; Sample Port in Cistern Discharge Pipe	
Photo 3: LPBMP0003: Lower Lot Area, Mid-Point Lower Lot BMP; Sediment Basin Outlet Box	
Photo 4: LPBMP0003: Lower Lot Area, Mid-Point Lower Lot BMP; Sediment Basin Outlet Box	
Photo 5: LPBMP0004: Lower Lot Area, Downstream Lower Lot Treatment BMP; Discharge from Biofilter Effluent Pipe	
Photo 6: LPBMP0004: Lower Lot Area, Downstream Lower Lot Treatment BMP; Discharge from Biofilter Effluent Pipe	

Tasks

5. OF009 Sediment Basin

Inspection Checklist Questions	Answers
Date	
Client	
Inspection Status	
Project Name	
Is the area free of odors, suspended materials, floating materials, etc.?	
County	
Are erosion/sediment controls in good condition?	
State	
Is the area free of overflow in the Lower Lot?	
Inspector Company	
Corrective Actions Identified	
Project Manager	
Inspection Type(s)	
Photo SB-1: Sediment Basin Overview	
Inspection Date	
Photo SB-2: Inside Sediment Basin Riser Structure	
Inspection Time	
Inspector	
Precipitation Present	
Estimated Time Since Last Storm	
Action Item	

Tasks

6. OF009 BIOFILTER

Inspection Checklist Questions	Answers
Date	
Client	
Inspection Status	
Project Name	
Is the Biofilter free of odors, suspended materials, floating materials, etc.?”	
County	
Are erosion/sediment controls in good condition?	
State	
Are upstream areas free of erosion or sediment?	
Inspector Company	
Is all flow contained within the riser structure?	
Project Manager	
If above is NO, please record a video	
Inspection Type(s)	
Is there flow in the riser structure?	
Inspection Date	
Corrective Actions Identified	
Inspection Time	
Inspector	
Photo BF-1: Sediment Basin Discharge Pipe	
Precipitation Present	
Photo BF-2: Biofilter Overview	
Estimated Time Since Last Storm	
Photo BF-3: Biofilter Discharge Pipe	

Inspection Checklist Questions	Answers
Action Item	
Photo BF-4: Biofilter Outlet Structure	

Tasks

7. OF009 CM-9 A1LF Area

Inspection Checklist Questions	Answers
Date	
Client	
Inspection Status	
Project Name	
Is the area free of odors, suspended materials, floating materials, etc.?	
County	
Are erosion/sediment controls in good condition?	
State	
Are upstream areas free of erosion or sediment?	
Inspector Company	
Is the culvert basin clear of unwanted sediment/debris?	
Project Manager	
Is flow below the top of the weir boards?	
Inspection Type(s)	
If above is NO, does the underdrain appear to be constricted?	
Inspection Date	
If above is NO, please record a video	
Inspection Time	
Is the upstream perforated pipeline draining properly?	
Inspector	
Is the inlet swale along Area II Road clear of unwanted sediment/debris?	
Precipitation Present	
Is rip rap berm clear of unwanted sediment/debris?	
Estimated Time Since Last Storm	

Inspection Checklist Questions	Answers
Is the landfill slope free of discharging water?	
Action Item	
Are the streambed sidewalls viewable upstream from the weir boards stable?	
Is the streambed viewable upstream from the weir boards free of water quality pollution? If not, enter a description of conditions observed, take photos, and notify Haley & Aldrich within 24 hours.	
Is the streambed viewable upstream from the weir boards free of excessive erosion? (Note: erosion of the streambed is to be evaluated, not the accumulation and/or deposit of sediment in the streambed.)	
Corrective Actions Identified	
Photo CM9-1: Asphalt Swale Inlet from Area 2 Road – ILBMP0002	
Photo CM9-1: Asphalt Swale Inlet from Area 2 Road – ILBMP0002_16	
Photo CM9-2a: CM-9 Basin Overview (Upstream)	
Photo CM9-2b: CM-9 Basin Overview (Towards Weir Boards)	
Photo CM9-3a: Along Perforated Pipeline (upstream)	
Photo CM9-3b: Along Perforated Pipeline (downstream)	
Photo CM9-4a: Rip Rap Berm (upstream)	
Photo CM9-4b: Rip Rap Berm (downstream)	
Photo 7: A1BMP0002: CM-9 Area, Upstream (South), CM-9 BMPs	
Photo 8: A1BMP0002: CM-9 Area, Upstream (South), CM-9 BMPs	
Photo 9: A1BMP0003: CM-9 Area, Downstream, CM-9 BMPs; CM-9 Underdrains	
Photo 10: A1BMP0003: CM-9 Area, Downstream, CM-9 BMPs; CM-9 Underdrains	
Photo 11: A1BMP0004: CM-9 Area, Culvert Inlet on North Side of Area II Road Between CM8 and CM-9	
Photo 12: A1BMP0004: CM-9 Area, Culvert Inlet on North Side of Area II Road Between CM8 and CM-9	
Photo 13: ILBMP0002: CM-9 Area, Upstream (East), CM-9 BMPs; Culvert Inlet Off Area II Road	
Photo 14: LBMP0002: CM-9 Area, Upstream (East), CM-9 BMPs; Culvert Inlet Off Area II Road	

Tasks

8. OF009 B-1 Retention Basin

Inspection Checklist Questions	Answers
Date	
Client	
Inspection Status	
Project Name	
Is the Retention Basin free of odors, suspended materials, floating materials, etc.?	
County	
Are erosion/sediment controls in good condition?	
State	
Are upstream areas free of erosion or sediment?	
Inspector Company	
Is the retention basin clear of unwanted sediment/debris?	
Project Manager	
Is the perimeter of the basin free of erosion?	
Inspection Type(s)	
Corrective Actions Identified	
Inspection Date	
Inspection Time	
Photo B1RB-1: B-1 Retention Overview	
Inspector	
Photo B1RB-2: Close-up of Riser Structure in Retention Basin	
Precipitation Present	
Estimated Time Since Last Storm	
Action Item	

Tasks

9. OF009 Upper Lot Media Filter

Inspection Checklist Questions	Answers
Date	
Client	
Inspection Status	
Project Name	
Is the Media Filter free of odors, suspended materials, floating materials, etc.?	
County	
Are erosion/sediment controls in good condition?	
State	
Are upstream areas free of erosion or sediment?	
Inspector Company	
Is flow contained within the box?	
Project Manager	
If above is NO, does the underdrain appear to be constricted?	
Inspection Type(s)	
If above is NO, please record a video	
Inspection Date	
Is hillside free of erosion?	
Inspection Time	
Is the asphalt/gunite swale going towards Upper Lot Media Filter clear of unwanted sediment/debris?	
Inspector	
Note % flow from north underdrain	
Precipitation Present	
Note % flow from south underdrain	
Corrective Actions Identified	

Inspection Checklist Questions	Answers
Estimated Time Since Last Storm	
Action Item	
Photo ULMF-1: Upper Lot Media Filter Overview	
Photo ULMF-2: Upper Lot Retention Basin Discharge Pipe (inside of the riser structure)	
Photo ULMF-3: ULMF Area, Gunite Swale Conveying Road Runoff	
Photo 15: B1BMP0009: B-1 Area, Gunite Swale Conveying Road Runoff	
Photo 16: B1BMP0009: B-1 Area, Gunite Swale Conveying Road Runoff	
Photo 17: B1BMP0010: B-1 Area, Culvert Outlet from Upper Parking Lot Area	
Photo 18: B1BMP0010: B-1 Area, Culvert Outlet from Upper Parking Lot Area	
Photo 19: B1BMP0011: B-1 Area, Underdrains	
Photo 20: B1BMP0011: B-1 Area, Underdrains	

Tasks

10. OF009 Detention Bioswales

Inspection Checklist Questions	Answers
Date	
Client	
Inspection Status	
Project Name	
Are the Bioswales free of odors, suspended materials, floating materials, etc.?	
County	
Are erosion/sediment controls in good condition?	
State	
Are upstream areas free of erosion or sediment?	
Inspector Company	
Is rip rap swale clear of unwanted sediment/debris?	
Project Manager	
Are vegetated swales in good condition?	
Inspection Type(s)	
Note % flow from northern underdrain	
Inspection Date	
Note % flow from southern underdrain	
Inspection Time	
Corrective Actions Identified	
Inspector	
Precipitation Present	
Photo B1DB-1: Northern B1436 Bioswale Overview (from the north end)	
Estimated Time Since Last Storm	
Photo B1DB-2: Northern B1436 Bioswale Overview (from the south end)	

Inspection Checklist Questions	Answers
Action Item	
Photo B1DB-3: Southern B1436 Bioswale Overview (from the north end)	
Photo B1DB-4: Southern B1436 Bioswale Overview (from the south end)	
Photo B1DB-6: Western Swale Inlet to Southern B1436 Bioswale – ILBMP0004	
Photo B1DB-7: Eastern Swale Inlet to Southern B1436 Bioswale – ILBMP0008	
Photo 21: ILBMP0008: Upstream, B1436 Southern Detention Bioswale (Concrete Swale Diverting Sheet Flow into Rock Crib – East)	
Photo 22: ILBMP0008: Upstream, B1436 Southern Detention Bioswale (Concrete Swale Diverting Sheet Flow into Rock Crib – East)	
Photo 23: ILBMP0004: Upstream, B1436 Southern Detention Bioswale (Concrete Swale Diverting Sheet Flow into Rock Crib – West)	
Photo 24: ILBMP0004: Upstream, B1436 Southern Detention Bioswale (Concrete Swale Diverting Sheet Flow into Rock Crib – West)	
Photo 25: ILBMP0005: Downstream, B1436 Southern Detention Bioswale; 12-inch Underdrain	
Photo 26: ILBMP0005: Downstream, B1436 Southern Detention Bioswale; 12-inch Underdrain	

Tasks

11. OF009 CM-8

Inspection Checklist Questions	Answers
Date	
Client	
Project Name	
County	
State	
Inspector Company	
Project Manager	
Inspection Type(s)	
Inspection Date	
Inspection Time	
Inspector	
Precipitation Present	
Estimated Time Since Last Storm	
Action Item	

Tasks

12. OF009 CM-11

Inspection Checklist Questions	Answers
Date	
Client	
Project Name	
County	
State	
Inspector Company	
Project Manager	
Inspection Type(s)	
Inspection Date	
Inspection Time	
Inspector	
Precipitation Present	
Estimated Time Since Last Storm	
Action Item	

Tasks

13. OF009 CM-7

Inspection Checklist Questions	Answers
Date	
Client	
Project Name	
County	
State	
Inspector Company	
Project Manager	
Inspection Type(s)	
Inspection Date	
Inspection Time	
Inspector	
Precipitation Present	
Estimated Time Since Last Storm	
Action Item	

Tasks

14. OF009 CM-6

Inspection Checklist Questions	Answers
Date	
Inspection Status	
Is the area free of odors, suspended materials, floating materials, etc.?	
Are erosion/sediment controls in good condition?	
Are upstream areas free of erosion or sediment?	
Is the culvert basin clear of unwanted sediment/debris?	
If above is NO, note approximate depth (inches)	
Is flow below the top of the weir boards?	
If above is NO, does the underdrain appear to be constricted?	
Corrective Actions Identified	
Action Item	
Photo CM6-1a: CM-6 Basin Overview (Upstream)	
Photo CM6-1b: CM-6 Basin Overview (Towards Weir Boards)	

Tasks

15. OF009 CM-5 Sage Ranch

Inspection Checklist Questions	Answers
Date	
Client	
Inspection Status	
Project Name	
Is the area free of odors, suspended materials, floating materials, etc.?	
County	
Are erosion/sediment controls in good condition?	
State	
Are upstream areas free of erosion or sediment?	
Inspector Company	
Is the culvert basin clear of unwanted sediment/debris?	
Project Manager	
If above is NO, note approximate depth (inches)	
Inspection Type(s)	
Is flow below the top of the weir boards?	
Inspection Date	
Is there sediment accumulation in the culvert basin?	
If above is NO, does the underdrain appear to be constricted?	
Inspection Time	
If above is NO, please record a video	
If yes, record approximate depth (Inches)	
Inspector	
Are the streambed sidewalls viewable upstream from the weir boards stable?	
Is the drop inlet on the north side of the road clogged or otherwise obstructed?	

Inspection Checklist Questions	Answers
Precipitation Present	
Is there erosion at the diversion pipe outlet?	
Is the streambed viewable upstream from the weir boards free of water quality pollution? If not, enter a description of conditions observed, take photos, and notify Haley & Aldrich within 24 hours.	
Estimated Time Since Last Storm	
Is the streambed viewable upstream from the weir boards free of excessive erosion? (Note: erosion of the streambed is to be evaluated, not the accumulation and/or deposit of sediment in the streambed.)	
Action Item	
Corrective Actions Identified	
Photo CM2-1: CM-2 Basin Overview (Upstream)	
Photo CM2-1: CM-2 Basin Overview (Towards Weir Boards)	
Photo CM5-1a: CM-5 Basin Overview (Upstream)	
Photo CM12-1a: CM-12 Basin Overview (Upstream)	
Photo CM10-1: CM-10 Basin Overview (Upstream)	
Photo CM5-1b: CM-5 Basin Overview (Towards Weir Boards)	
Photo CM12-1b: CM-12 Basin Overview (Towards Weir Boards)	
Photo CM3-1a: CM-3 Basin Overview (Upstream)	
Photo CM10-1: CM-10 Basin Overview (Towards Weir Boards)	
Photo CM3-1b: CM-3 Basin Overview (Towards Weir Boards)	
Photo 2: CM-3 Roadway Inlet	
Photo 3: CM-3 Diversion Outlet	
Photo 27: LXBMP0010: CM-3 Area, upstream of Service Area Road BMP; Outlet on South Side of Road (Looking East)	
Photo 28: LXBMP0010: CM-3 Area, upstream of Service Area Road BMP; Outlet on South Side of Road (Looking West)	
Photo 29: LXBMP0011: CM-3 Area, Upstream of Service Area Road BMP, Natural Drainage Upstream of CM-3 (Upstream of Check Dam)	
Photo 30: LXBMP0012: CM-3 Area, Downstream of Service Area Road BMP, Underdrains	

16. OF009 CM-12 Sage Ranch

Inspection Checklist Questions	Answers
Date	
Client	
Inspection Status	
Project Name	
Is the area free of odors, suspended materials, floating materials, etc.?	
County	
Are erosion/sediment controls in good condition?	
State	
Are upstream areas free of erosion or sediment?	
Inspector Company	
Is the culvert basin clear of unwanted sediment/debris?	
Project Manager	
If above is NO, note approximate depth (inches)	
Inspection Type(s)	
Is flow below the top of the weir boards?	
Inspection Date	
If above is NO, does the underdrain appear to be constricted?	
Inspection Time	
If above is NO, please record a video	
Inspector	
Are the streambed sidewalls viewable upstream from the weir boards stable?	
Precipitation Present	
Is the streambed viewable upstream from the weir boards free of water quality pollution? If not, enter a description of conditions observed, take photos, and notify Haley & Aldrich within 24 hours.	
Estimated Time Since Last Storm	

Inspection Checklist Questions	Answers
Is the streambed viewable upstream from the weir boards free of excessive erosion? (Note: erosion of the streambed is to be evaluated, not the accumulation and/or deposit of sediment in the streambed.)	
Action Item	
Corrective Actions Identified	
Photo CM12-1a: CM-12 Basin Overview (Upstream)	
Photo CM12-1b: CM-12 Basin Overview (Towards Weir Boards)	

Tasks

17. OF009 CM-4

Inspection Checklist Questions	Answers
Date	
Client	
Inspection Status	
Project Name	
Is the area free of odors, suspended materials, floating materials, etc.?	
County	
Are erosion/sediment controls in good condition?	
State	
Are upstream areas free of erosion or sediment?	
Inspector Company	
Is the culvert basin clear of unwanted sediment/debris?	
Project Manager	
If above is NO, note approximate depth (inches)	
Inspection Type(s)	
If above is NO, does the underdrain appear to be constricted?	
Inspection Date	
If above is NO, please record a video	
Inspection Time	
Are the streambed sidewalls viewable upstream from the weir boards stable?	
Inspector	
Is the streambed viewable upstream from the weir boards free of water quality pollution? If not, enter a description of conditions observed, take photos, and notify Haley & Aldrich within 24 hours.	
Precipitation Present	
Is the streambed viewable upstream from the weir boards free of excessive erosion? (Note: erosion of the streambed is to be evaluated, not the accumulation and/or deposit of sediment in the streambed.)	

Inspection Checklist Questions	Answers
Corrective Actions Identified	
Estimated Time Since Last Storm	
Action Item	
Photo CM4-1a: CM-4 Basin Overview (Upstream)	
Photo CM4-1b: CM-4 Basin Overview (Towards Weir Boards)	

Tasks

18. OF009 CM-3

Inspection Checklist Questions	Answers
Date	
Client	
Inspection Status	
Project Name	
Is the area free of odors, suspended materials, floating materials, etc.?	
County	
Are erosion/sediment controls in good condition?	
State	
Are upstream areas free of erosion or sediment?	
Inspector Company	
Is the culvert basin clear of unwanted sediment/debris?	
Project Manager	
If above is NO, note approximate depth (inches)	
Inspection Type(s)	
Is flow below the top of the weir boards?	
Inspection Date	
If above is NO, does the underdrain appear to be constricted?	
Inspection Time	
If above is NO, please record a video	
Inspector	
Is the drop inlet on the north side of the road clogged or otherwise obstructed?	
Precipitation Present	
Is there erosion at the diversion pipe outlet?	
Estimated Time Since Last Storm	

Inspection Checklist Questions	Answers
Are the streambed sidewalls viewable upstream from the weir boards stable?	
Action Item	
Is the streambed viewable upstream from the weir boards free of water quality pollution? If not, enter a description of conditions observed, take photos, and notify Haley & Aldrich within 24 hours.	
Is the streambed viewable upstream from the weir boards free of excessive erosion? (Note: erosion of the streambed is to be evaluated, not the accumulation and/or deposit of sediment in the streambed.)	
Corrective Actions Identified	
Photo CM3-1a: CM-3 Basin Overview (Upstream)	
Photo CM3-1b: CM-3 Basin Overview (Towards Weir Boards)	
Photo 2: CM-3 Roadway Inlet	
Photo 3: CM-3 Diversion Outlet	
Photo 27: LXBMP0010: CM-3 Area, upstream of Service Area Road BMP; Outlet on South Side of Road (Looking East)	
Photo 28: LXBMP0010: CM-3 Area, upstream of Service Area Road BMP; Outlet on South Side of Road (Looking West)	
Photo 29: LXBMP0011: CM-3 Area, Upstream of Service Area Road BMP, Natural Drainage Upstream of CM-3 (Upstream of Check Dam)	
Photo 30: LXBMP0012: CM-3 Area, Downstream of Service Area Road BMP, Underdrains	

Tasks

19. OF009 CM-10

Inspection Checklist Questions	Answers
Date	
Client	
Inspection Status	
Project Name	
Is the area free of odors, suspended materials, floating materials, etc.?	
County	
Are erosion/sediment controls in good condition?	
State	
Are upstream areas free of erosion or sediment?	
Inspector Company	
Is flow below the top of the weir boards?	
Project Manager	
If above is NO, does the underdrain appear to be constricted?	
Inspection Type(s)	
If above is NO, please record a video	
Inspection Date	
Is there sediment accumulation in the culvert basin?	
Inspection Time	
If yes, record approximate depth (Inches)	
Inspector	
Is there erosion at the diversion pipe outlet?	
Precipitation Present	
Are the streambed sidewalls viewable upstream from the weir boards stable?	
Estimated Time Since Last Storm	

Inspection Checklist Questions	Answers
Is the streambed viewable upstream from the weir boards free of water quality pollution? If not, enter a description of conditions observed, take photos, and notify Haley & Aldrich within 24 hours.	
Action Item	
Is the streambed viewable upstream from the weir boards free of excessive erosion? (Note: erosion of the streambed is to be evaluated, not the accumulation and/or deposit of sediment in the streambed.)	
Corrective Actions Identified	
Photo CM10-1: CM-10 Basin Overview (Upstream)	
Photo CM10-1: CM-10 Basin Overview (Towards Weir Boards)	

Tasks

20. OF009 CM-2

Inspection Checklist Questions	Answers
Date	
Client	
Inspection Status	
Project Name	
Is the area free of odors, suspended materials, floating materials, etc.?	
County	
Are erosion/sediment controls in good condition?	
State	
Are upstream areas free of erosion or sediment?	
Inspector Company	
Is flow below the top of the weir boards?	
Project Manager	
If above is NO, does the underdrain appear to be constricted?	
Inspection Type(s)	
If above is NO, please record a video	
Inspection Date	
Are the streambed sidewalls viewable upstream from the weir boards stable?	
Inspection Time	
Is the streambed viewable upstream from the weir boards free of water quality pollution? If not, enter a description of conditions observed, take photos, and notify Haley & Aldrich within 24 hours.	
Inspector	
Is the streambed viewable upstream from the weir boards free of excessive erosion? (Note: erosion of the streambed is to be evaluated, not the accumulation and/or deposit of sediment in the streambed.)	
Precipitation Present	
Corrective Actions Identified	

Inspection Checklist Questions	Answers
Estimated Time Since Last Storm	
Action Item	
Photo CM2-1: CM-2 Basin Overview (Upstream)	
Photo CM2-1: CM-2 Basin Overview (Towards Weir Boards)	

Tasks

Boeing 72 Hours After Rain Event Ponding Inspection Form

Perform inspection after each storm exceeding 0.75 inches of rain.

Date/Time of Inspection _____

Inspector's Name/Title _____ **Signature** _____

Culvert Modification	Ponding? Yes	Ponding? No	Depth (feet)
CM-2			
CM-3			
CM-4			
CM-5			
CM-6			
CM-8			
CM-9			
CM-10			
CM-11			
CM-12			
SEDIMENT BASIN			
BIOFILTER			
UPPER LOT MEDIA FILTER			
NORTHERN DETENTION BIOSWALE			
SOUTHERN DETENTION BIOSWALE			
ADMIN AREA FILTER BASKET			

Printed on 12/10/2025

Surface Water Monitoring Inspection and Sample Collection Form
PERFORMANCE MONITORING and BMP MONITORING PROGRAMS

Sampling Responsibility: Boeing

Inspector/Sampler:

Date:

Outfall/Watershed: 009

Weather:

Rain Event Start Date/Time:

	Sample Tracking Information							Sample Field Measurements				Leaf Test				Sample Observations
	ISRA Area(s) & Location	Sample Frequency	Qualitative Flow Observations*	Photo Number(s)	Object ID	Sample ID (Object ID_yyyymmdd)	Sample/ Observation Time	Conductivity (mS or µS)	pH	Temperature (°C)	Turbidity (NTU)	Distance (ft)	Time (s)	Speed (ft/s)	Water Depth (in)	**REQUIRED for effluent BMP samples: Was overflow or bypass observed during sample collection?** Additional Notes: color, odor, sheen, foam, biological material, nearby erosion, etc.
B-1 AREA	Gunite swale conveying road runoff	Two Storm			B1BMP0009	B1BMP0009_										
B-1 AREA	Culvert outlet from upper parking lot area	Two Storm			B1BMP0010	B1BMP0010_										
B-1 AREA	Underdrains	Two Storm			B1BMP0011	B1BMP0011_										
B1436 DETENTION BIOSWALES	Upstream, B1436 southern detention bioswale (concrete swale diverting sheet flow into rock crib - west)	Two Storm			ILBMP0004	ILBMP0004_										
B1436 DETENTION BIOSWALES	Downstream, B1436 southern detention bioswale; 12-inch underdrain	Two Storm			ILBMP0005	ILBMP0005_										
B1436 DETENTION BIOSWALES	Upstream, B1436 southern detention bioswale (concrete swale diverting sheet flow into rock crib - east)	Two Storm			ILBMP0008	ILBMP0008_										

Notes:

***Qualitative Flow Observations:**

No Flow
Low Flow: Trickle or minor amount of flow.
Moderate Flow: Water is flowing normally, no significant erosion or turbid water.
High Flow: Significant water flow/velocity, slope erosion.

NPDES Permit Limits:

Temperature < 86 °F

pH 6.5 - 8.5

ALL RECEIVING AND SAMPLE COLLECTION BOTTLES MUST BE PRE-RINSED THREE TIMES WITH SOURCE WATER, PRIOR TO COLLECTION OF THE SAMPLE.

EXCEPTION IS THE HNO_3 (NITRIC) PRESERVED POLY BOTTLES - DO NOT PRE-RINSE THE HNO_3 PRESERVED POLYS.

NOTE: COLLECT TWO FIELD DUPLICATE SAMPLES FROM ANY LOCATIONS WITH SUFFICIENT FLOW.

Additional Observations:

Surface Water Monitoring Inspection and Sample Collection Form
PERFORMANCE MONITORING and BMP MONITORING PROGRAMS

Sampling Responsibility: Boeing

Inspector/Sampler:

Date:

Outfall/Watershed: 009

Weather:

Rain Event Start Date/Time:

	Sample Tracking Information							Sample Field Measurements				Leaf Test				Sample Observations
	ISRA Area(s) & Location	Sample Frequency	Qualitative Flow Observations*	Photo Number(s)	Object ID	Sample ID (Object ID_yyyymmdd)	Sample/ Observation Time	Conductivity (mS or µS)	pH	Temperature (°C)	Turbidity (NTU)	Distance (ft)	Time (s)	Speed (ft/s)	Water Depth (in)	**REQUIRED for effluent BMP samples: Was overflow or bypass observed during sample collection?** Additional Notes: color, odor, sheen, foam, biological material, nearby erosion, etc.
LOWER LOT AND ADMINISTRATION BUILDING AREA	Upstream Lower Lot Treatment BMP; sample port in cistern discharge pipeline	Two Storm			LPBMP0002	LPBMP0002_										
	Mid-Point Lower Lot BMP; Sediment Basin outlet box	Two Storm			LPBMP0003	LPBMP0003_										Overflow or Bypass observed: Yes / No
	Downstream Lower Lot Treatment BMP; discharge from Biofilter effluent pipe	Two Storm			LPBMP0004	LPBMP0004_										
CM-9 Area	Upstream (South), CM-9 BMPs	Two Storm			A1BMP0002	A1BMP0002_										
	Downstream, CM-9 BMPs; CM-9 underdrains	Two Storm			A1BMP0003	A1BMP0003_										Overflow or Bypass observed: Yes / No
	Upstream (East), CM-9 BMPs; culvert inlet off Area II Road	Two Storm			ILBMP0002	ILBMP0002_										

Notes:

***Qualitative Flow Observations:**

No Flow
Low Flow: Trickle or minor amount of flow.
Moderate Flow: Water is flowing normally, no significant erosion or turbid water.
High Flow: Significant water flow/velocity, slope erosion.

NPDES Permit Limits:

Temperature < 86 °F

pH 6.5 - 8.5

ALL RECEIVING AND SAMPLE COLLECTION BOTTLES MUST BE PRE-RINSED THREE TIMES WITH SOURCE WATER, PRIOR TO COLLECTION OF THE SAMPLE.

EXCEPTION IS THE HNO_3 (NITRIC) PRESERVED POLY BOTTLES - DO NOT PRE-RINSE THE HNO_3 PRESERVED POLYS.

NOTE: COLLECT TWO FIELD DUPLICATE SAMPLES FROM ANY LOCATIONS WITH SUFFICIENT FLOW.

Additional Observations:

Surface Water Monitoring Inspection and Sample Collection Form
PERFORMANCE MONITORING and BMP MONITORING PROGRAMS

Sampling Responsibility: Boeing

Inspector/Sampler:

Date:

Outfall/Watershed: Area 1 Burn Pit/ Outfalls 001 and 011

Weather:

Rain Event Start Date/Time:

	Sample Tracking Information							Sample Field Measurements				Leaf Test				Sample Observations
	ISRA Area(s) & Location	Sample Frequency	Qualitative Flow Observations*	Photo Number(s)	Object ID	Sample ID (Object ID_yyyymmdd)	Sample/ Observation Time	Conductivity (mS or µS)	pH	Temperature (°C)	Turbidity (NTU)	Distance (ft)	Time (s)	Speed (ft/s)	Water Depth (in)	**REQUIRED for effluent BMP samples: Was overflow or bypass observed during sample collection?** Additional Notes: color, odor, sheen, foam, biological material, nearby erosion, etc.
Outfall 001	Potential BMP Location, AIBP west side runoff draining toward Outfall 001 (At the bottom of the hill to the north of the intersection of the Southern Buffer Zone Road and Outfall 01 Road).	Every storm			EPSW001IE01	EPSW001IE01_										
Outfall 011	Potential BMP Location, AIBP east side runoff draining toward Outfall 011 (On felt liner by HDPe pipe)	Every storm			A1BPSW0001	A1BPSW0001_										

Notes:

***Qualitative Flow Observations:**

No Flow

Low Flow: Trickle or minor amount of flow.

Moderate Flow: Water is flowing normally, no significant erosion or turbid water.

High Flow: Significant water flow/velocity, slope erosion.

NPDES Permit Limits:

Temperature < 86 °F

pH 6.5 - 8.5

ALL RECEIVING AND SAMPLE COLLECTION BOTTLES MUST BE PRE-RINSED THREE TIMES WITH SOURCE WATER, PRIOR TO COLLECTION OF THE SAMPLE.

EXCEPTION IS THE HNO_3 (NITRIC) PRESERVED POLY BOTTLES - DO NOT PRE-RINSE THE HNO_3 PRESERVED POLYS.

NOTE: COLLECT FIELD DUPLICATE FROM EPSW001IE01 TWICE PER YEAR.

Additional Observations:

Surface Water Monitoring Inspection and Sample Collection Form
PERFORMANCE MONITORING and BMP MONITORING PROGRAMS

Sampling Responsibility: Boeing

Inspector/Sampler:

Date:

Outfall/Watershed: Sage Ranch / Former Shooting Range

Weather:

Rain Event Start Date/Time:

	Sample Tracking Information							Sample Field Measurements				Leaf Test				Sample Observations
	ISRA Area(s) & Location	Sample Frequency	Qualitative Flow Observations*	Photo Number(s)	Object ID	Sample ID (Object ID_yyyymmdd)	Sample/ Observation Time	Conductivity (mS or µS)	pH	Temperature (°C)	Turbidity (NTU)	Distance (ft)	Time (s)	Speed (ft/s)	Water Depth (in)	**REQUIRED for effluent BMP samples: Was overflow or bypass observed during sample collection?** Additional Notes: color, odor, sheen, foam, biological material, nearby erosion, etc.
Sage Ranch / Former Shooting Range	Sage Ranch location -- Upstream of the Former Shooting Range cleanup area, access near the front gate, along a small branch of the Northern Drainage.	Two Storm			BGBMP0005 (EPNDSW07)	EPNDSW07_										
	Sage Ranch location --Downstream of the Former Shooting Range cleanup area along the Northern Drainage; east of LOX.	Two Storm			EPNDSW04	EPNDSW04_										
CM-12	Influent to CM-12, prior to the weir board stationed in front of the culvert	Two Storm			CM12INF	CM12INF_										Overflow or Bypass observed: Yes / No
	Effluent of CM-12, directly behind the weir board in front of the culvert	Two Storm			CM12EFF	CM12EFF_										Overflow or Bypass observed: Yes / No

Notes:

***Qualitative Flow Observations:**

No Flow

Low Flow: Trickle or minor amount of flow.

Moderate Flow: Water is flowing normally, no significant erosion or turbid water.

High Flow: Significant water flow/velocity, slope erosion.

NPDES Permit Limits:

Temperature < 86 °F

pH 6.5 - 8.5

ALL RECEIVING AND SAMPLE COLLECTION BOTTLES MUST BE PRE-RINSED THREE TIMES WITH SOURCE WATER, PRIOR TO COLLECTION OF THE SAMPLE.

EXCEPTION IS THE HNO_3 (NITRIC) PRESERVED POLY BOTTLES - DO NOT PRE-RINSE THE HNO_3 PRESERVED POLYS.

Additional Observations:

Surface Water Monitoring Inspection and Sample Collection Form
PERFORMANCE MONITORING and BMP MONITORING PROGRAMS

Sampling Responsibility: Boeing

Inspector/Sampler:

Date:

Outfall/Watershed: B-1 Media Filter

Weather:

Rain Event Start Date/Time:

	Sample Tracking Information							Sample Field Measurements				Leaf Test				Sample Observations
	ISRA Area(s) & Location	Sample Frequency	Qualitative Flow Observations*	Photo Number(s)	Object ID	Sample ID (Object ID_yyyymmdd)	Sample/ Observation Time	Conductivity (mS or µS)	pH	Temperature (°C)	Turbidity (NTU)	Distance (ft)	Time (s)	Speed (ft/s)	Water Depth (in)	**REQUIRED for effluent BMP samples: Was overflow or bypass observed during sample collection?** Additional Notes: color, odor, sheen, foam, biological material, nearby erosion, etc.
B-1 Media Filter	Upstream (North), Tributary drainage	Two Storm			B1BMP0004	B1BMP0004_										
	Upstream (South), Asphalt swale downstream of retention basin discharge	Two Storm			B1BMP0005	B1BMP0005_										
	Downstream, B-1 Media Filter under drain	Two Storm			B1BMP0006	B1BMP0006_										Overflow or Bypass observed: Yes / No

Notes:

***Qualitative Flow Observations:**

No Flow

Low Flow: Trickle or minor amount of flow.

Moderate Flow: Water is flowing normally, no significant erosion or turbid water.

High Flow: Significant water flow/velocity, slope erosion.

NPDES Permit Limits:

Temperature < 86 °F

pH 6.5 - 8.5

ALL RECEIVING AND SAMPLE COLLECTION BOTTLES MUST BE PRE-RINSED THREE TIMES WITH SOURCE WATER, PRIOR TO COLLECTION OF THE SAMPLE.

EXCEPTION IS THE HNO_3 (NITRIC) PRESERVED POLY BOTTLES - DO NOT PRE-RINSE THE HNO_3 PRESERVED POLYS.

Additional Observations:

BMP Visual Inspection Form - OF009 NASA

Inspection Frequency: TWICE PER YEAR and After Significant Rain Events (>2.5 inches)

Sandbag Berm - Near LOX Area - Inspection Frequency: TWICE PER YEAR and After Significant Rain Events (>2.5 inches)

Photo # _____ Photo Location: _____

Photo # _____ Photo Location: _____

Photo # _____ Photo Location: _____

Photo # _____ Additional Photo(s): _____

	Yes	No	N/A	Comments/Corrective Action:
During Rain Event Inspection				
Any odors, suspended material, floating material, etc. observed?				
Are the sandbags in good condition?				
Is area behind sandbag berm free of debris/sediment buildup?				
Are upstream areas free of erosion or sediment? If no, note location and description under comments.				
72 Hours After the End of the Rain Event Inspection				
Any odors, suspended material, floating material, etc. observed?				
Are slope drains in good condition?				
Are the sandbags in good condition?				
Is area behind sandbag berm free of debris/sediment buildup?				
Are upstream areas free of erosion or sediment? If no, note location and description under comments.				
Other _____				

BMP Visual Inspection Form - OF009 NASA

Inspection Frequency: TWICE PER YEAR and After Significant Rain Events (>2.5 inches)

Helipad Area BMPs – Inspection Frequency: TWICE PER YEAR and After Significant Rain Events (>2.5 inches)

Photo #		Photo Location:	Helipad Berm Overview (Eastern Berm)
Photo #		Photo Location:	Helipad Berm Overview (Western Berm)
Photo #		Photo Location:	Culvert Inlet Passing Beneath Helipad Road
Photo #		Photo Location:	
Photo #		Additional Photo(s):	

	Yes	No	N/A	Comments/Corrective Action:
During Rain Event Inspection				
Are the Helipad Berms in good condition?				
Are upstream areas free of erosion or sediment? If no, note location and description under comments.				
Is area behind Helipad Berms free of debris/sediment buildup?				
Is parking lot free of excessive debris/sediment?				
Is water overtopping the Helipad Berm? If yes, note which berm(s) are being overtopped. If yes, please record a video.				
72 Hours After the End of the Rain Event Inspection				
Are the Helipad Berms in good condition?				
Are upstream areas free of erosion or sediment? If no, note location and description under comments.				
Is area behind Helipad Berms free of debris/sediment buildup?				
Is parking lot free of excessive debris/sediment?				
Other _____				

BMP Visual Inspection Form - OF009 NASA

Inspection Frequency: TWICE PER YEAR and After Significant Rain Events (>2.5 inches)

Additional Notes/Observations

BMP Visual Inspection Form - OF009 NASA

Inspection Frequency: TWICE PER YEAR and After Significant Rain Events (>2.5 inches)

Date/Time of Inspection _____

Inspector's Name/Title _____ **Signature** _____

Weather and Observations		
Precipitation present during inspection?	☐ Yes	☐ No

LOX Area BMPs – Inspection Frequency: TWICE PER YEAR and After Significant Rain Events (>2.5 inches)

Photo #		Photo Location:	LOX Berm Overview (West End)
Photo #		Photo Location:	LOX Berm Overview (East End)
Photo #		Photo Location:	Northern Drainage Overview Where Slope Drains Discharge
Photo #		Additional Photo(s):	

During Rain Event Inspection	Yes	No	N/A	Comments/Corrective Action:
Any odors, suspended material, floating material, etc. observed?				
Are erosion/sediment controls in good condition?				
Are slope drains in good condition?				
Is the gravel bag berm in good condition?				
Are upstream areas free of erosion or sediment? If no, note location and description under comments.				

72 Hours After the End of the Rain Event Inspection				
Any odors, suspended material, floating material, etc. observed?				
Are slope drains in good condition?				
Is the gravel bag berm in good condition?				
Are upstream areas free of erosion or sediment? If no, note location and description under comments.				
Other _____				

NASA 72 Hours After Rain Event Ponding Inspection Form

Perform inspection after each storm exceeding 0.75 inches of rain.

Date/Time of Inspection _____

Inspector's Name/Title _____ **Signature** _____

Culvert Modification	Ponding? Yes	Ponding? No	Depth (feet)
CM-1			
ELV			

Printed on 12/10/2025

Surface Water Monitoring Inspection and Sample Collection Form
PERFORMANCE MONITORING and BMP MONITORING PROGRAMS

Sampling Responsibility: NASA

Inspector/Sampler:

Date:

Outfall/Watershed: 009

Weather:

Rain Event Start Date/Time:

	Sample Tracking Information						Sample Field Measurements				Leaf Test					Sample Observations
	ISRA Area(s) & Location	Sample Frequency	Qualitative Flow Observations*	Photo Number(s)	Object ID	Sample ID (Object ID_yyyymmdd)	Sample/ Observation Time	Conductivity (mS or uS)	pH	Temperature (°C)	Turbidity (NTU)	Distance (ft)	Time (s)	Speed (ft/s)	Water Depth (in)	**REQUIRED for effluent BMP samples:** Was overflow or bypass observed during sample collection? **Additional Notes:** color, odor, sheen, foam, biological material, nearby erosion, etc.
ELV TREATMENT BMP, ASH PILE AND HELIPAD	Culvert inlet; runoff will only be present when rain events exceed ELV BMP design storm	Two Storm			EVBMP0001	Observation Only										
	Sample port in BMP influent pipe prior to "T" connection	Two Storm			EVBMP0007	EVBMP0007_										
	Discharge from media filter tank pipe	Two Storm			EVBMP0008	EVBMP0008_										
	Composite of samples from eastern and western sample ports between settling tanks and media filter	Two Storm			EVBMP0009	EVBMP0009_										
	Ash Pile drainage, surface flow immediately east (downstream) of the effluent of the ELV BMP discharge pipe	Two Storm			APBMP0002	APBMP0002_										

Notes:

Additional Observations:

***Qualitative Flow Observations:**

No Flow

Low Flow: Trickle or minor amount of flow.

Moderate Flow: Water is flowing normally, no significant erosion or turbid water.

High Flow: Significant water flow/velocity, slope erosion.

NPDES Permit Limits:

Temperature < 86 °F

pH 6.5 - 8.5

ALL RECEIVING AND SAMPLE COLLECTION BOTTLES MUST BE PRE-RINSED THREE TIMES WITH SOURCE WATER, PRIOR TO COLLECTION OF THE SAMPLE.

EXCEPTION IS THE HNO_3 (NITRIC) PRESERVED POLY BOTTLES - DO NOT PRE-RINSE THE HNO_3 PRESERVED POLY'S.

Surface Water Monitoring Inspection and Sample Collection Form
PERFORMANCE MONITORING and BMP MONITORING PROGRAMS

Sampling Responsibility: NASA
Inspector/Sampler:
Date:
Outfall/Watershed 009

Weather:
Rain Event Start Date/Time:

	Sample Tracking Information						Sample Field Measurements				Leaf Test					Sample Observations
	ISRA Area(s) & Location	Sample Frequency	Qualitative Flow Observations*	Photo Number(s)	Object ID	Sample ID (Object ID_yyyymmdd)	Sample/ Observation Time	Conductivity (mS or uS)	pH	Temperature (°C)	Turbidity (NTU)	Distance (ft)	Time (s)	Speed (ft/s)	Water Depth (in)	**REQUIRED for effluent BMP samples:** Was overflow or bypass observed during sample collection? **Additional Notes:** color, odor, sheen, foam, biological material, nearby erosion, etc.
CM-1 AND AREA II ROAD	Sheetflow along Area II Road upstream of sandbag berm	Two Storm			EVBMP0003	EVBMP0003_										
	CM-1 eastern tributary drainage	Two Storm			A2BMP0006	A2BMP0006_										
	CM-1 culvert outlet	Two Storm			A2BMP0007	A2BMP0007_										
	Outlet pipe south side of road	Two Storm			A2BMP0012	A2BMP0012_										

Notes:

***Qualitative Flow Observations:**

No Flow
Low Flow: Trickle or minor amount of flow.
Moderate Flow: Water is flowing normally, no significant erosion or turbid water.
High Flow: Significant water flow/velocity, slope erosion.

NPDES Permit Limits:

Temperature < 86 °F

pH 6.5 - 8.5

ALL RECEIVING AND SAMPLE COLLECTION BOTTLES MUST BE PRE-RINSED 3 TIMES WITH SOURCE WATER, PRIOR TO COLLECTION OF THE SAMPLE.

EXCEPTION IS THE HNO3 (NITRIC) PRESERVED POLY BOTTLES - DO NOT PRE-RINSE THE HNO3 PRESERVED POLY'S

Additional Observations:

Printed on 12/10/2025

Surface Water Monitoring Inspection and Sample Collection Form
PERFORMANCE MONITORING and BMP MONITORING PROGRAMS

Sampling Responsibility: NASA
Inspector/Sampler:
Date:
Outfall/Watershed 009

Weather:
Rain Event Start Date/Time:

	Sample Tracking Information						Sample Field Measurements				Leaf Test					Sample Observations
	ISRA Area(s) & Location	Sample Frequency	Qualitative Flow Observations*	Photo Number(s)	Object ID	Sample ID (Object ID_yyyymmdd)	Sample/ Observation Time	Conductivity (mS or uS)	pH	Temperature (°C)	Turbidity (NTU)	Distance (ft)	Time (s)	Speed (ft/s)	Water Depth (in)	**REQUIRED for effluent BMP samples:** Was overflow or bypass observed during sample collection? **Additional Notes:** color, odor, sheen, foam, biological material, nearby erosion, etc.
A2LF and WELL 13 ROAD	Area II landfill western tributary drainage	Two Storm			A2BMP0001	A2BMP0001_										
	Well 13 road runoff east of OF009 autosamplers	Two Storm			A2BMP0009	A2BMP0009_										

Notes:

***Qualitative Flow Observations:**

No Flow
Low Flow: Trickle or minor amount of flow.
Moderate Flow: Water is flowing normally, no significant erosion or turbid water.
High Flow: Significant water flow/velocity, slope erosion.

NPDES Permit Limits:

Temperature < 86 °F

pH 6.5 - 8.5

ALL RECEIVING AND SAMPLE COLLECTION BOTTLES MUST BE PRE-RINSED 3 TIMES WITH SOURCE WATER, PRIOR TO COLLECTION OF THE SAMPLE.

EXCEPTION IS THE HNO3 (NITRIC) PRESERVED POLY BOTTLES - DO NOT PRE-RINSE THE HNO3 PRESERVED POLY'S

Additional Observations:

ATTACHMENT B
Santa Susana Field Laboratory
Background Stormwater Sampling Plan 2021

Geosyntec consultants

924 Anacapa Street, Suite 4A
Santa Barbara, CA 93101
PH 805.897.3800
www.geosyntec.com

MEMORANDUM

Date:	December 10, 2021
To:	Stormwater Sampling Team
From:	SSFL Surface Water Expert Panel, Geosyntec Consultants
Subject:	Santa Susana Field Laboratory Background Stormwater Sampling Plan

Monitoring Locations

One non-industrial subwatershed (Box Canyon) and two natural background subwatersheds (Las Llajas and Montgomery Canyons) were selected as primary locations for sampling, and two subwatersheds (Chesebro and East Las Virgenes Canyons) were selected as backup locations to be sampled if the primary locations cannot be accessed or are not flowing at the time of sampling. Figure 1 shows the location of each subwatershed and monitoring location relative to SSFL. GPS coordinates for the selected downstream monitoring locations are shown in Table 1. Maps showing access points and monitoring locations are included in Attachment A.

Table 1. Subwatershed Characteristics

Sample Location Type	Name	Watershed	Sample Location (latitude, longitude)	Drainage Area (acres)
Primary Background	Las Llajas Canyon	Calleguas Creek	34.300070°, -118.681550°	4,020
	Montgomery Canyon	Calleguas Creek	34.235774°, -118.784127°	908
Non-Industrial	Box Canyon	Los Angeles River	34.234664°, -118.642553°	694
Secondary Background	*Chesebro Canyon*	*Malibu Creek*	*34.159300°, -118.725314°*	*1,814*
	East Las Virgenes Canyon	*Malibu Creek*	*34.171851°, -118.701614°*	*1,454*

Sampling and Analysis

Samples will be collected using grab sampling techniques and may be collected from runoff up to 12 hours after the end of a rainfall event. Sampling will only be conducted during daylight hours and may be aborted if unsafe conditions exist (e.g., lightning, flooding). Sample bottles will be labeled with the date, time, unique sample ID, and sampler's initials, at a minimum. A clean pair of disposable gloves (e.g., nitrile) will be worn by the sampler at each sample location. Samples will be collected from the bank of the stream either directly into the sample bottles or using a clean secondary bottle that is not reused between locations. If necessary, a sampling pole or other technique may be used to allow safe sample collection.

Parameters that will be analyzed for each sample are shown in **Error! Reference source not found.**. A total of 14 bottles will be collected for each sampling location. One field blank and one field duplicate will be prepared for each sampling event where at least one location is sampled. **Thus, five sets of sample bottles will be required for each sampling event (two background locations, one non-industrial location, one field duplicate, and one field blank).** Sample bottles will be immediately placed on ice after collection and shipped overnight or via courier to Eurofins Test America in Irvine, CA.

Analytical Parameters

The parameters listed in in Attachment B will be analyzed by Eurofins Test America according to the methods and within the holding times listed. Calculations will also be made to determine Nitrate + Nitrite as N, Radium-226 + Radium-228, TCDD TEQ, and TCDD TEQ (No DNQ) concentrations.

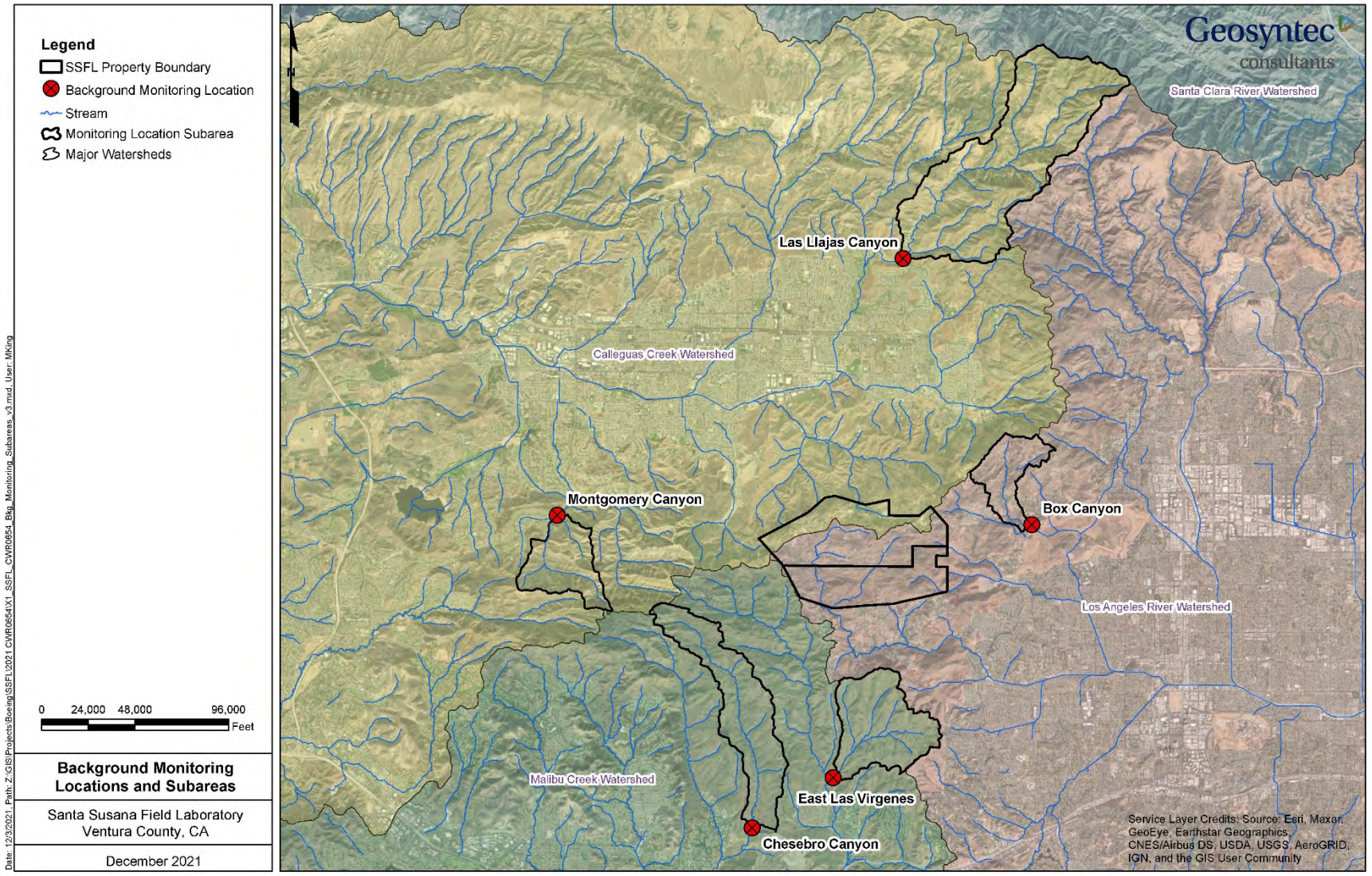


Figure 1. Offsite Background Stormwater Monitoring Subwatersheds

ATTACHMENT A: MONITORING LOCATIONS AND ACCESS POINTS


Las Llajas Canyon
Legend
Access
Creek
Sampling Location
Trail
Sampling Location
Las Llajas Canyon Rd
Cherokee Cir
Evening Sky Dr
Access
Evening Sky Dr
Google Earth
N
700 ft

Las Llajas Canyon – Primary Natural Background Sampling Location:

- Park on Evening Sky Drive at the Las Llajas Canyon Trailhead
- Walk 0.3 miles to the sampling location, through gate, to where the creek crosses a concrete area on the dirt road

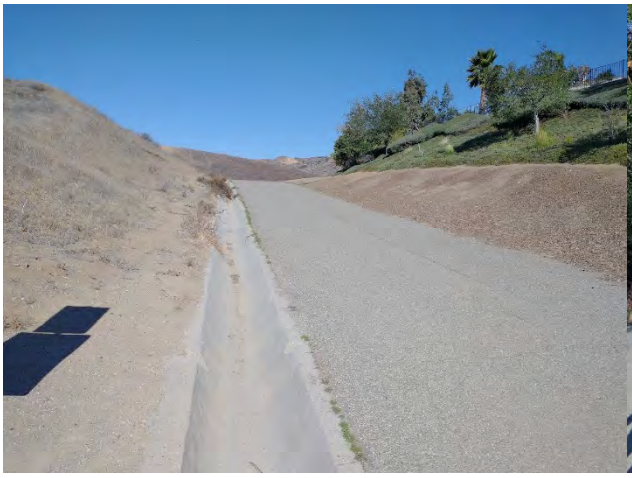


Figure 1. Las Llajas Canyon Trail at Trailhead

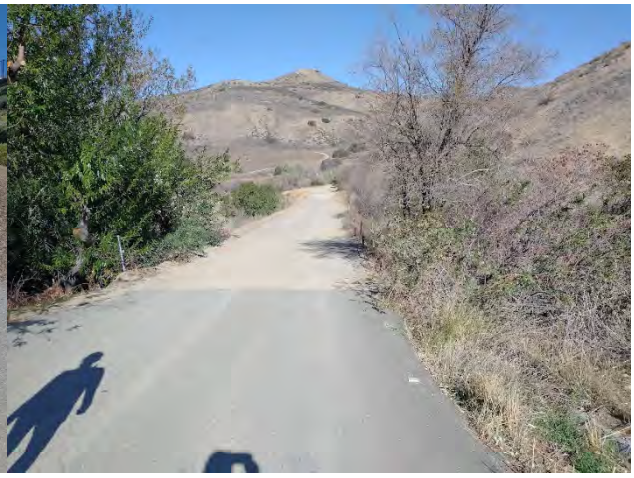


Figure 2. Las Llajas Canyon Trail



Figure 3. Sampling Location



Figure 4. Gate on Las Llajas Canyon Trail


Montgomery Canyon
Legend
Access
Creek
Sampling Location
Trail
Brooks Rd
Access
Sampling Location
Long Canyon Rd
Montgomery Trail
Long Canyon E
Google Earth
N
300 ft

Montgomery Canyon – Primary Natural Background Sampling Location:

- Park on Long Canyon Road at the Long Canyon East Trailhead (pull out w/ no parking sign)
- Walk 0.1 miles to the sampling location where the two creeks converge and cross the dirt road



Figure 5. Long Canyon East Trailhead



Figure 6. Sampling Location



Figure 7. Looking Downstream at Sampling Location


Box Canyon
Legend
Access
Creek
Sampling Location
Trail
Access
Sampling Location
STOP
STOP
Valley Circle Blvd
Google Earth
N
200 ft

Box Canyon – Non-Industrial Sampling Location:

- Park on Valley Circle Blvd just east of Woolsey Canyon Road
- Walk <0.1 miles to the sampling location where culvert crosses under Valley Circle Blvd (may need sampling pole or other collection device for this location)



Figure 8. Parking on Valley Circle Blvd



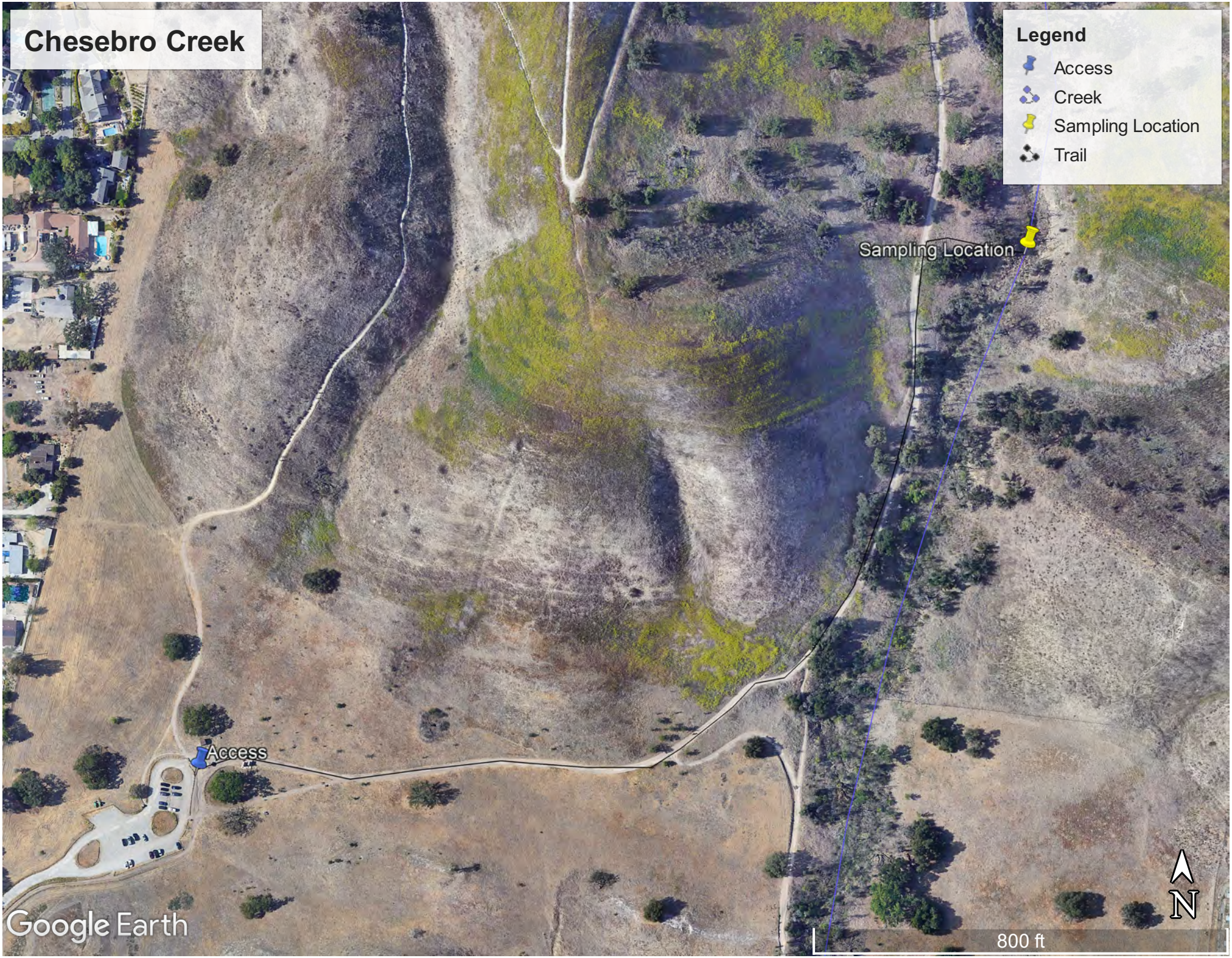
Figure 9. Culvert under Valley Circle Blvd



Figure 10. Alternate View of Culvert



Figure 11. Sampling Location


Chesebro Creek
Legend
Access
Creek
Sampling Location
Trail
Sampling Location
Access
Google Earth
N
800 ft

Chesebro Creek – Alternate Natural Background Sampling Location:

- Park in parking lot at Chesebro Canyon Trailhead (closed sunset to 8am)
- Walk 0.5 miles to the sampling location, just off the main trail



Figure 12. Chesebro Canyon Trailhead



Figure 13. Chesebro Canyon Trail



Figure 14. Sampling Location from Main Trail



Figure 15. Sampling Location


East Las Virgenes
Legend
Access
Creek
Sampling Location
Trail
N1
Sampling Location
N1
Access
Google Earth
N
700 ft

East Las Virgenes Creek – Alternate Natural Background Sampling Location:

- Park at the end of Las Virgenes Road at the Upper Las Virgenes Canyon Open Space Trailhead
- Walk 0.4 miles to the sampling location, small trail just off the main trail



Figure 16. Las Virgenes Trailhead



Figure 17. Las Virgenes Trail



Figure 18. Trail to Sampling Location



Figure 19. Sampling Location

ATTACHMENT B: MONITORING PARAMETERS AND ANALYTICAL METHODS

Group	Analyte	Method	MDL (target)	RL	Bottle	Hold Time
Metals, Total & Dissolved	Antimony	200.8	0.5 ug/L	2.0 ug/L	1 x 250mL poly, HNO3	180 Days
	Arsenic	200.8	0.5 ug/L	1.0 ug/L		
	Barium	200.8	5 ug/L	10 ug/L		
	Beryllium	200.8	0.5 ug/L			
	Cadmium	200.8	0.25 ug/L	1.0 ug/L		
	Chromium	200.8	2.5 ug/L	5.0 ug/L		
	Copper	200.8	0.5 ug/L	2.0 ug/L		
	Iron	200.8	8.0 ug/L	20 ug/L		
	Lead	200.8	0.5 ug/L	1.0 ug/L		
	Manganese	200.8	0.5 ug/L	1.0 ug/L		
	Nickel	200.8	5.0 ug/L	10 ug/L		
	Selenium	200.8	0.5 ug/L	1.0 ug/L		
	Silver	200.8	0.5 ug/L	1.0 ug/L		
	Thallium	200.8	0.2 ug/L	1 ug/L		
	Zinc	E200.7	2.0 ug/L	20 ug/L		
	Boron	E200.7	0.025 mg/L	0.05 mg/L		
	Mercury	245.1	0.017 ug/L	0.05 ug/L		28 days
	Chromium VI	218.6	0.25 ug/L	1	2 x 250mL poly, unpreserved	10 days
	bis (2-ethylhexyl) phthalate	E625.1	2.2 ug/L	5.0 ug/L	# x 40 mL VOA	3 days
	Cyanide	SM4500-CN-E	2.5 ug/L	5.0 ug/L	500-mL Poly-CN/ NaOH	14 days
	Fluoride	E300	0.25 mg/L	0.5 mg/L	60-mL Poly-300.0/314	28 days
	Perchlorate	E314.0	0.95 ug/L	4.0 ug/L	60-mL Poly-300.0/314	28 days
	Trichloroethene	E624.1	0.25 ug/L	0.5 ug/L	40-mL VOA-624.1	3 days
Nutrients	Nitrate as N	300	0.055 mg/L	0.11 mg/L	1 x 500mL poly, unpreserved	2 days
	Nitrite as N		0.024 mg/L	0.15 mg/L		
	Sulfate		0.25 mg/L	0.5 mg/L		
Dioxins and Furans	17 congeners to calculate TCDD TEQ	1613B	1.4 – 45.9 pg/L[1]	10 – 100 pg/L[1]	2 x 1L amber, unpreserved	1 Year
Radioactivity	Gross Alpha	900	N/A	3.0 pCi/L	1 x 1L poly, unpreserved	180 days
	Gross Beta		N/A	4.0 pCi/L		
	Radium-226	903	N/A	1.0 pCi/L	2 x 1L poly, HNO3	180 days
	Radium-228	904	N/A	1.0 pCi/L		180 days
	Strontium-90	905	N/A	3.0 pCi/L	2 x 1L poly, NHO3	180 days
	Tritium	E906.0	N/A	500 pCi/L	Unknown	180 days
Solids	TSS	2540D	0.5 mg/L	1.0 mg/L	1 x 1L poly, unpreserved	7 days
	% sand	ASTM D4462	N/A	0.01%	1 x 1L poly, unpreserved	
	% silt		N/A	0.01%		
	% clay		N/A	0.01%		

MDL = Method Detection Limit, RL = Reporting Limit, N/A = Not Applicable

1. MDL and RL vary by congener

Appendix B: Stormwater Control Historical Summary

Prepared for

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Appendix B: Stormwater Control Summary

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Acronyms

BMP	Best Management Practice
CM	Culvert Modification
ELV	Expendable Launch Vehicle
GAC	Granular Activated Carbon
ISE	Imminent and Substantial Endangerment
ISRA	Interim Source Removal Action
LOX	Liquid Oxygen
SSFL	Santa Susana Field Laboratory
SWTS	Stormwater Treatment System

Introduction

Stormwater controls have been implemented throughout the Santa Susana Field Laboratory (Site) to treat stormwater before discharge. Site-wide measures also include erosion and sediment controls, revegetation, stabilization of repaved and unpaved roads, and other soil-stabilization activities. In some areas, impervious surfaces, including building roofs and parking lots, have been removed or disconnected by reintroducing vegetation and open space. Figure 1-2 presents major structural treatment-control stormwater controls implemented at the Site. It does not include the full inventory of Site-wide erosion and sediment controls, unpaved-road measures, building demolition areas, or paved areas converted through soil scarification and revegetation. The major structural stormwater controls are documented in the ISRA Performance Monitoring and Stormwater Control Monitoring for the Outfalls 008 and 009 Watersheds, 2014/2015 Reporting Year (MWH et al., 2015), the 2015 Stormwater Control Plan (Haley & Aldrich, Inc., 2015), and subsequent annual reports. Table 1 summarizes the major controls by implementation year.

Table 1. Major Stormwater Controls by Implementation Year

Year	Watershed / Area	Stormwater Control or Activity	Stormwater Control Type
2009	Outfall 009	Culvert modifications	Distributed passive treatment controls
2010	Outfall 008	ISRA excavations	Source-control and interim cleanup measures
2011	Outfall 009	Helipad berms and pumps	Runoff capture and transfer
2011	Outfall 011	Stormwater conveyance and treatment system	Centralized active treatment systems
2011	Outfall 018	Stormwater conveyance and treatment system	Centralized active treatment systems
2012	Outfall 009	B-1 sedimentation basin and media filter	Distributed passive treatment controls
2012	Outfall 009	Northern Drainage restoration measures	Erosion and sediment controls
2012	Outfall 009	CM-9 additional improvements	Distributed passive treatment controls
2013	Outfall 009	Lower Parking Lot sedimentation basin and biofilter	Distributed passive treatment controls
2013	Outfall 009	ISRA excavations	Source-control and interim cleanup measures
2013	Outfall 009	ELV treatment stormwater control	Distributed passive treatment controls
2013	Outfall 009	LOX sandbag berms and slope drains	Diversion and conveyance controls
2015	Outfall 009	B1436 detention bioswales	Distributed passive treatment controls
2017	Outfall 009	Wattles around roadside utility poles	Utility-pole controls

Year	Watershed / Area	Stormwater Control or Activity	Stormwater Control Type
2017	Outfall 009	Upper Parking Lot media filter	Distributed passive treatment controls
2017	Outfall 009	Roadway diversion to CM-3	Diversion and conveyance controls
2017	Outfall 009	Administration Area inlet filters	Distributed passive treatment controls
2017	Outfall 009	Enhanced erosion controls in the Former Shooting Range Area	Erosion and sediment control
2017	Outfall 009	Roadway diversion to CM-1	Diversion and conveyance controls
2018	Outfall 009	CM-1 reconstruction	Distributed passive treatment controls
2019	Outfall 009	Mulch-sack curb extension in the Lower Parking Lot	Erosion and sediment controls
2019	Area II	Utility-pole vegetation clearing and soil-base stabilization	Utility-pole controls
2020	Outfall 009	Generators added at the ELV and biofilter cisterns	Distributed passive treatment controls – added reliability
2020	Outfall 009	CM-3 check dams and media-filter reconstruction	Distributed passive treatment controls
2020	Southern Buffer Zone	Utility-pole stormwater controls	Utility-pole controls
2021	Outfall 009	ELV treatment stormwater control media-filter underdrain reconstruction	Distributed passive treatment controls
2022	R-1 Pond	Berm repair	Diversion and conveyance controls
2023	Site-wide	Treated-wood utility-pole stormwater control adjustments	Utility-pole controls
2023	Former Shooting Range	ISE Order cleanup initiated	Source-control and interim cleanup measures
2024	Area I Burn Pit	ISE Order cleanup initiated	Source-control and interim cleanup measures
2024	Area I Burn Pit	Stormwater runoff diversion	Diversion and conveyance controls
2025	Outfall 009	CM-12 reconstruction	Diversion and conveyance controls
2025	Outfall 009 – Former Shooting Range	ISE excavation, stabilization, and revegetation completed	Source-control and interim cleanup measures
2025	Area I Burn Pit	Excavation activities	Source-control and interim cleanup measures
2026	Outfall 009	B-1 Media Filter rebuilt with sulfur-impregnated GAC media	Distributed passive treatment controls
2026	Outfalls 001 and 011 – Coca Road	Roadway runoff diversion to Perimeter Pond completed	Diversion and conveyance controls
2026	Site-wide – Sandy Fire access areas	Disturbed roadway and access areas stabilized following fire-response activities	Road and impervious-area controls

Year	Watershed / Area	Stormwater Control or Activity	Stormwater Control Type
2026	Outfalls 001 and 011 – Area I Burn Pit	ISE excavation completed; post-excavation stabilization ongoing	Source-control and interim cleanup measures

SSFL Stormwater Control Summary

Stormwater from the Outfall 011 collects in Perimeter Pond and is pumped up to the R-1 Pond for settling and evaporation. Similarly, stormwater from the Outfall 018 watershed collects in R-2A pond just upstream from the outfall and is pumped up to Silvernale Pond for treatment at SWTS 018. These ponds also serve as added storage to reduce stormwater discharges. Ponded stormwater is treated using an advanced SWTS as soon as the depth is sufficient for the intake pipe. Treated stormwater is discharged at Outfall 011 and 018 and then flows through a natural channel to Outfalls 001 and 002, respectively.

Stormwater runoff up to the outfall-specific design volumes at Outfalls 003, 004, 005, 006, 007, 009[1], and 010 is pumped to Silvernale Pond before being treated by the Outfall 018 SWTS alongside stormwater runoff from the local Outfall 018 Watershed. The Outfall 018 SWTS has been shown to be highly effective at reducing both the magnitude and frequency of Permit limit exceedances (Santa Susana Surface Water Expert Panel and Geosyntec Consultants, 2019).

Distributed stormwater controls in the Outfall 009 watershed include revegetation, erosion and sediment controls, and natural treatment systems. The statistical evaluations in Appendix B (2024/25 Stormwater Control Performance Analysis) indicate significant reductions in constituent-of-potential-concern loads within subareas treated by structural stormwater controls, with the greatest influent-to-effluent reductions observed at higher influent concentrations. The Northern Drainage, the primary stormwater conveyance in the Outfall 009 watershed, is inspected annually to identify where additional stabilization measures, such as bank riprap or rock check structures, may be appropriate.

Following completion of ISRA activities in 2010, new erosion and sediment controls, revegetation, and unpaved-road stabilization measures were implemented in the Outfall 008 watershed. The ISRA activities included identifying and evaluating affected areas; remediating or stabilizing soils containing constituents of potential concern; and restoring disturbed areas.

Sampling results from distributed structural stormwater controls indicate effective performance and support the water-quality improvements achieved through the iterative, adaptive-management approach used in these watersheds.

[1] Stormwater runoff from a small area within the Outfall 009 watershed, the helipad area, is pumped to the storage pond for treatment prior to being discharged from Outfall 018, while stormwater runoff from the remaining, vast majority of the watershed flows to Outfall 009.



2009: Culvert Modifications



2010: Outfall 008 Watershed ISRA Excavations



2011: Helipad Berms and Pumps



2011: Outfall 011 SWTS



2011: Outfall 018 SWTS



2012: B-1 Sedimentation Basin (not shown) and Media Filter



2012: Northern Drainage Channel Stabilization Measures



2012: CM-9 Additional Improvements (Perforated Pipe, Extended Sedimentation Area and Riprap Berm)



2013: Lower Parking Lot Sedimentation Basin and Biofilter



2013: Outfall 009 Watershed ISRA Excavations



2013: ELV Treatment BMP



2013: LOX Sandbag Berms and Slope Drains



2015: B1436 Detention Bioswales



2017: Wattles around Poles along Roads



2017: Upper Parking Lot Media Filter



2017: Roadway Diversion to CM-3



2017: Administration Area Inlet Filter (Filter Basket)



2017: Administration Area Filter Socks and Riprap at Culvert Inlet



2017: Enhanced Erosion and Sediment Controls in Former Shooting Range Area



2017: Roadway Diversion to CM-1



2018: CM-1 Reconstruction Including Enlargement



2019: Area II Utility Pole Vegetation Clearing and Soil Base Stabilization



2020: Outfall 009 CM-3 Filter Media Reconstruction



2020: Outfall 009 CM-3 Check Dams Added



2020: Southern Buffer Zone Utility Pole BMPs



2020: Outfall 009 ELV and Biofilter Cistern Generators Added



2021: Outfall 009 ELV Treatment BMP Media Filter Reconstruction



2022: R1 Pond Berm Repair



2023: Treated Wood Utility Pole BMP Adjustments



2023-2024: Shooting Range ISE Excavations



2024: ISE Area I Burn Pit Excavations



2024: Area I Burn Pit Stormwater Diversion BMP



2025: CM-12 Reconstruction



2025: Area I Burn Pit Excavation



2025: Example of Former Shooting Range with Stabilization BMPs



2026: Completion of B1 Media Filter media replacement with sulfonated GAC



2026: Coca Roadway runoff diversion to Perimeter Pond completed



2026: Disturbed roadway and access areas stabilized for Sandy Fire access areas



2026: Completion of Area I Burn Pit Excavation and continued stabilization

Figure 1. Photos of Example Structural BMPs and Years of Construction

Appendix C: 2025/26 Stormwater Control Performance Analysis

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Appendix C: Stormwater Control Performance Analysis

2025/26 Reporting Year

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CWR1080
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Acronyms

BMP	Best Management Practice
BAFs	Bioaccumulation Factor
CA	California
CM	Culvert Modification
COPC	Constituent of Potential Concern
COV	Coefficient of Variation
DNQ	Detected not Quantified
EBV	Empty Bed Volumes
ELV	Expendable Launch Vehicle
GAC	Granulated Activated Carbon
GIS	Geographic Information System
HDPE	High Density Polyethylene
IQR	Interquartile Range
ISRA	Interim Source Removal Action
µg/L	micrograms per liter
mg/L	milligram per liter
NASA	National Aeronautics and Space Administration
ND	Non-Detect
NPDES	National Pollutant Discharge Elimination System
POR	Period of Record
QA/QC	Quality Assurance/Quality Control
SSFL	Santa Susana Field Laboratory
SWMM	Storm Water Management Model
TCDD	Tetrachlorodibenzo-*p*-dioxin
TEQ	Toxic Equivalence
TSS	Total Suspended Solids

1. Introduction

Ongoing performance monitoring and evaluations are conducted at existing stormwater treatment controls, formerly referred to as Best Management Practices (BMPs), installed at the Boeing Santa Susana Field Laboratory (SSFL, or Site) at the direction of the Surface Water Expert Panel ("Expert Panel"). These include passive stormwater treatment controls distributed across the Outfall 009 watershed and active stormwater treatment systems (SWTSs) treating discharges from Outfalls 011 and 018 plus a portion of Outfall 009 runoff from the helipad. The stormwater controls are intended to reduce pollutants and stormwater volume via sedimentation, filtration, adsorption, ion exchange, and evapotranspiration processes before stormwater reaches its discharge point from the Site, in order to comply with the National Pollutant Discharge Elimination System (NPDES) Permit limits as issued to Boeing by the Los Angeles Regional Water Quality Control Board (LARWQCB). The Site was subject to the NPDES permit that became effective in 2015 (NPDES Permit No. CA0001309 for the Boeing Company, SSFL, Canoga Park, CA, Order No. R4-2015-0033 ["2015 Permit"]) (LARWQCB, 2015); however, a renewed permit became effective on January 1, 2024 (NPDES Permit No. CA0001309 for the Boeing Company, SSFL, Canoga Park, CA, Order No. R4-2023-0359 ["2023 Permit"]) (LARWQCB, 2023). Figure 1-1 in the 2025/26 annual report presents the locations of the distributed stormwater treatment controls at SSFL.

Data collected during the 2025/26 reporting year (July 1, 2025 through June 30, 2026) were incorporated into an existing dataset that began in December 2009 as an update to the stormwater control performance analysis conducted annually in accordance with the *Site-Wide Stormwater Work Plan and 2014/15 Annual Report* ("2015 Work Plan") (Santa Susana Surface Water Expert Panel and Geosyntec Consultants, 2015). Analyzed NPDES constituents of potential concern (COPCs) are defined herein as constituents having a notable risk of Permit limit exceedance or being used for treatment performance diagnostic purposes. The COPCs monitored at the inlet and outlet locations of these controls included total suspended solids (TSS), total lead, total copper[1], dioxins (tetrachlorodibenzo-p-dioxin toxic equivalency [TCDD TEQ], detected but not quantified [DNQ] excluded, bioaccumulation factor [BAFs] included), total mercury, and total aluminum. The NPDES Permit includes other constituents with Permit limits; however, these COPCs were selected as the most important constituents for evaluating the performance of the stormwater controls. Performance monitoring data were analyzed to assess the effectiveness and anticipate major maintenance needs of the culvert modification (CM) media filters, Upper Lot Media Filter, lower parking lot sedimentation basin and biofilter (Lower Lot Biofilter), ELV Treatment Control, and B1436 Detention Bioswales (Northern and Southern Detention Bioswales). A summary of stormwater control observations during and after storm events is included with appropriate maintenance recommendations.

Table 1 summarizes the 2023 Permit limits for TSS, total lead, total copper, total mercury, total aluminum, and dioxins at NPDES outfalls. The Permit limits do not apply to effluent discharges from the Outfall 009 distributed stormwater controls themselves (since they are not located at compliance monitoring outfalls); however, the Permit limits are used as a reference for evaluating performance of existing

[1] Copper is not included as a COPC for the Outfall 009 watershed in the 2015 Work Plan. However, data for total copper are retained for the paired line plots.

stormwater controls in the SSFL watersheds. There is not a TSS Permit limit for stormwater discharges at any outfalls, as the TSS Permit limits shown in Table 1 apply to dry weather samples only. However, TSS is often used as a surrogate for particulate-associated COPCs, as well as for computing particulate strengths of other COPCs.

Table 1. COPC NPDES Permit Limits by Outfall

Outfall	2023 NPDES Permit Limit					
	TSS (mg/L)[1]	Total Lead (µg/L)	Total Copper (µg/L)	Dioxins (µg/L)	Total Mercury (µg/L)	Total Aluminum (µg/L)
001	45	5.2	67.5	2.80 x 10-8	0.1	1,000
002	45	5.2	67.5	2.80 x 10-8	0.1	1,000
003	-	5.2	31	2.80 x 10-8	0.024	1,000
004	-	5.2	31	2.80 x 10-8	0.024	1,000
005	-	5.2	31	2.80 x 10-8	0.024	1,000
006	-	5.2	31	2.80 x 10-8	0.024	1,000
007	-	5.2	31	2.80 x 10-8	0.024	1,000
008	-	5.2	67.5	2.80 x 10-8	0.024	1,000
009	-	5.2	31	2.80 x 10-8	0.024	1,000
010	-	5.2	31	2.80 x 10-8	0.024	1,000
011	45	5.2	67.5	2.80 x 10-8	0.1	1,000
018	45	5.2	67.5	2.80 x 10-8	0.1	1,000

[1] TSS limit applies to dry weather samples only. There is no NPDES Permit limit for TSS in wet weather.

Long-term average annual rainfall at SSFL from 1958/59 through 2025/26 is 17.8 inches[2]. A total of 27.81 inches of precipitation was recorded in 2025/26, which is greater than the annual rainfall for 85% of the period of record. In 2025/26, the B-1 Media Filter, Upper Lot Media Filter, Southern Detention Bioswale, ELV Treatment Control, CM-9, and CM-1 stormwater controls were sampled in the Outfall 009 Watershed; samples were also collected at the SWTSs at Outfalls 011 and 018. The stormwater controls were visually inspected for maintenance needs following most significant rain events. A rain event is defined by the 2015 and 2023 Permit as at least 0.1 inches of rainfall in 24 hours preceded by at least 72 hours of dry weather. Table 2 summarizes rain events from the 2025/26 reporting year. Non-qualifying rain events describe rainfall that did not meet the "rain event" definition. Rows shaded gray in Table 2 indicate rain events without a complete pair of influent and effluent samples, often dictated by a lack of sampleable

[2] Historical rainfall records covering 1958/59 – 2000/01 from the Simi Hills-Rocketdyne Laboratory gauge (Ventura County Watershed Protection District, site 249) (rainfall data were not available from 1977/1978 through 1984/1985) and 2001/02 – 2025/26 from the Area 4 gage were combined and referenced to assess average annual rainfall over the 60-year period of record (POR).

flow into or out of the stormwater control or due to the reduction in sampling following the 2016/17 reporting year[3].

In the 2025/26 reporting year, there were two rain events with 24-hr rainfall totals that exceeded the Expert Panel SSFL design storm (Santa Susana Surface Water Expert Panel and Geosyntec Consultants, 2008)[4], from 11/13/2025 to 11/21/2025, and on 12/23/2025. These rain events had a maximum 24-hour rainfall total of 3.49, and 5.14 inches, respectively. For reference, the 100-year, 24-hour storm is 7.76 inches, the 10-year, 24-hour storm is 5.14 inches, and the 2-year, 24-hour storm is 3.33 inches. Table 2 indicates rain events where overflow, or bypass, conditions occurred at one or more of the stormwater control, indicating that stormwater runoff was not fully treated by a stormwater control, which typically occurs when a rain event exceeds the stormwater control design storm.

Table 2. Sample Collection Event Rainfall Data Summary
(gray rows indicate dates without complete paired samples)

Date(s)	Average Intensity (in/hr)	Max 1- hr Intensity (in/hr)	Event Total (in)	Event Duration (hrs)	Cumulative Rainfall - Qualifying Events (in)	Stormwater Controls Where Overflow Occurred	Number of Stormwater Control Samples[1]
9/18/2025-9/18/2025	0.03	0.06	0.15	5	0.15	N/A[3]	0
10/14/2025-10/15/2025	0.11	0.40	1.93	33	2.08	Lower Lot Low Flow Diversion to Biofilter (LFD)	4
11/13/2025-11/21/2025	0.09	0.50	7.64	180	9.72	Lower Lot LFD	8
12/23/2025-12/27/2025	0.13	0.75	8.42	87	18.14	CM-9, Lower Lot LFD, Upper Lot, CM-8, CM-11, CM-4, CM-3, CM-10, CM-2, CM-1[4], Outfall 011 SWTS[4], Outfall 018 SWTS[4]	11
12/31/2025-1/6/2026	0.06	0.33	3.32	137	21.46	CM-5, CM-3, Lower Lot LFD	0
2/10/2026-2/11/2026	0.12	0.28	0.82	14	22.28	None	2
2/16/2026-2/19/2026	0.11	0.59	4.35	80	26.63	Lower Lot LFD	9
3/31/2026-4/1/2026	0.10	0.22	0.59	6	27.22	N/A[3]	1
4/12/2026-4/12/2026	0.04	0.06	0.27	2	27.49	N/A[3]	0
4/21/2026-4/21/2026	0.03	0.07	0.2	4	27.69	N/A[3]	0
Non-qualifying rain event total[2]			0.12			N/A[3]	0
2025/26 Total			**27.81**				**35**

[1] Number of Stormwater Control samples include influent and effluent, background and non-background. Influent samples are presented as weighted average composite samples when multiple influent sample results are available. Therefore, the sample count is assumed to be one in these cases.
[2] Rainfall was observed but did not meet the NPDES definition for a rain event.
[3] No inspection was conducted.
[4] Stormwater control was sampled during overflow.

[3] Starting in 2017/18, sampling frequency was reduced to twice annually at the following locations: the Upper Lot Media Filter, Southern Detention Bioswale, Lower Lot Biofilter, CM-1 (both influent-west and effluent), and the ELV Treatment Control.
[4] The design storm is not applicable to the CMs, B-1 Media Filter, and Upper Lot Media Filter, as they were constructed based on the available area and topography and are therefore generally under-sized compared to the design storm.

1.1 Stormwater Treatment Controls

Performance assessments of stormwater treatment controls at the SSFL site were conducted through collection and analysis of water quality sample data and are presented in the following sections. Table 3 summarizes evaluated stormwater controls as well as their characteristics and components. Monitoring data analyzed in performance evaluations of the stormwater controls are described in Section 3.

Culvert Modifications (CMs) and Other Media Filters. Culverts that convey stormwater under roadways were modified by installing headboards and removable weir boards in front of the upstream culvert inlet. Stormwater entering the treatment control is blocked from flowing directly through the culverts by the weir boards, forcing the stormwater through filter media beds for treatment before exiting through perforated pipe laterals and flowing into the existing culvert. Excess water overtops the weir boards, bypassing the media treatment, during periods of large flow rates. The CMs were installed as provisional sedimentation and filtration stormwater control measures to be continually evaluated for pollutant reduction capabilities and capture performance. The six CMs analyzed are comprised of media filters and HDPE linings laid above existing, galvanized[5] corrugated metal pipes. The B-1 Media Filter consists of a media bed without a slip-liner. In addition to evaluating stormwater control performance, monitoring data have been used to evaluate potential stormwater control enhancements that could improve treatment performance and to assess their effectiveness once implemented.

- **CM-1** was installed and initially sampled in 2009/10. Improvements at the CM include 2011/12 addition of filter fabric over the weir board for enhanced flow control and 2017/18 construction of an inlet for runoff from the adjacent roadway area. CM-1 was reconstructed and outfitted with new treatment media in August 2018. Sampling of the newly reconstructed CM and road runoff inlet began in 2018/19.
- **CM-3** was installed and initially sampled in 2009/10. Performance monitoring data used in these analyses were first collected in 2016/17. An inlet allowing the CM to receive runoff from an adjacent roadway was constructed in May 2017, and sampling of the influent road runoff began in 2016/17. In 2019/20, CM-3 was rebuilt with a modified configuration, upstream check dams were installed, and the first paired influent and effluent samples were collected at the newly reconstructed CM.
- **CM-9** was installed and initially sampled in 2009/10. Improvements were made in 2011/12, including the September 2011 removal of Area I Landfill (A1LF) asphalt upstream and the January 2012 addition of filter fabric over the weir board, among other improvements.
- The **B-1 Media Filter** was installed and first sampled in 2011/12. Curb cut improvements were implemented at the media filter in November 2012. Media filter reconstruction was carried out in January 2026.
- The **Upper Lot Media Filter** was installed and initially sampled in 2016/17.

[5] Galvanization of the metal does not present a water quality concern as zinc is not a COPC at the Site.

- **CM-8** and **CM-11** receive runoff from areas without history of industrial activities or known soil contamination, which are therefore considered to be similar to the background conditions at the SSFL site. Both CMs were installed and first sampled in 2009/10.

Lower Lot Biofilter. The stormwater detention and biofiltration control was installed and first sampled in 2013/14. It includes a sedimentation basin for pretreatment upstream of a biofiltration media bed. The Lower Lot Biofilter receives flow from the lower parking lot, making up roughly 40% of the total tributary area to the biofilter, and the drainage area to the 24-inch storm drain that enters a cistern in the lower lot upstream of the biofilter. The storm drain collects runoff from areas near the administrative building, natural hillsides, and effluent flows from the Southern Detention Bioswales and Boeing administrative area inlet filter.

Detention Bioswales. The Northern and Southern B1436[6] Detention Bioswales were installed upstream of the Lower Lot Biofilter in December 2014 to capture and slowly release flows downstream to the Lower Lot Biofilter. Treatment occurs in the bioswales, although the primary purpose was to slow the influent runoff to the Lower Lot Biofilter and reduce flows that bypass the Lower Lot Biofilter during large storm events. Initial performance monitoring was conducted at the Northern Detention Bioswale in 2014/15 and at the Southern Detention Bioswale in 2015/16. The change in total volume of runoff captured after implementation of the Detention Bioswales was estimated by simulating the period from implementation on November 1, 2014, through April 1, 2019, using the site-wide calibrated Stormwater Management Model (SWMM), both with and without the bioswales. Model results indicated installation of the bioswales provided a 24% increase in biofilter capture of runoff volumes, from 59% to 73%. Considering runoff from only the lower parking lot priority treatment area, results indicated an 8% increase in runoff volume captured, from 80% to 88%, over the same period.

ELV Treatment Control. The stormwater detention and filtration ELV Treatment Control was installed by NASA and initially monitored in 2013/14. The drainage storage layer and filtration media of the treatment control were re-worked in Summer 2021 to reduce apparent media washout during stormwater treatment. New, clean gravel was installed at the bottom of the tank, a layer of pea gravel was added above the larger gravel, and the existing media was placed back on top of the pea gravel (i.e., the treatment media itself was not replaced). Following the reconstruction, the system was flushed with potable water to reduce potential washout of fines within the system. Continued performance monitoring of the rebuilt stormwater treatment control was conducted starting in 2021/22.

Active Stormwater Treatment Systems (SWTSs). Outfalls 011 and 018 have had active SWTSs since 2012 to augment the storage and sedimentation provided by existing ponds. The SWTSs provide advanced stormwater treatment using a treatment train consisting of a screen filter, flocculation, oxidation, ActiFlo coagulation, buffering, sand and bag filters. Stormwater ponds upstream of the SWTs provided flow equalization and sedimentation pretreatment.

[6] B1436 refers to a former building at this location that was demolished by Boeing in its effort to remove man-made structures at SSFL.

Stormwater in the Perimeter Pond near Outfall 011 is pumped to the R-1 Pond for flow equalization, settling and evaporation. When the storage of the pond nears capacity, stormwater in the pond is treated using the advanced SWTS. The SWTS at Outfall 011 has experienced lapses in operation in its lifetime, most recently due to damage from the Woolsey Fire; however, it was repaired in late 2019 and operational again prior to the first storm event in 2019/20.

Stormwater is pumped from Outfalls 003, 004, 005, 006, 007, 009 helipad, and 010 to Silvernale Pond before being treated by the Outfall 018 SWTS alongside stormwater from the Outfall 018 Watershed. Local storage volumes and pumping rates vary for each outfall capture and diversion system but for the most part they are all believed to exceed the Expert Panel's site-specific design storm based on past performance. There have only been five discharges at Outfall 004, seven discharges at Outfall 006, and four discharges at Outfall 010, and none at Outfall 003, 005, and 007 since the pumps and conveyance lines were installed in 2010/11 (there were no discharges at Outfalls 003, 005, 006, 007, and 010 and one discharge at Outfall 004 during this reporting year, as flows from these small drainage areas were pumped to the Silvernale pond for treatment at the Outfall 018 SWTS).

Table 3. Summary of Stormwater Control Features

Stormwater Control Characteristic	Stormwater Control						
	CM Sites	B-1 Media Filter	Upper Lot Media Filter	Lower Lot Biofilter	ELV Treatment Control	Detention Bioswales	SWTSs
Media filtration[1]	x	x	x	x	x		
Subsurface storage						x	
Sedimentation pretreatment	x	x		x	x	x	x
Outlet flow controls				x	x	x	
Vegetation				x		x	
Vertical flow regime		x	x	x	x	x	
Horizontal flow regime	x	x					
Active treatment (e.g., chemical addition, enhanced settling, pressurized vessels)							x

[1] Using a custom treatment medium for SSFL stormwater controls consisting of sand, zeolite, and granulated activated carbon (GAC).

The aforementioned stormwater controls are discussed herein; however, it should be noted that other stormwater control activities have been conducted at SSFL that are not discussed herein but also affect the quality of stormwater runoff. These other activities include but are not limited to channel stabilization measures in the Northern Drainage channel, interim soil removal actions, building/parking lot removal, erosion and sediment control, and site revegetation.

1.2 Stormwater Control Evaluation Sampling

Concentrations of influent and effluent grab samples collected at evaluated stormwater controls were compared against each other to determine pollutant concentration reductions achieved by the treatment measures. Although split samples were periodically collected and used for quality assurance/quality control (QA/QC) purposes, only primary samples were included in these performance analyses.

Stormwater control performance sampling was reduced following the 2016/17 reporting year given the completion of building demolition and revegetation in the Outfall 009 watershed. Also, available data from previous sampling efforts were sufficient to statistically calculate the performance of the stormwater controls already in operation for a number of years. Starting in 2017/18, sampling was reduced to two storm events per year at the Upper Lot Media Filter, Southern Detention Bioswale, Lower Lot Biofilter, CM-1 (influent-west and effluent sample points), and the ELV Treatment Control, as a check of continued performance with time and to track maintenance needs. Monitoring was discontinued at the Boeing Administrative Area Inlet Filter following the 2021/22 reporting year due to its poor COPC removal.

In addition to evaluating stormwater control performance, the monitoring data have also been used in the site selection evaluations for consideration for enhancements to selected control measures for improved performance in areas where the effluent remains problematic. This was the case at CM-9 where upgradient improvements were added in 2013 based on historical data. Other examples of improvements include asphalt removal in the upper drainage area and filter fabric installation over the weir boards. Separate graphs are shown for sample results that occurred before and after the improvements were made at the affected locations.

The following subsections describe sampling locations for the stormwater controls. Tributary areas (i.e., drainage areas) contributing surface runoff to stormwater controls are characterized by sampling at an influent monitoring location. Some stormwater controls are characterized by multiple influent drainage areas, as described in the subsections below. In these cases, a single, flow-weighted influent concentration was calculated from each measured influent concentration for each rain event, flow-weighted according to drainage area size and imperviousness.

CMs and Other Media Filters. Influent grab samples taken at CMs are collected from flowing surface water upstream of the maximum ponding extent observed at the CM. Since October 2011, effluent grab samples at CM-1, CM-9, CM-3, and the B-1 Media Filter have been collected from the underdrain outlet rather than from the culvert outlet. Effluent grab samples at CMs, including CM-8 and CM-11, were previously collected at downstream culvert outlets where culvert pipes discharge to the Northern Drainage. Flows from the culvert outlets may include both treated and partially treated runoff, where partially treated runoff still receives some sedimentation treatment from the upstream ponded storage area. **Two pairs of influent and effluent samples were collected at each of the CM-1 and CM-9 locations during the 2025/26 reporting year, for a total of four pairs. One influent sample was mistakenly collected from the paved road below CM-9, at a location which does not contribute runoff to CM-9. Therefore, this sample is not included in the analyses or sample pair counts.**

Initial samples collected at the B-1 Media Filter in 2012/13 indicated possible media washout as the stormwater control was becoming operational and therefore were not included in the performance analyses. Subsequent quantitative assessments of data collected at the B-1 Media Filter from 2013/14 through 2015/16 indicated effective treatment performance with sufficient samples, such that sampling at the stormwater control could be subsequently discontinued. **However, the B-1 Media Filter was reconstructed in January 2026; therefore, one pair of influent and effluent samples was collected during the 2025/26 reporting year after the filter media replacement was completed.**

CMs and other media filters with multiple influent drainage areas and monitoring locations are described below.

- **CM-1** receives runoff from an eastern tributary comprised of largely undeveloped hillsides and part of the now-demolished Building 212 site, a western tributary comprised of paved roadway and a hillside previously utilized for ELV activity, and another area mainly comprised of road runoff.
- **CM-3** receives runoff from undeveloped hillsides and a clean soil borrow area at the top of the watershed, south of the adjacent roadway. After the addition of a road runoff inlet in May 2017, CM-3 also receives runoff from a portion of roadway.
- **CM-9** receives runoff from a paved roadway to the east known as Area II Road, as well as from A1LF and the parking lot of former Building 1324, which was demolished late Summer 2011.
- The **B-1 Media Filter** receives runoff from a northern drainage area of paved roadway and a southern drainage area that includes upper B-1 Interim Source Removal Action (ISRA) areas, road runoff, and effluent from the sedimentation basin.
- The **Upper Lot Media Filter** receives runoff predominantly from undeveloped hillsides to the southeast and a parking lot to the south.

Performance data collected at background locations CM-8 and CM-11 were evaluated separately from other CMs and media filters to quantify background COPC concentrations and to assess CM performance for lower COPC concentrations in background, non-industrial runoff. Comprehensive evaluations of background conditions were conducted on sample data collected at CM-8 and CM-11 through 2010/11, resulting in sufficient data such that sampling at the CMs could be discontinued. Prior to 2019/20, the eastern tributary area to CM-1 was considered reflective of background conditions. However, further site assessments indicated that it was less representative of background conditions than the drainage areas above CM-8 and CM-11; therefore, influent data collected from the CM-1 eastern tributary area were evaluated in non-background analyses starting in 2020/21.

As slip-lined HDPE pipes at CM-3 were inserted from both influent and effluent sides, they could not be sealed where they joined under the roadway. Intermittent discharge from the HDPE pipe outlet was observed between February 2010 and March 2011 without influent runoff flowing into the CM, indicating subsurface interflow contributing to the effluent discharge. Sampling at the CM was temporarily discontinued after 2010/11 and was resumed in 2016/17, after the road runoff inlet was constructed to address the subsurface interflows. CM-3 samples collected prior to 2016/17 were not retained for performance analyses. Sampling to characterize influent runoff from an adjacent roadway area began in 2016/17 following the addition of a road runoff inlet to the CM in the second quarter of 2017.

Lower Lot Biofilter. Sampling, which began in 2012/13, at the Lower Lot Biofilter includes influent, mid-point, and effluent samples, collected from the cistern discharge pipeline, the sediment basin outlet, and the biofilter effluent pipe, respectively. **No samples were collected during the 2025/26 reporting year due to staff prioritizing sampling of locations that were required by the Permit (whereas the treatment control monitoring is voluntary*).***

Performance evaluations include influent and effluent samples from a storm event in early 2014 where the post-biofilter effluent samples represented a blend of treated, filtered underdrain water and biofilter overflow, in addition to a storm event in 2014/15 with unusually turbid samples (in both the influent and effluent). The observed high turbidity values may have resulted from the Building 1436 area contributing sediments to stormwater runoff as the building was removed and before the site was fully stabilized. Samples were not collected at the biofilter midpoint during 2013/14, as the sample location was submerged and inaccessible. In the spring of 2023, the Lower Lot began being used for soil stockpiling for the Former Shooting Range Imminent and Substantial Endangerment (ISE) cleanup project, so the intermediate and effluent sampling locations were inaccessible. Therefore, during 2023/24, only influent samples were able to be collected from the Lower Lot Biofilter. In 2024/2025, the effluent samples were accidentally collected in a different location, which is representative of the sediment basin outlet instead of the biofilter outlet, so those results are classified as from an additional midpoint (sediment basin outlet) sample location.

Detention Bioswales. The bioswales provide stormwater storage and pretreatment, reducing peak flows and promoting flow equalization to increase the volume of runoff treated by the Lower Lot Biofilter. The bioswales also provide partial removal of stormwater particulates by filtration through the sand media. There are three sampling locations along the Southern Detention Bioswale, including two representing influent and one representing effluent. Influent samples are collected from the outlet of the upstream rock crib swale and the inlet for runoff from the adjacent contractor laydown area, and effluent samples are collected from the underdrain. COPC concentrations observed at the two influent sample points are flow-weighted based on size and imperviousness of the corresponding drainage area to estimate single representative influent concentrations to the bioswale. **Paired influent and effluent performance samples were collected at the Southern Detention Bioswale during two rain events in 2025/26.**

Paired influent and effluent samples were collected at the Northern Detention Bioswale from a curb cut along the eastern side of the bioswale and from the underdrain, respectively, in 2015/16 and 2016/17. Sampling at the Northern Detention Bioswale was subsequently discontinued because it was determined that data from the Southern Detention Bioswale was sufficient to assess the performance of both Detention Bioswales.

ELV Treatment Control. Sampling at the ELV Treatment Control includes locations representing influent, midpoint, and effluent stormwater. The samples are collected from the influent pipe, combined flow from the eastern and western sample ports between the settling tanks and media filter, and the effluent pipe, respectively. **Two pairs of samples were collected during 2025/26, which included influent and effluent locations in addition to the midpoint location.**

Sample data collected during the initial storm events treated by the treatment control in 2013/14 indicated fine media flushing as the control became operational. Two separate power outages also occurred during the operation of the ELV Treatment Control. During a large storm event from the end of February through early March 2014, a storm drain plug under Helipad Road diverted excess roadway runoff to the ELV sump and treatment system. Erosion controls in the upstream earthen channel were overwhelmed by the storm event, and large inflows to the control caused a failure of the sump pump resulting in a power outage.

Performance monitoring could not be conducted at the ELV Treatment Control for the remainder of 2018/19 after the November 2018 Woolsey Fire caused a power outage. A generator was installed by NASA to prevent future outages, and the control was operational again in 2019/20. Drainage layers and filter media of the ELV Treatment Control were rebuilt in Summer 2021, as described in Section 1.1, after previously collected data indicated likely media fines being exported through the underdrain. This was confirmed by a decrease in dioxins particulate strength in the treated stormwater before and after the media layer implying a dilution effect of the contaminated fine particulates by fine media material.

SWTSs. Samples collected from the stormwater ponds as the water is pumped to the SWTSs represent influent to the SWTSs Outfalls 011 and 018 are close to the SWTSs and are considered representative of the SWTS effluent. **Two influent and effluent sample pairs from the Outfall 011 SWTS, and four sample pairs from the Outfall 018 SWTS, were collected during the 2025/26 reporting year.**

SWTS influent samples are collected either once per discharge or once per year depending on the constituent, in accordance with the NPDES Permit. Outfalls 011 and 018, considered representative of SWTS effluent, are sampled during every discharge event according to the NPDES Permit.

1.3 Stormwater Control Drainage Areas

Table 4 lists stormwater controls included in the performance analysis as well as descriptions of their respective drainage areas, including approximate percentages of impervious cover (characterized by exposed rock, roadways, and buildings). The overall SSFL site includes numerous other areas managed by controls that vary in type from asphalt removal and erosion control BMPs to CMs and additional types of treatment controls.

Table 4. Stormwater Control Sites and Drainage Areas

Stormwater Control	Drainage Area (acres)	Approximate Imperviousness
CM-1	52.8 (pre-ELV improvements)	6.5%
	43.5 (post-ELV improvements)	6.8%
CM-3	17.2	6.5%
CM-8[1]	2.6	12%
CM-9	10.2	48%
CM-11[1]	5.7	26%
B-1 Media Filter	8.6	23%
ELV Treatment Control	15.6 (Helipad plug in place)	26%
	6.6 (Helipad plug removed)	37%
Lower Lot Biofilter	29.9[2]	53%
Northern Detention Bioswale	2.6	50%
Southern Detention Bioswale	15.6	50%
Upper Lot Media Filter	5.1	35%
Outfall 011 SWTS	303	10%
Outfall 018 SWTS	586	20%

[1] CM-8 and CM-11 receive runoff from undeveloped areas with no history of industrial activities or soil contamination; therefore, stormwater quality influent is considered to be reflective of natural background conditions at the SSFL site.

[2] Comprised of an 11.7-acre drainage area to the lower parking lot and an 18.2-acre drainage area to a diversion weir in the 24-inch storm drain upstream of the Lower Lot Biofilter.

1.4 Summary of Stormwater Control Sizing

Pitt, et al. (2022) evaluated the long-term performance of the distributed stormwater controls at SSFL. As the relative footprint of the treatment media area compared to the drainage area increases, greater fractions of the annual stormwater flows are fully treated (compared to small treatment media areas). Figure 1 compares these treatment media/drainage area ratio values for the stormwater controls examined (except for the ELV Treatment Control, which is more efficient with a smaller footprint) to the average portion of the stormwater flows treated by the stormwater controls, as determined by Storm Water Management Model (SWMM) modeling[7]. Media footprints of about 0.1% of the drainage area resulted in approximately half (or less) of the annual flows being fully treated, while about 0.7% was needed to provide treatment of about 70% of the annual flows, and greater than 1% was necessary to fully treat about 90% of the annual flows. The excess flows bypassed the media treatment with no, or partial treatment by the pretreatment sedimentation processes.

CM-1, the first media treatment system rebuilt due to clogging, has a media treatment area to drainage area ratio of only approximately 0.003%, the smallest of the site controls. The culvert modifications were installed early in the process in 2009 and 2010 before data were collected and analyzed, as these could be installed quickly and at relatively low cost. They were sized based on the available area at the culvert road crossings, with the understanding that they were treating larger drainage areas than desired for optimal performance. CM-9 has undergone several phases of enhancements, and CM-1 was recently rebuilt. The Detention Bioswales have the largest relative footprints compared to their drainage areas and have been shown to be more consistently effective than the other controls.

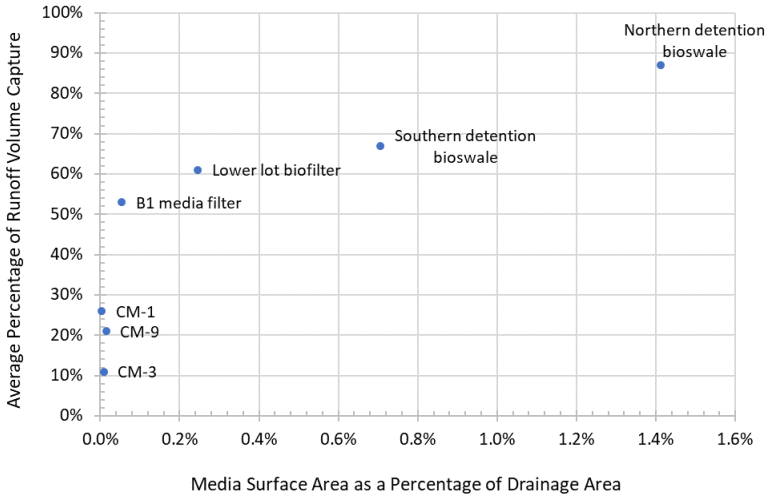


Figure 1: Percentage of Annual Flows Treated vs. Media Surface as a Percentage of Drainage Area for SSFL Distributed Control Locations

Note: the Detention Bioswales do not contain a treatment media mixture, so the media surface area for the Detention Bioswales here is characterized as the (bottom) ponding area of the bioswales.

[7] For determination of the runoff volumes treated in an average rainfall year, historical rainfall data were used to model the 2009/10 through 2021/22 rainy seasons.

2. Overview of Stormwater Control Performance & Maintenance Analyses

Data from the performance sampling program allows for evaluation of the effectiveness of the stormwater controls in reducing concentrations of COPCs in stormwater runoff and also assessment of stormwater control operation and maintenance needs. Section 2 generally describes the analyses performed on the available performance data and observations, while Section 3 presents results of the performance analyses for each control, and Section 4 presents findings of the stormwater control maintenance assessment.

2.1 Box Plots

Box plots illustrate the ranges and basic statistics of observed influent and effluent COPC concentrations at the stormwater controls. Figure 2 is an example of a box plot identifying the median, interquartile range (IQR) from the 25th-percentile to 75th-percentile value, and the 1.5x quartile value of the dataset; higher and lower levels beyond the 1.5x quartile values are plotted as circles.

Influent and effluent data for a given stormwater control are plotted adjacent to each other, and the extents of the overlap of the influent and effluent boxes of a given stormwater control visually indicate the difference in observed influent and effluent concentrations (statistical tests, described in Section 2.2, calculate the significance of the differences). Boxes representing paired influent and effluent data without any, or with very little, overlap indicate very effective stormwater control performance, while influent and effluent datasets producing boxes with a substantive overlap indicate smaller, if any, differences in observed influent and effluent concentrations (i.e., less robust stormwater control performance). Small to moderate size paired datasets are generally assumed statistically different when a median value of one data set lies outside the IQR of the other data set. Larger paired datasets may exhibit statistically significant differences even with some overlap between resulting influent and effluent boxes.

If influent concentrations are low, the differences between the influent and effluent concentrations may not be as significant (i.e., smaller percentage reductions) as when the influent concentrations are high. Effluent concentrations that are low and consistently below the numeric effluent limits or benchmarks (although not applicable at internal stormwater control locations) are the best indicator of desired treatment performance, especially when influent concentrations may be higher than the limits. The box plots allow this behavior to be observed and is further discussed during additional evaluations herein.

Box plots, as well as statistical analyses, were developed using only paired sample datasets consisting of an equal number of influent and effluent samples per stormwater control. Sample results that were not detected, or when the detection limits were greater than the 2023 Permit limits, were excluded from the analyses. Samples collected at the treatment stormwater controls during bypass or overflow conditions were also excluded. Multiple stormwater control box plots are presented in Section 2.1, by COPC.

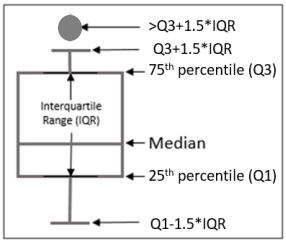


Figure 2. Box Plot Example (*not to scale*)

2.2 Statistical Analyses

Statistical evaluations of the paired data over the 2009-2026[8] sampling period for the SSFL stormwater controls were performed using the non-parametric, one-tailed, binomial sign test. The sign test assesses whether the difference in the number of sample pairs showing a decrease in concentration from the influent to the effluent, compared to sample pairs with an increase in concentration, is statistically significant. The null hypothesis suggests that the median of the difference between paired influent and effluent samples is zero (for the number of paired data available), or in other words, the number of data pairs showing an increase in concentration from the influent to effluent equals the number of data pairs showing a decrease in concentration from the influent to effluent. The test was executed based on a selected alpha value, α, in this case 0.05, the traditional critical value indicating 95% level of confidence. The null hypothesis is rejected, with a 95% or greater confidence level, by a p-value of 0.05 or less, indicating a statistically significant difference in the number of data pairs that show a decrease, compared to an increase, in concentration from the influent to the effluent. The p-values of two-tailed binomial sign tests were divided by 2 to determine the corresponding one-tailed p-values indicating the significance of decreases in concentration with stormwater treatment.

A p-value greater than 0.05 indicates that the null hypothesis cannot be rejected, and the difference in the numbers of pairs showing an increase, compared to a decrease in concentration, is not statistically significant, based on the number of sample pairs available. This conclusion could be due to a lack of sample pairs with reduced concentrations. Additionally, because the total number of sample pairs used to calculate p-values excludes pairs with equal influent and effluent concentrations, which occurs most often in the case of non-detect (ND) results at both the influent and effluent, the conclusion could also be due to an insufficient number of non-equal sample pairs to be able to reject the null hypothesis. Results of the statistical analyses are presented in Section 3.2, by stormwater control.

2.3 Comparison to Permit Limits

The stormwater controls were installed for purposes of reducing COPC concentrations in stormwater prior to discharge at the NPDES Permit compliance points. The passive dispersed stormwater controls within

[8] Paired samples taken during bypass or overflow events were not included in statistical analyses, nor did the analyses consider copper data, as copper is not listed as a pollutant of concern in the 2015 Work Plan. Sample pairs were generally not sampled for mercury and aluminum until the 2022/23 reporting year. Therefore, not all statistical summaries include data for mercury and aluminum.

the Outfall 009 watershed have been observed to often achieve concentration reductions resulting in effluent concentrations below respective Permit limits at Outfall 009, although not designed to meet the limits individually, as Outfall 009 Permit limits are not applicable to effluent discharges from the passive treatment controls, themselves. However, to evaluate stormwater control effectiveness as it relates to the Outfall 009 Permit limits, the percentage of influent and effluent concentrations observed in excess of Outfall 009 Permit limits at non-background CMs and other media filters (CM-1, CM-3 post-2016/17, CM-9, B-1 Media Filter, and the Upper Lot Media Filter), ELV Treatment Control, the Lower Lot Biofilter, and Northern and Southern Detention Bioswales, were determined. Influent and effluent concentrations for the Outfall 011 and Outfall 018 SWTSs are compared to their respective outfall Permit limits. The maximum and average excess ratios are also calculated as part of this analysis, and they represent the maximum and average ratios of observed concentrations in excess of the applicable Permit limit.

The Permit limits for each analyte and outfall are presented in Table 1. Permit limits for dioxins and lead did not change in the 2023 Permit compared to the 2015 Permit. Aluminum did not have a Permit limit in the 2015 Permit; however, a limit of 1,000 µg/L was added in the 2023 Permit for aluminum. The Permit limit for mercury was 0.13 µg/L for Outfall 009 in the 2015 Permit, which was reduced to 0.024 µg/L in the 2023 Permit; however, it did not change from 0.1 µg/L for Outfalls 011 and 018. TSS does not have a Permit limit for Outfall 009, but both the 2015 and 2023 Permits include a limit of 45 mg/L for Outfalls 011 and 018 (applies to dry weather samples only).

The comparison to Permit limits utilizes data collected at influent and effluent sample points, regardless of whether they are individual or paired samples; therefore, some analyses include more influent samples than effluent or vice versa. This analysis only includes influent and effluent samples; samples collected at stormwater control midpoint locations are not included in this analysis. Sample results that were not detected and the detection limit was greater than the applicable Permit limits were also excluded from the analysis. Unlike the box plots and statistical analyses, samples collected at the stormwater controls during bypass or overflow conditions were included in this comparison to Permit limits. The comparison to Permit limits is presented in Section 3.2, by stormwater control.

2.4 Paired Line Plots

Log-scale paired line plots illustrate changes in measured concentrations between influent and effluent sample pairs at stormwater controls. Individual paired samples are represented by an influent and an effluent point connected by a single line, while individual values without corresponding influent or effluent values are shown as single points. Points and lines are shaded based on the sampling year during which they were collected, where black lines and points represent data from the most recent 2025/26 reporting year and data from all previous reporting years are shown in gray. Distinct influent and effluent sample locations are represented by various symbols, as presented in the legends. Samples that have been collected at the stormwater treatment controls during bypass or overflow conditions are denoted by red markers. Typical detection limits[9] are represented by the black dotted lines, while non-detect (ND)

[9] Laboratory detection limits of COPCs may vary slightly from year to year.

results are plotted at the given detection limit. Sample results that were not detected and with detection limits greater than the 2023 Permit limits were excluded from the analyses.

Paired line plots serve primarily as visual aids for understanding recent and past treatment control performance consistency; while results of statistical tests were utilized as the basis for quantitative stormwater control performance evaluations. Though not applicable to effluent discharges from the passive stormwater controls within the Outfall 009 watershed, Outfall 009 Permit limits[10] are plotted as red dotted lines for the dioxins, lead, copper, mercury, and aluminum paired line plots as references. The Outfall 011 and 018 Permit limits[11] are plotted for comparison with performance data from the Outfall 011 and 018 SWTSs, respectively.

Stormwater control effectiveness during events having influent concentrations above the outfall Permit limits is used as the most important performance criterion since any influent values below the Permit limit are already of acceptable quality (and are generally considered to be at levels unlikely to be further reduced using typical stormwater controls). The most substantial influent-to-effluent percentage reductions of COPCs in stormwater have been observed when influent concentrations to the stormwater controls are elevated compared to low influent concentrations.

Stormwater quality can fluctuate greatly during storms and grab sample results represent concentrations at a single point in time during the rain event. Therefore, relatively large numbers of samples collected over many storm events are expected to best represent varying conditions with reasonable statistical confidence and power. Paired line plots illustrate variability of influent and effluent COPC concentrations observed at stormwater controls. The paired line plots are presented in Section 3.2, by stormwater control[12].

2.5 Stormwater Control Maintenance Analyses

The potential need for maintenance of the passive stormwater controls was assessed through several methods. First, the cumulative sediment loading to the passive stormwater controls was estimated and compared to the sediment loading at which filter media maintenance is needed, as estimated by lab studies. Additionally, the empty bed volumes (EBVs) treated by each passive stormwater control, since installation or reconstruction, were estimated, which can serve as another helpful tool in predicting media maintenance. Most importantly, observations of the function and performance of the passive stormwater control during and following rain events (such as extended periods of ponded water) were also used to determine stormwater control maintenance needs. The stormwater control maintenance analyses are presented in Sections 4.1 through 4.3, with conclusions presented in Section 4.4.

[10] TSS plots have no red lines plotted, due to not having TSS Permit Limits within the Outfall 009 watershed.
[11] There are no red dotted lines plotted for a Permit Limit for the Outfall 011 and 018 SWTSs. There is a Permit Limit for TSS for these outfalls; however, it is only applicable to dry weather samples (i.e., there is no TSS Permit Limit in wet weather).
[12] Copper plots are included although copper is not listed as a pollutant of concern in the 2015 Work Plan.

2.5.1 Cumulative TSS Loading

The cumulative TSS loads captured to date by media-based passive stormwater control were estimated utilizing historical storm event rain depths, calculated runoff volumes, and measured TSS concentrations. Resulting TSS loads were compared to the cumulative sediment load shown by a lab column study of filter media performance (Pitt and Clark, 2010) to likely obstruct flows through the filter media and increase the potential for bypass flows. Results from the cumulative TSS Loading analysis are presented in Section 4.1.

Prior to 2016/17, passive stormwater controls were assumed to treat stormwater runoff, and therefore experience TSS loading to the media, for each storm event where a sample was collected (at either the influent or effluent location). In light of reduced sampling at the majority of stormwater controls in the Outfall 009 Watershed following 2016/17, a predictive logistic regression model was developed to estimate whether passive stormwater controls had discharged during unsampled storm events. Average storm intensity (inches per hour), maximum storm intensity (inches per hour), total rainfall depth (inches), and antecedent dry period (days) were used to perform predictive assessments for CM-1, CM-9, the ELV Treatment Control, B-1 Media Filter, and the Lower Lot Biofilter. A model could not be developed for the Upper Lot Media Filter as the amount of data needed for input into the model was not available prior to the sampling reduction. The number of observations in "test-and-train" datasets ranged from 21 to 49 observations, depending on how long the stormwater control has been operational and sampled. The resulting classification accuracy, or ratio of correct predictions to total predictions, was 0.86, 0.93, 1.00, 0.82, and 0.82, for CM-1, CM-9, the ELV Treatment Control, B-1 Media Filter, and Lower Lot Biofilter models, respectively.

Cumulative TSS loads captured by filter media were estimated at the passive stormwater control for storm events observed or predicted to have produced discharge from the passive stormwater controls, as follows:

- Average annual percent capture of runoff was estimated by stormwater control using the USEPA Storm Water Management Model (SWMM).
- A volumetric runoff coefficient, Rv, based on characteristics of the drainage area to the stormwater control was estimated using SWMM and simulated over the average annual year scenario.
- Stormwater control drainage areas were delineated in Geographic Information Systems (GIS).
- Estimated runoff volume captured by a given stormwater control was calculated by storm event as:
    - Runoff volume captured = Rainfall Depth x Rv x Drainage Area x Average Annual % Capture
- Estimated TSS load captured by the stormwater control during an individual storm event was calculated as:
    - Storm event TSS load captured = Runoff Volume Captured x TSS concentration retained [Influent-Effluent TSS Concentrations]

- Estimated TSS loads captured by the stormwater control during individual storms were summed to determine the cumulative estimated TSS load captured during all storms where stormwater runoff was treated by the stormwater control, since its implementation or most recent filter media replacement.
- Treatment media surface area was estimated for each stormwater control, and the cumulative TSS load captured per unit media surface area was calculated.

At evaluated passive stormwater controls that include pretreatment, such as the ELV Treatment Control and Lower Lot Biofilter, influent concentrations were represented by stormwater control midpoint samples results taken from the pretreatment effluent before flows enter the treatment media. In storms without a complete paired sample collected at a stormwater control, the unsampled difference in influent or effluent concentration was represented by the average respective concentration difference observed at the stormwater control within three years before or after the given storm.

The cumulative estimated TSS loading per unit media area was compared to the estimated sediment load that the filter media can accommodate (up to 50 kg/m^2) until maintenance or replacement of the media is recommended (Pitt and Clark, 2010).

Based on a 2017 flow monitoring data analysis, estimates of the initial hydraulic conductivities of filter media at CM-1 and CM-9 were near or above 33 inches per hour, the "average flow rate before initial clogging" found by the lab column study (Pitt and Clark, 2010). Initial hydraulic conductivities become reduced substantially over long periods of stormwater control operation, suggesting that filter media maintenance or replacement may benefit continued effective treatment performance of a stormwater control. Since the media mounds of the CMs are covered with backfill and gravel, it is possible that these surface materials are clogged with sediment and the actual media itself may not be the limiting factor. Therefore, the 2017 analysis shows that media may actually be clogged more than results for this analysis indicate.

It is acknowledged that there are large variations in TSS loading rates, in addition to the percentage of sediment loading to the media until maintenance is needed, among the stormwater control. As passive treatment controls were installed wherever feasible within the Outfall 009 watershed, stormwater controls with less media surface area like CMs were at times installed in locations that receive flow from relatively large drainage areas that can contribute to high TSS loading, thus resulting in relatively smaller estimated TSS capture capacities. Such is the case at CM-1 which receives runoff from an approximately 45-acre drainage area, roughly 3 to 4 times the sizes of drainage areas to similar CMs.

2.5.2 Cumulative EBVs Treated

The EBVs treated by each passive stormwater control, since installation or reconstruction, were estimated as another tool to aid in determining when passive stormwater control maintenance may be needed. The runoff volumes treated by each stormwater control in both an average rainfall year, and cumulative since the stormwater controls were built or reconstructed, were estimated using historic rainfall data and SWMM models for the Upper Lot Media Filter, B-1 Media Filter, CM-1, CM-3, CM-8, CM-9, CM-11, the Lower Lot Biofilter, and the ELV Treatment Control (to estimate runoff volume treated by the stormwater controls). The runoff volumes for stormwater controls where SWMM models were not available (CM-2,

CM-4, CM-5, CM-6, CM-7, CM-10, and CM-12) were calculated using estimated average annual percent capture rates based on data from other CMs with substantially similar hydrologic conditions[13]. The volume of treatment media was also estimated for each passive stormwater control, and the EBVs (defined as the volume of treatment media, not accounting for porosity) treated in both an average rainfall year and cumulative since stormwater control installation or reconstruction were then estimated.

Cumulative EBVs provide a useful relative measure of the hydraulic loading and degree of use experienced by each stormwater control; however, available literature does not identify a single number of EBVs at which clogging or chemical breakthrough is expected. Clogging is more directly related to cumulative particulate loading, while chemical breakthrough depends on the constituent-specific sorption or ion-exchange capacity of the treatment media and the associated constituent mass loading. Therefore, cumulative EBVs are considered together with estimated sediment loading, observed hydraulic performance, and influent-to-effluent sample results when evaluating maintenance needs.

2.5.3 Stormwater Control Observations During and After Storm Events

Additional analyses of stormwater control performance observations were continually conducted, considering ponding and whether bypass flows occur to help characterize potential stormwater control clogging and associated maintenance needs. These observations are important for determining maintenance needs for all stormwater controls implemented at SSFL and should be performed consistently. Approximately six post- and during-storm inspections were completed during the 2025/26 reporting year.

[13] For the CMs with available SWMM results (CM-1, CM-3, CM-9, CM-8, and CM-11), the relationship between impervious drainage area per CM filter media surface area versus the modeled average annual percentage of runoff volume captured was examined. There was a linear relationship with a R2 value of 0.86. This relationship was used with the impervious drainage area per filter media surface area for the CMs without available SWMM results to estimate the average annual percentage of runoff volume captured anticipated for those CMs.

3. Stormwater Control Performance Results

Section 3.1 presents box plots comparing the distribution of influent and effluent concentrations for the different stormwater controls, by COPC. Sections 3.2.1 through 3.2.5 present the results of the remaining analyses (i.e., statistical analyses, comparison to Permit limits, and paired line plots), by stormwater control.

3.1 Multiple Stormwater Control Box Plots

Box plots comparing influent and effluent concentrations for the CMs and other media filters (CM-1, CM-3 post-2016/17, CM-9, B-1 Media Filter, and the Upper Lot Media Filter), as well as the Lower Lot Biofilter, ELV Treatment Control, the Northern and Southern Detention Bioswales, and the SWTSs are shown in Figure 3, Figure 4, Figure 5, Figure 6, and Figure 7, respectively, for TSS, dioxins, lead, mercury, and aluminum.

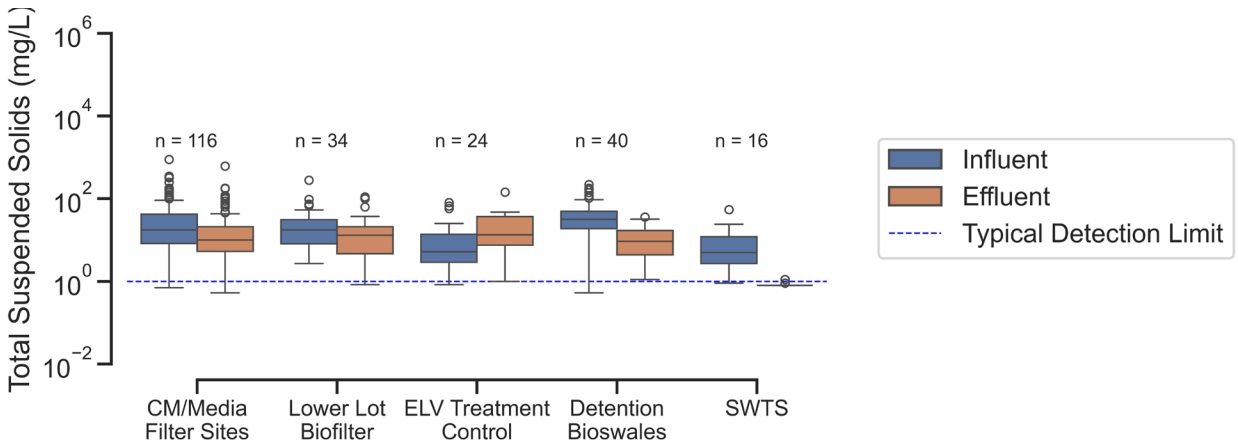
The Detention Bioswales and the SWTSs were the only stormwater controls without overlap between interquartile ranges (IQR) of influent and effluent TSS concentrations, generally indicating robust stormwater treatment control performance for a wide range of conditions. Overall decreases in TSS concentrations were observed at CM/media filter sites and the Lower Lot Biofilter, although overlap was apparent between respective influent and effluent boxes. Overlap was also present between influent and effluent concentration boxes for the ELV Treatment Control, where an increase in TSS concentrations was observed.

Substantial decreases in dioxins concentrations were observed at the Lower Lot Biofilter, Detention Bioswales, and the SWTSs, and overlaps of influent and effluent IQRs were not present. Overall, decreases in dioxins concentrations were observed at CM/media filter sites and the ELV Treatment Control, though data for both stormwater controls show an overlap between influent and effluent boxes. Almost all of the effluent dioxins concentrations from the Lower Lot Biofilter, ELV Treatment Control, and Detention Bioswales were lower than the Outfall 009 Permit limit (all but one of the available SWTS effluent sample concentrations were not detected), while most of the influent dioxins concentrations at the Lower Lot Biofilter, CMs/media filters, and Detention Bioswales were greater than the Outfall 009 Permit limit. The ELV Treatment Control and SWTSs generally had lower influent dioxins concentrations compared to the other stormwater controls, with some above the relevant outfall Permit limits.

Overall decreases in lead concentrations were observed at the CM/media filter sites, ELV Treatment Control, Detention Bioswales, and SWTSs, with some overlap of influent and effluent concentrations at CM/media filter sites and the ELV Treatment Control, and no overlap at the Detention Bioswales and SWTSs. Minimal differences in influent and effluent lead concentrations were observed in the boxes for the Lower Lot Biofilter. Relative to the Outfall 009 Permit limit, approximately 25% of influent lead concentrations were greater than the Permit limit at the CM/media filters, ELV Treatment Control, and Detention Bioswales, while only a few were greater than the Permit limit at the Lower Lot Biofilter. Effluent concentrations were below the Outfall 009 Permit limit for the Detention Bioswales and ELV Treatment Control, with only some above the Permit limit at the CM/media filter sites and the Lower Lot Biofilter. Both the influent and effluent SWTS concentrations for lead were below the relevant outfall Permit limits.

Overall decreases in mercury concentrations were observed at the SWTSs. The box plots show that influent and effluent concentrations were very similar at the CM/media filter sites and the ELV Treatment Control, and increases in mercury concentrations were observed at the Lower Lot Biofilter and Detention Bioswales. Most paired influent and effluent concentrations were below the Outfall 009 Permit limit in the 2023 Permit for the CM/media filters, and Detention Bioswales, and all were below the Outfall 009 Permit limit in the 2023 Permit for the Lower Lot Biofilter and ELV Treatment Control. All influent and effluent concentrations were below the relevant outfall Permit limits at the SWTSs.

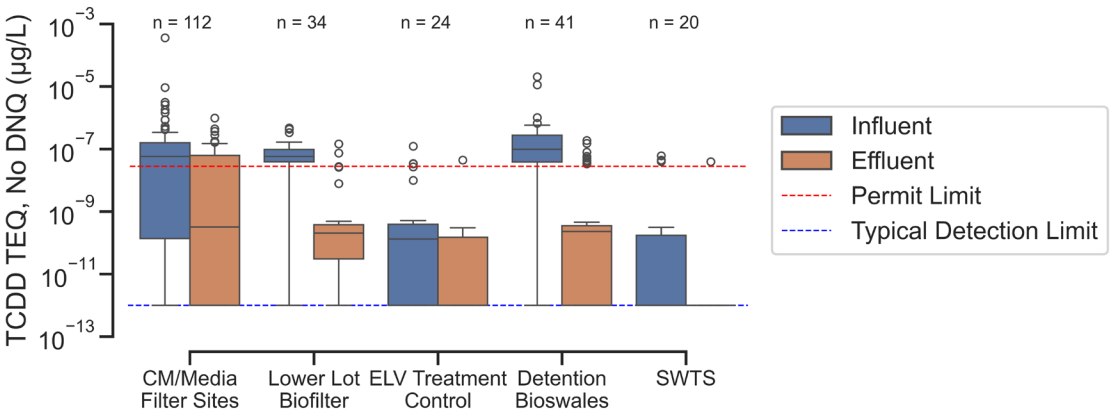
Decreases in aluminum concentrations were observed at the Detention Bioswales and SWTSs, with no overlap of the IQRs at the SWTSs and minimal overlap at the Detention Bioswales. An increase in aluminum concentration was observed at the ELV Treatment Control, although both influent and effluent concentrations were below the Outfall 009 Permit limit, and influent and effluent concentrations were very similar at the CMs/media filters. Both influent and effluent concentrations were below the Outfall 011 and 018 Permit limit for the SWTSs. The majority of the influent and effluent samples were below the Outfall 009 Permit limit for the CM/media filter sites. For the Detention Bioswales, the majority of influent samples (three out of five) were above the Outfall 009 Permit limit, while the majority of effluent samples (four out of five) were below or equal to the Outfall 009 Permit limit. There is only one data pair for the Lower Lot Biofilter; therefore, the data are not plotted.



Note: There are no permit limits for TSS.

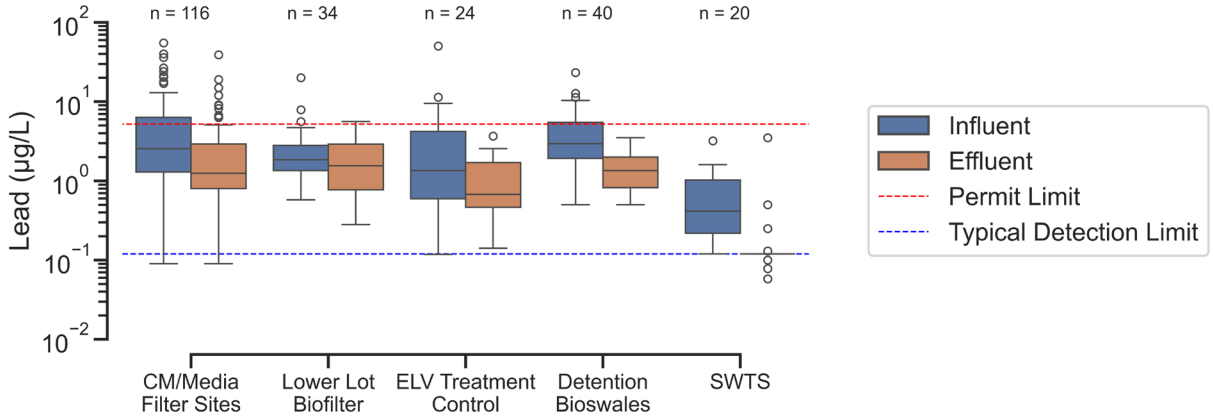
Note: n = number of available sample pairs, including NDs but excluding pairs where the effluent sample represents runoff not fully treated (bypass/Overflow).

Figure 3. Multiple Treatment Stormwater Control Box Plot for TSS



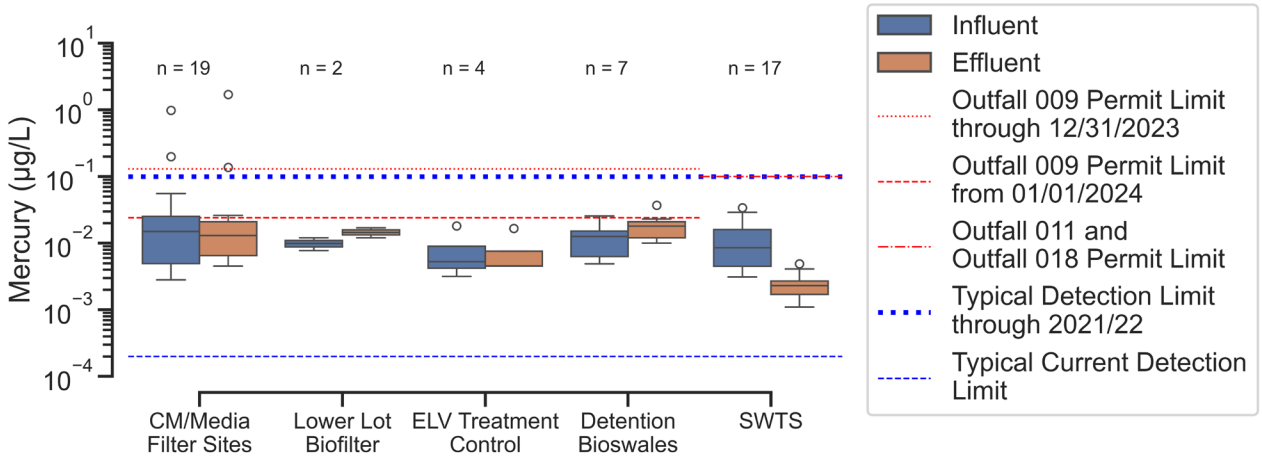
Note: n = number of available sample pairs, including NDs but excluding pairs where the effluent sample represents runoff not fully treated (bypass/Overflow).

Figure 4. Multiple Treatment Stormwater Control Box Plot for Dioxins



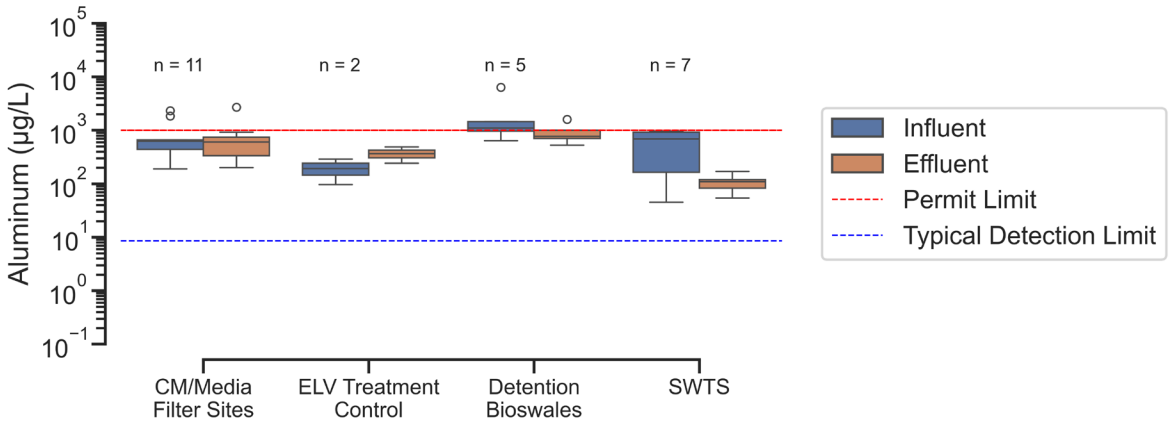
Note: n = number of available sample pairs, including NDs but excluding pairs where the effluent sample represents runoff not fully treated (bypass/Overflow).

Figure 5. Multiple Treatment Stormwater Control Box Plot for Lead



Note: n = number of available sample pairs, including NDs but excluding pairs where the effluent sample represents runoff not fully treated (bypass/Overflow).

Figure 6. Multiple Treatment Stormwater Control Box Plot for Mercury



Note: n = number of available sample pairs, including NDs but excluding pairs where the effluent sample represents runoff not fully treated (bypass/Overflow).

Figure 7. Multiple Treatment Stormwater Control Box Plot for Aluminum

3.2 Stormwater Control Performance by Stormwater Control

3.2.1 Culvert Modifications (CMs) and Media Filters

Statistical Analyses

The statistical analyses for the CMs/media filters indicate that the number of data pairs with decreases in concentration from the influent to the effluent, compared to pairs showing increases in concentration, is statistically significant ($p \leq 0.05$) for **TSS, dioxins**, and **lead** for non-background CMs and media filters, as shown in Table 5. There was a statistically significant difference in the number of data pairs showing a reduction in concentration from the influent to the effluent for the background CMs for TSS and lead, as shown in Table 6, though reductions of already-low COPC concentrations in runoff are generally considered unlikely given their largely natural and undeveloped drainage areas. There were insufficient data to demonstrate statistical significance for **mercury** and **aluminum** for non-background CMs and media filters (Table 5), and for dioxins for background CMs (Table 6).

It should be noted that no data were collected from the background CMs in the most recent reporting year. Additionally, paired samples of ND results, especially for dioxins, at both the influent and effluent demonstrate favorable water quality influent to and effluent from CM-8 and CM-11, though they are not considered in the statistical significance tests.

Table 5. Combined Non-Background Statistical Analyses: CM-1, CM-3[2], CM-9, B-1 Media Filter, and Upper Lot Media Filter

	TSS (mg/L)		Dioxins (µg/L)[2]		Lead (µg/L)		Mercury (µg/L)		Aluminum (µg/L)	
	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent
Minimum	0.70	0.53	1.0E-12	1.0E-12	0.09	0.09	0.0028	0.0045	190	200
Maximum	890	610	3.6E-04	9.8E-07	55	39	0.98	1.70	2,300	2,700
Average	48	26	3.5E-06	5.1E-08	5.6	2.8	0.076	0.108	790	720
Median	17	10	5.8E-08	3.2E-10	2.6	1.3	0.015	0.013	630	610
Standard Deviation	99	63	3.4E-05	1.1E-07	8.3	4.6	0.22	0.39	670	700
Coefficient of Variation (COV)	2.1	2.4	9.8	2.3	1.5	1.7	2.9	3.6	0.85	0.97
Total pairs of observations	116		112		116		19		11	
Pairs with influent-to-effluent concentration reductions	81		72		86		7		6	
Pairs with influent-to-effluent concentration increases	31		20		25		11		5	
Pairs with equal influent and effluent concentrations	4		20		5		1		0	
Paired sign test p-value[1]	<0.001		<0.001		<0.001		0.62		0.19	
Statistically significant number of data pairs with concentration reductions[1]?	Yes		Yes		Yes		No (data numbers insufficient to indicate significance)		No (data numbers insufficient to indicate significance)	

[1] Non-parametric, one-tailed binomial sign test; p-values ≤ 0.05 indicate statistical significance.

[2] Only CM-3 paired data post 2016/17 were included in the statistical analyses.

Table 6. Combined Background Statistical Analyses: CM-8 and CM-11

	TSS (mg/L)		Dioxins (µg/L)		Lead (µg/L)	
	Influent	**Effluent**	**Influent**	**Effluent**	**Influent**	**Effluent**
Minimum	1.0	1.0	1.0E-12	1.0E-12	0.20	0.20
Maximum	82	33	1.5E-10	3.5E-10	11	7.0
Average	13	7.6	2.7E-11	6.9E-11	3.2	1.6
Median	3.0	2.0	1.0E-12	1.0E-12	0.58	0.29
Standard Deviation	21	9.6	5.8E-11	1.3E-10	4.5	2.2
Coefficient of Variation (COV)	1.6	1.3	2.1	1.9	1.4	1.4
Total pairs of observations	21		11		10	
Pairs with influent-to-effluent concentration reductions	13		1		7	
Pairs with influent-to-effluent concentration increases	3		3		1	
Pairs with equal influent and effluent concentrations	5		7		2	
Paired sign test p-value[1]	0.011		0.31		0.035	
Statistically significant number of data pairs with concentration reductions[1]?	Yes		No (data numbers insufficient to indicate significance)		Yes	

[1] Non-parametric, one-tailed binomial sign test; p-values ≤ 0.05 indicate statistical significance.

Comparisons to Permit Limits

As shown in Table 7, effluent concentrations were observed below the respective Outfall 009 Permit limit more often than corresponding influent concentrations at the **B-1 Media Filter** for **lead** and **dioxins**, **CM-1** for **lead**, **dioxins**, and **aluminum**, **CM-9** for **lead**, **dioxins**, **mercury**, and **aluminum**, the **Upper Lot Media filter** for **lead** and **dioxins** (there were no influent or effluent concentrations above the Permit limit for mercury), and **CM-3** for **lead** (there were no influent or effluent concentrations above the Permit limit for dioxins or mercury)**,** showing reductions from influent to effluent at these locations for these analytes. Additionally, the maximum and average concentration excess ratios (ratios of observed concentrations to the Permit limits) are lower for effluent results compared to influent results, with the exception of the average concentration excess ratios for lead and mercury for the B-1 Media Filter, further suggesting reductions for the majority of COPCs mentioned previously.

Table 7. CMs and Other Media Filters: Summary of Influent and Effluent Results Compared to Reference Outfall 009 Permit Limits, 2009-2026 (CM-1, CM-3 post-2016/17, CM-9, B-1 Media Filter, and Upper Lot Media Filter)

Stormwater Control	Parameter	% Above Outfall 009 Permit Limit		Maximum Concentration Excess Ratio[1]		Average Concentration Excess Ratio[1]	
		Influent	Effluent	Influent	Effluent	Influent	Effluent
B-1 Media Filter	Lead	33%	8.3%	1.8	1.7	1.3	1.5
	Dioxins[2]	81%	70%	13,000	10	770	3.7
	Mercury	33%	71%	0.26	1.8	0.26	1.4
CM-1	Lead	26%	14%[4]	11	7.5	3.8	3.0
	Dioxins[3]	55%	44%[5]	3,100	150	140	13
	Mercury	6%	29%	8.3	5.9	8.3	5.8
	Aluminum	33%	0%	1.9	<1	1.9	<1
CM-9	Lead	43%	20%[6]	11	6.9	3.9	2.9
	Dioxins	49%	20%[7]	56	5.2	7.7	3.0
	Mercury	11%	0%	1.4	<1	1.4	<1
	Aluminum	20%	0%	2.1	<1	2.1	<1
Upper Lot Media Filter	Lead	13%	0%	1.9	<1	1.4	<1
	Dioxins	83%	65%	180	3.7	17	2.0
	Mercury	0%	0%	<1	<1	<1	<1
CM-3	Lead	22%	0%	1.7	<1	1.5	<1
	Dioxins	0%	0%	<1	<1	<1	<1
	Mercury	0%	0%	<1	<1	<1	<1

[1] A cell with "<1" indicates sample results were not observed above the respective Permit limit.

[2] Dioxins results from the B-1 Media Filter are greatly affected by an exceptionally high influent result of 3.6E-4 µg/L observed on December 2, 2014, without which, maximum and average influent ratios fall to 94 and 16, respectively.

[3] CM-1 data are similarly affected by a March 2012 high effluent result of 4.3E-6 µg/L, without which, maximum and average effluent ratios become 35 and 7.3, respectively. A leaking seal was observed at CM-1 in March 2017 and, although quickly repaired, it is unknown whether it may have contributed to the February 17, 2017, Outfall 009 exceedance of the Permit limit for dioxins.

[4] Two of the seven sample results above the Outfall 009 Permit limit occurred during bypass or overflow conditions.

[5] Two of the 22 sample results above the Outfall 009 Permit limit occurred during bypass or overflow conditions.

[6] Two of the eight sample results above the Outfall 009 Permit limit occurred during bypass or overflow conditions.

[7] One of the seven sample results above the Outfall 009 Permit limit occurred during bypass or overflow conditions.

Paired Line Plots

Figure 8 through Figure 47 present paired line plots of the CMs and other media filter treatment Stormwater controls.

B-1 Media Filter

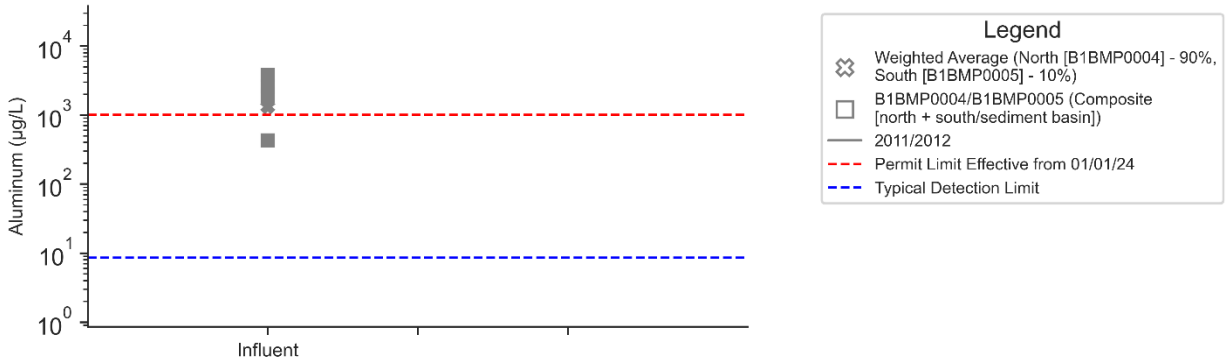


Figure 8: Aluminum at B-1 Media Filter Pre-Curb Cuts

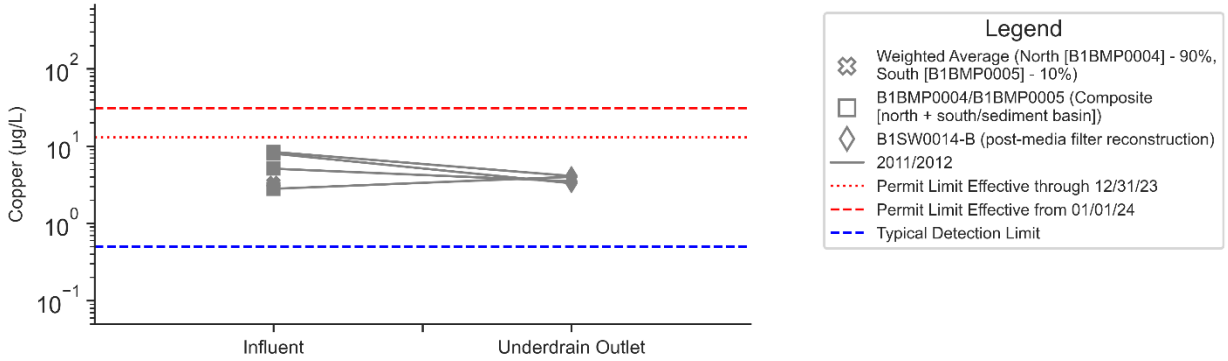


Figure 9: Copper at B-1 Media Filter Pre-Curb Cuts

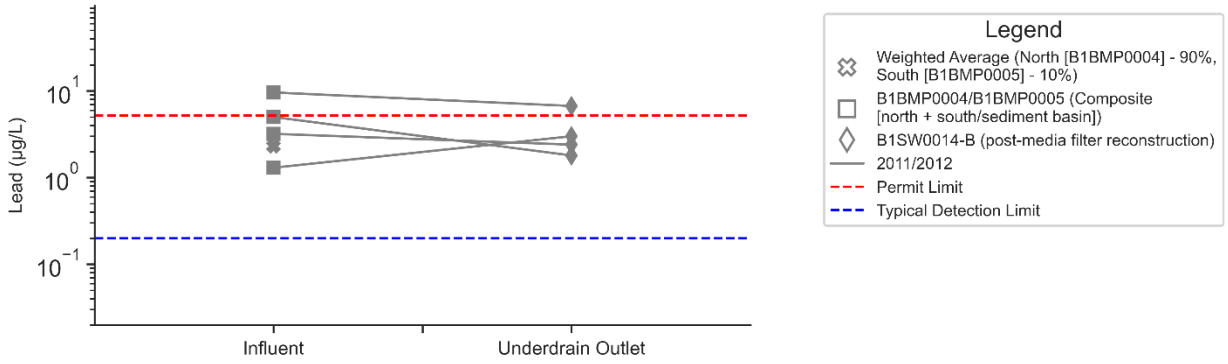


Figure 10: Lead at B-1 Media Filter Pre-Curb Cuts

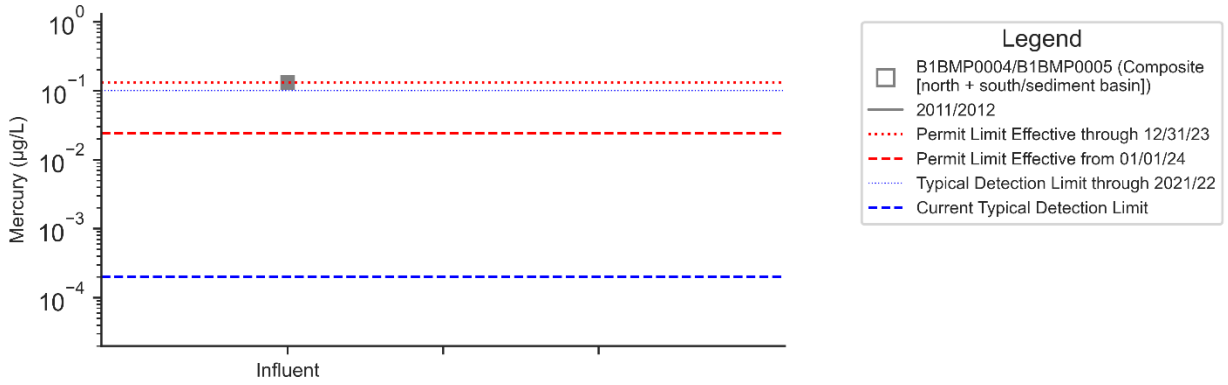
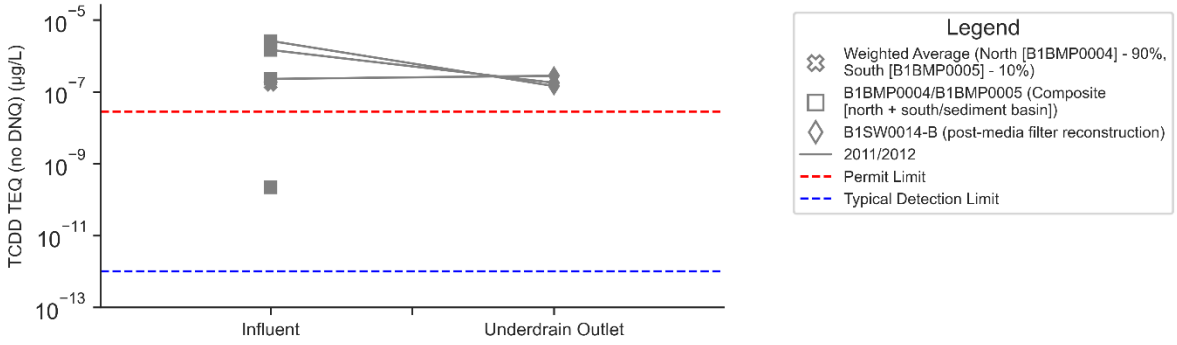


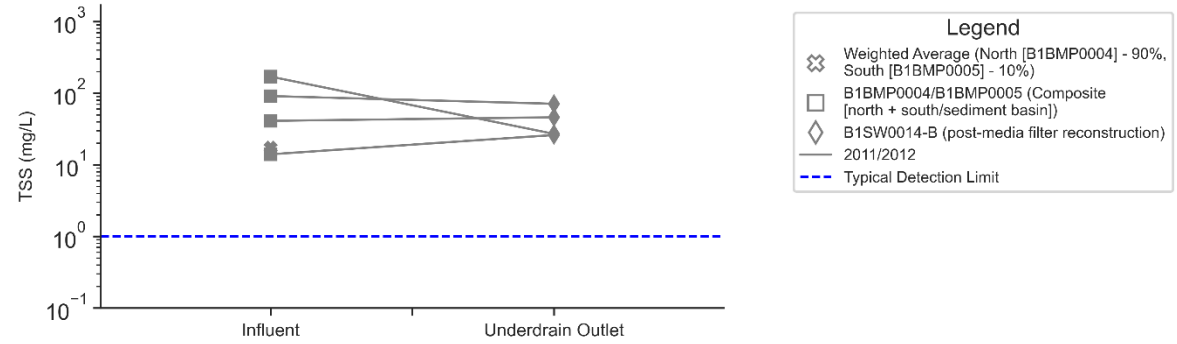
Figure 11: Mercury at B-1 Media Filter Pre-Curb Cuts



Note:

- 1E-12 ug/L is shown for ND TEQ results as this is in the range of the lowest reported TEQ results with DNQ excluded.

Figure 12: Dioxins at B-1 Media Filter Pre-Curb Cuts



Note:

- There are no Permit Limits designated for TSS therefore there are no Limits shown on this plot.

Figure 13: TSS at B-1 Media Filter Pre-Curb Cuts

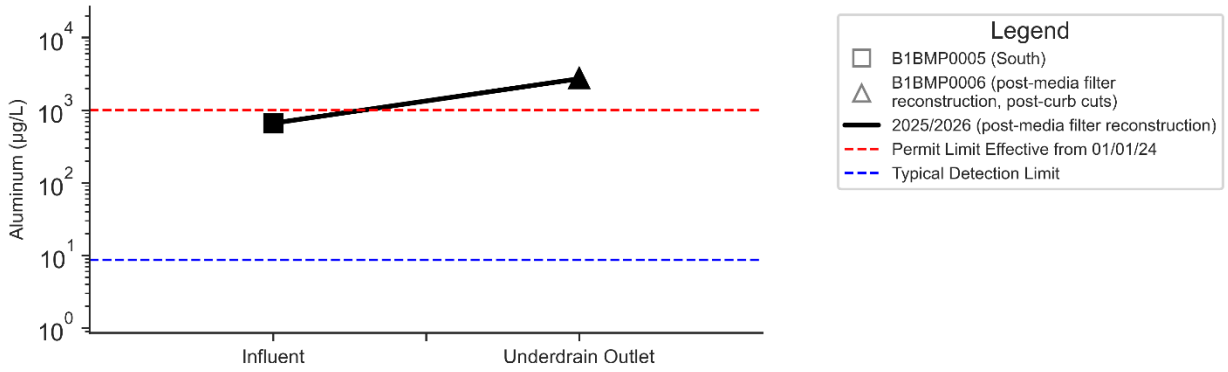


Figure 14: Aluminum at B-1 Media Filter Post-Curb Cuts

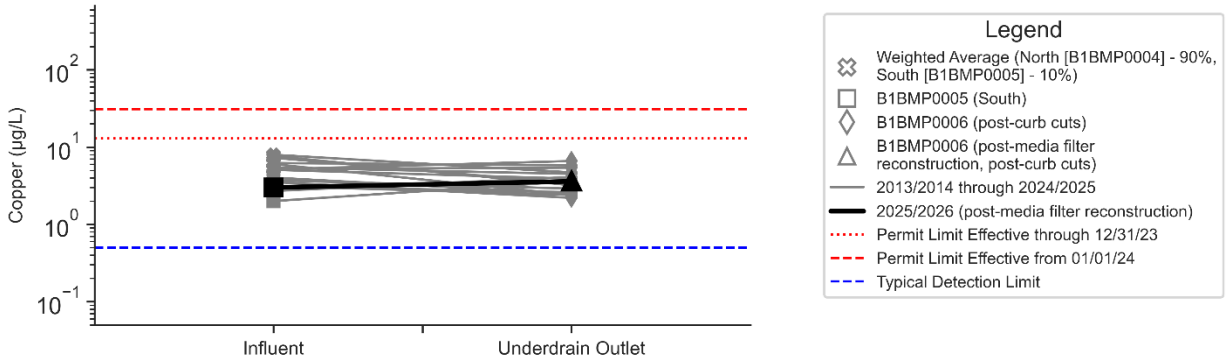
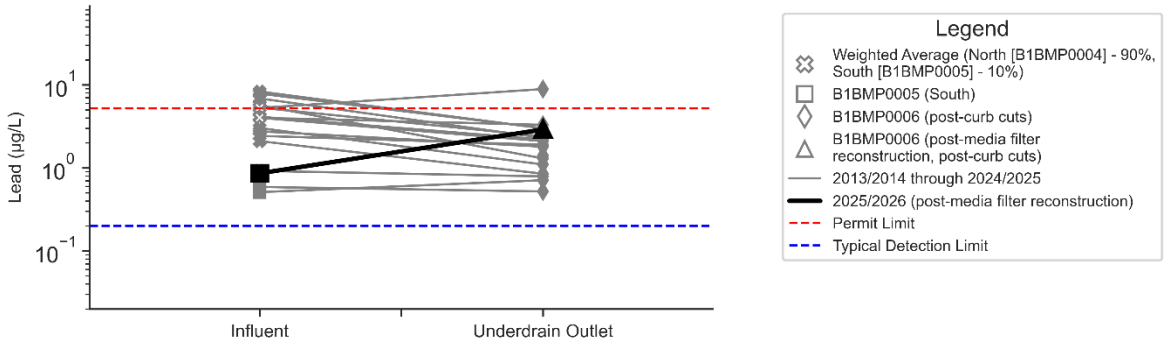


Figure 15: Copper at B-1 Media Filter Post-Curb Cuts



Note:

- Open symbols represent non-detect results or at least one non-detect sample in weighted average samples.

Figure 16: Lead at B-1 Media Filter Post-Curb Cuts

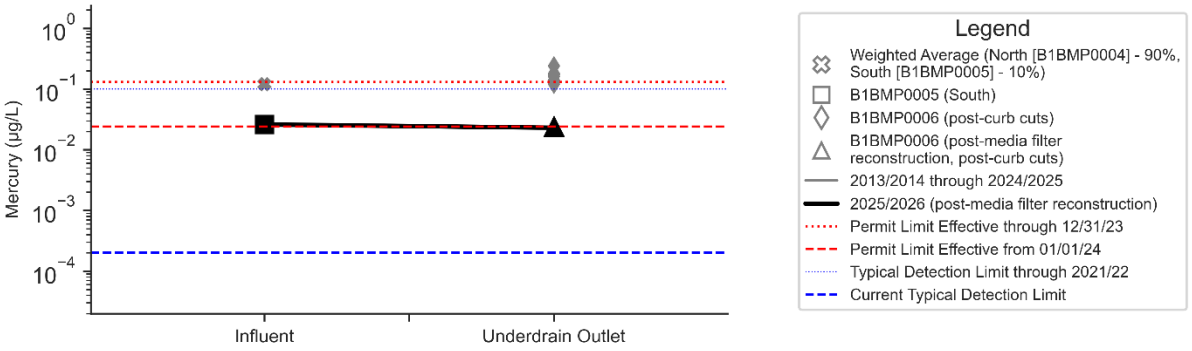
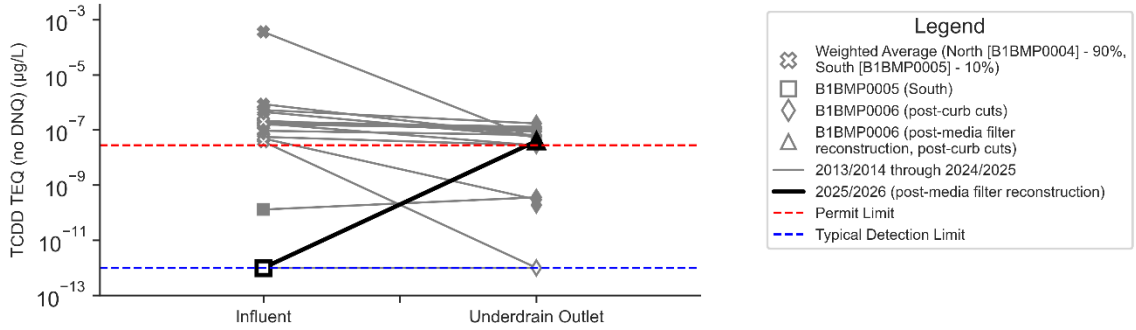


Figure 17: Mercury at B-1 Media Filter Post-Curb Cuts

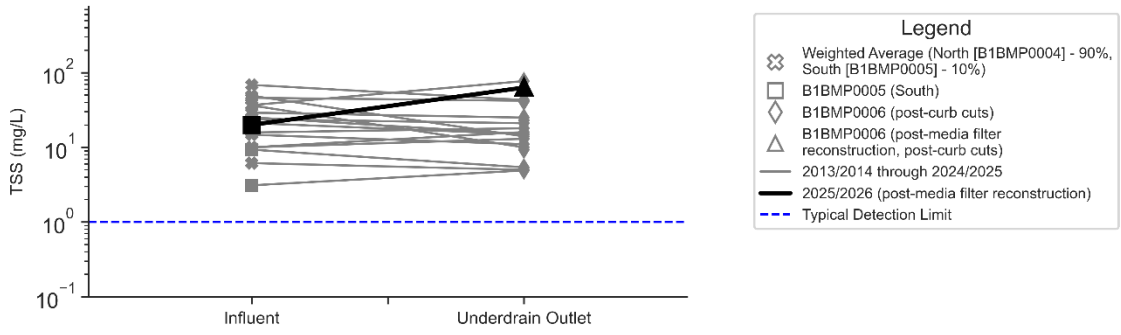


Note:

- 1E-12 ug/L is shown for ND TEQ results as this is in the range of the lowest reported TEQ results with DNQ excluded.

- Open symbols represent non-detect results or at least one non-detect sample in weighted average samples.

Figure 18: Dioxins at B-1 Media Filter Post-Curb Cuts



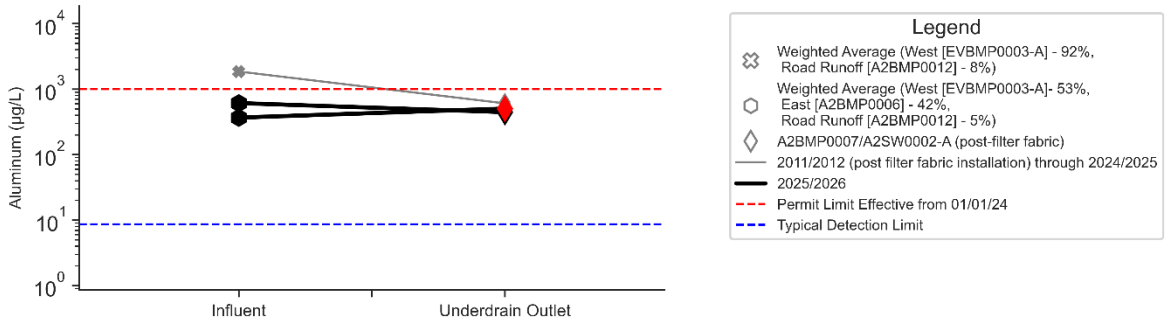
Note:

- There are no Permit Limits designated for TSS therefore there are no Limits shown on this plot.

- Open symbols represent non-detect results or at least one non-detect sample in weighted average samples.

Figure 19: TSS at B-1 Media Filter Post-Curb Cuts

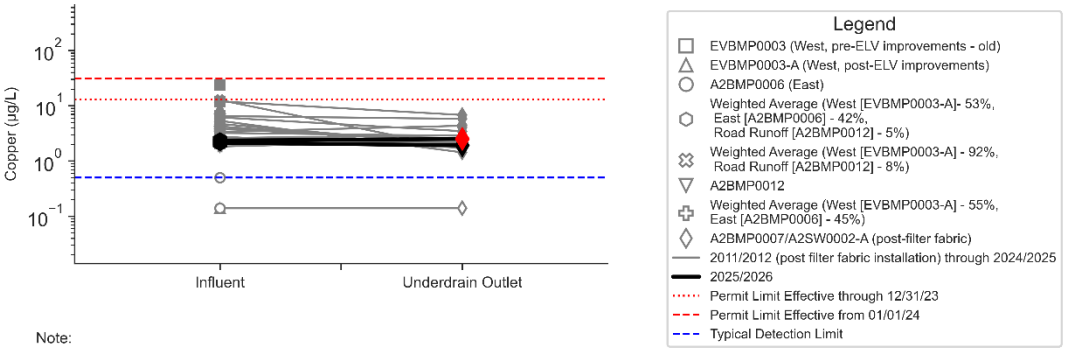
CM-1



Note:

- Red markers indicate samples collected during weir board overflow.

Figure 20: Aluminum at CM-1 Post-Curb Cuts

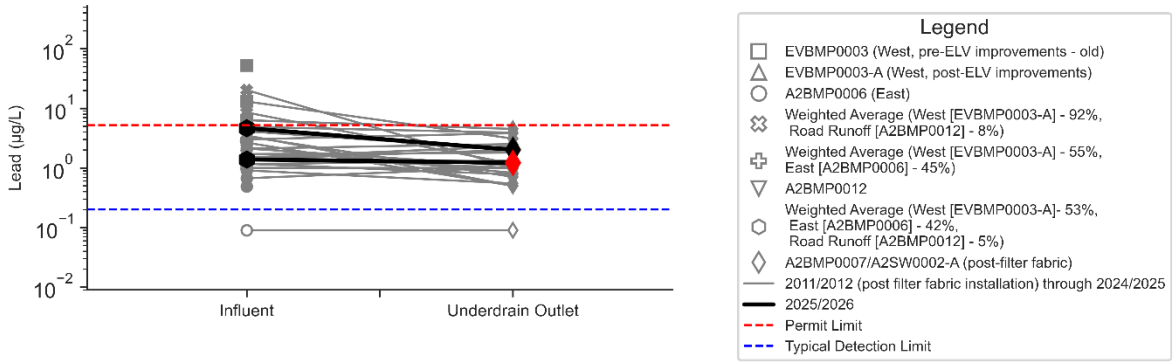


Note:

- Open symbols represent non-detect results or at least one non-detect sample in weighted average samples.

- Red markers indicate samples collected during weir board overflow.

Figure 21: Copper at CM-1 Post-Curb Cuts

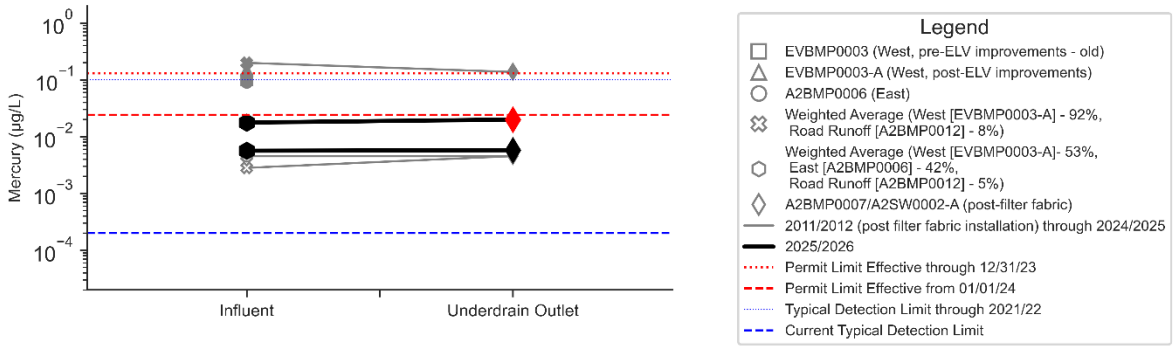


Note:

- Open symbols represent non-detect results or at least one non-detect sample in weighted average samples.

- Red markers indicate samples collected during weir board overflow.

Figure 22: Lead at CM-1 Post-Curb Cuts

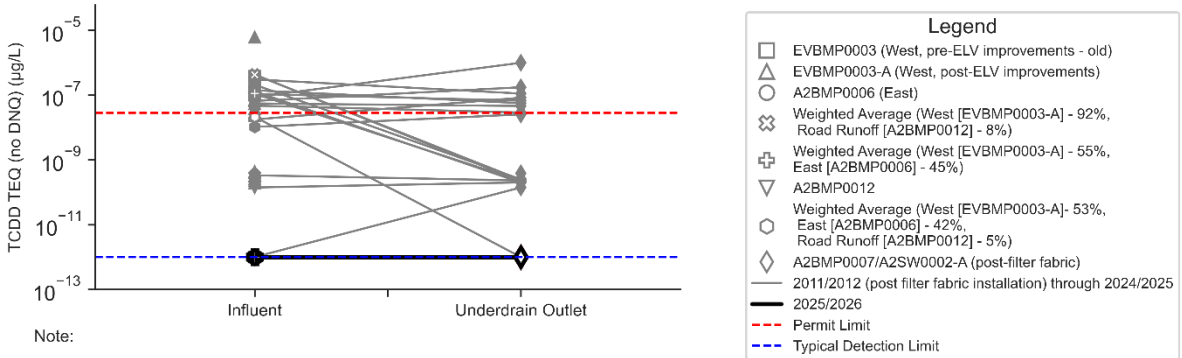


Note:

- Open symbols represent non-detect results or at least one non-detect sample in weighted average samples.

- Red markers indicate samples collected during weir board overflow.

Figure 23: Mercury at CM-1 Post-Curb Cuts



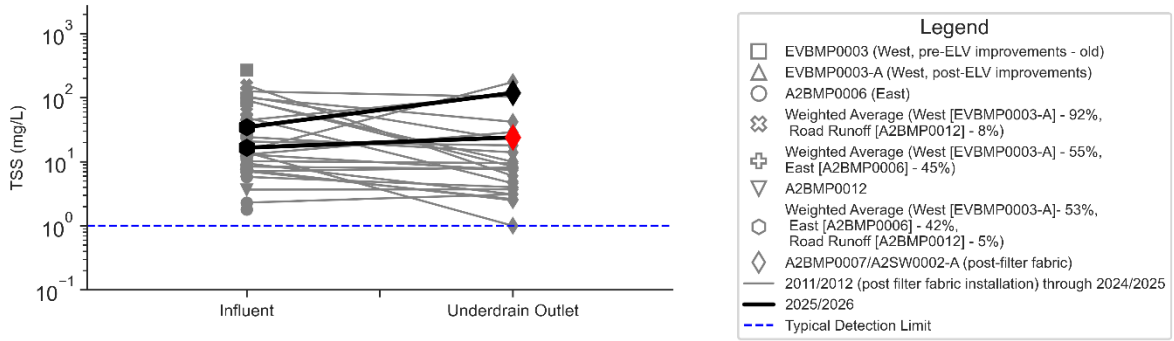
Note:

- 1E-12 ug/L is shown for ND TEQ results as this is in the range of the lowest reported TEQ results with DNQ excluded.

- Open symbols represent non-detect results or at least one non-detect sample in weighted average samples.

- Red markers indicate samples collected during weir board overflow.

Figure 24: Dioxins at CM-1 Post-Curb Cuts



Note:

- There are no Permit Limits designated for TSS therefore there are no Limits shown on this plot.

- Red markers indicate samples collected during weir board overflow.

Figure 25: TSS at CM-1 Post-Curb Cuts

CM-3

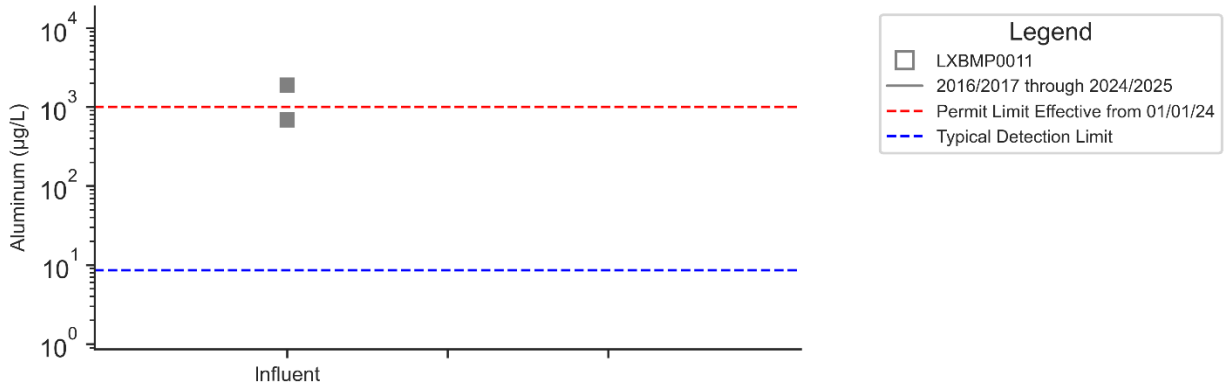
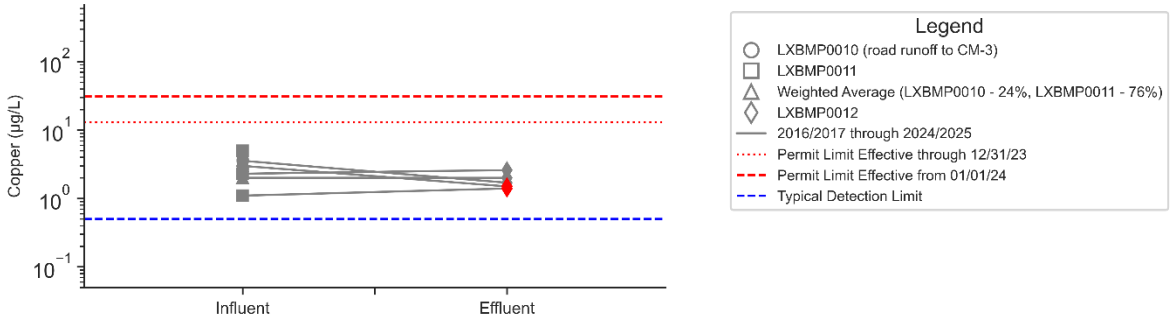


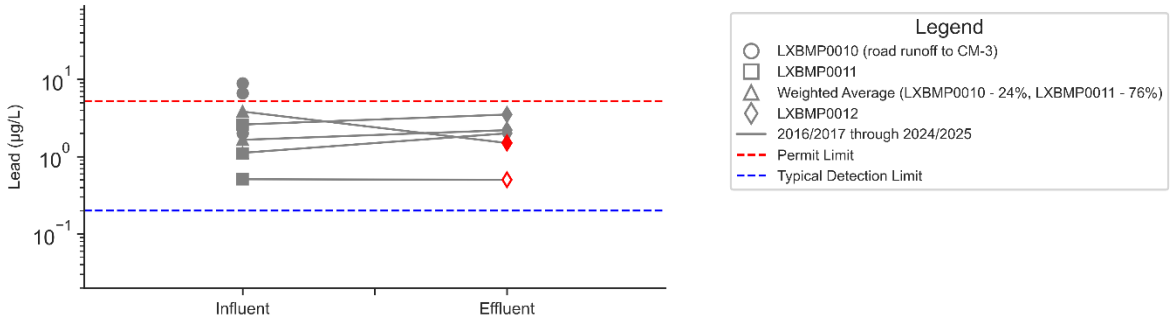
Figure 26: Aluminum at CM-3



Note:

- Red markers indicate samples collected during weir board overflow.

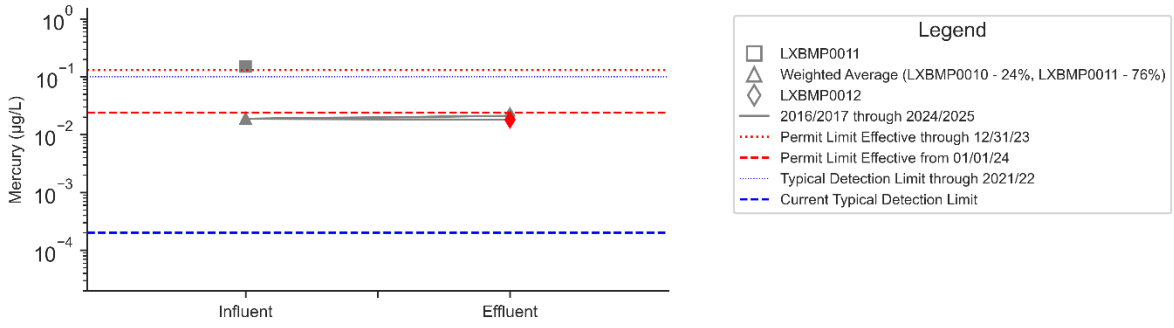
Figure 27: Copper at CM-3



Note:

- Open symbols represent non-detect results or at least one non-detect sample in weighted average samples.
- Red markers indicate samples collected during weir board overflow.

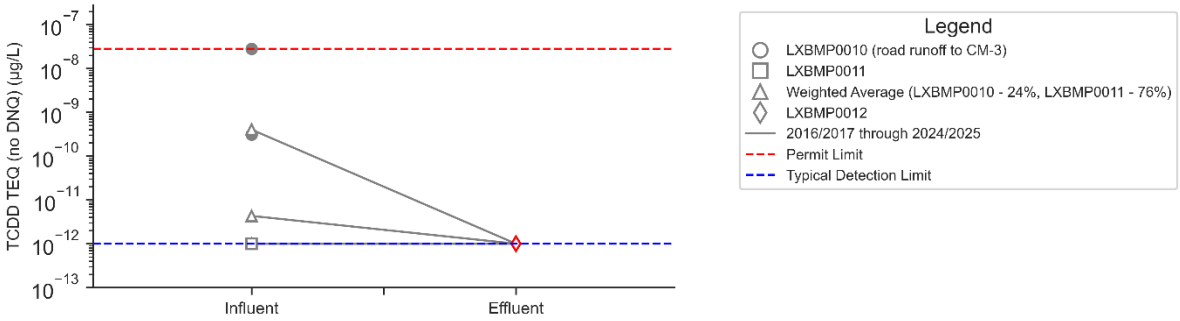
Figure 28: Lead at CM-3



Note:

- Red markers indicate samples collected during weir board overflow.

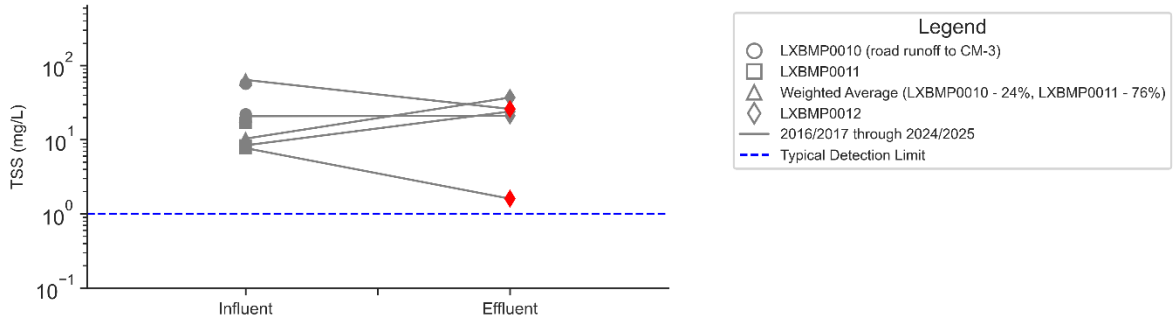
Figure 29: Mercury at CM-3



Note:

- 1E-12 ug/L is shown for ND TEQ results as this is in the range of the lowest reported TEQ results with DNQ excluded.
- Open symbols represent non-detect results or at least one non-detect sample in weighted average samples.
- Red markers indicate samples collected during weir board overflow.

Figure 30: Dioxins at CM-3

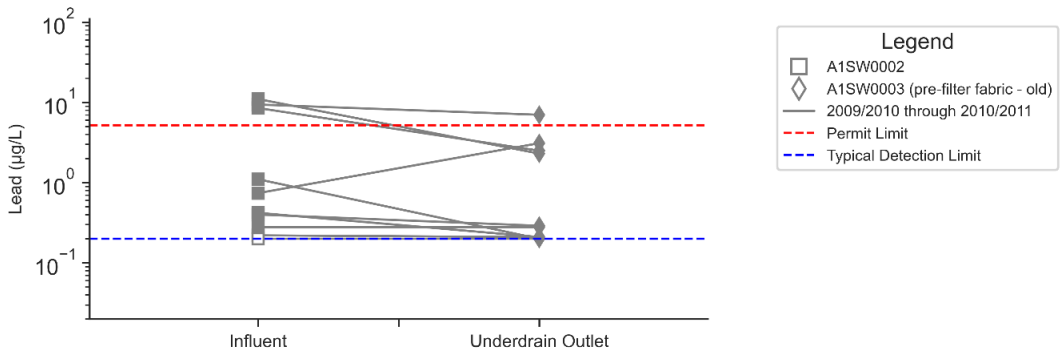


Note:

- There are no Permit Limits designated for TSS therefore there are no Limits shown on this plot.
- Red markers indicate samples collected during weir board overflow.

Figure 31: TSS at CM-3

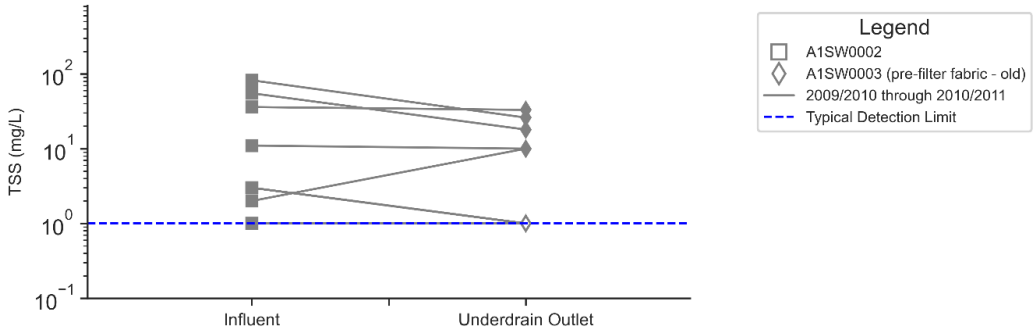
CM-8



Note:

- Open symbols represent non-detect results or at least one non-detect sample in weighted average samples.

Figure 32: Lead at CM-8

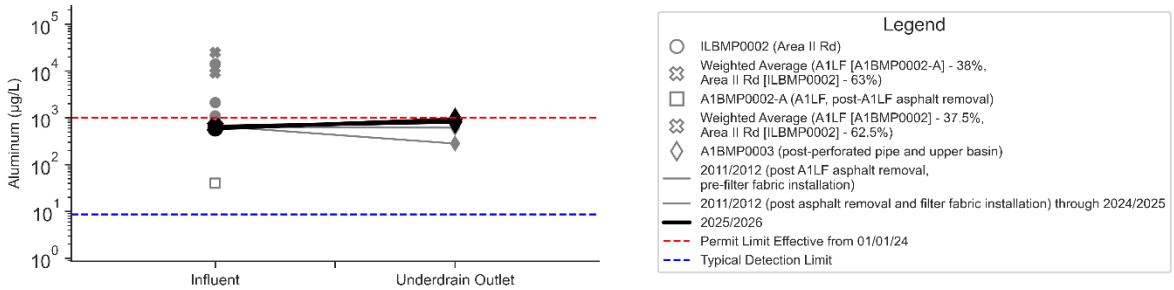


Note:

- There are no Permit Limits designated for TSS therefore there are no Limits shown on this plot.
- Open symbols represent non-detect results or at least one non-detect sample in weighted average samples.

Figure 33: TSS at CM-8

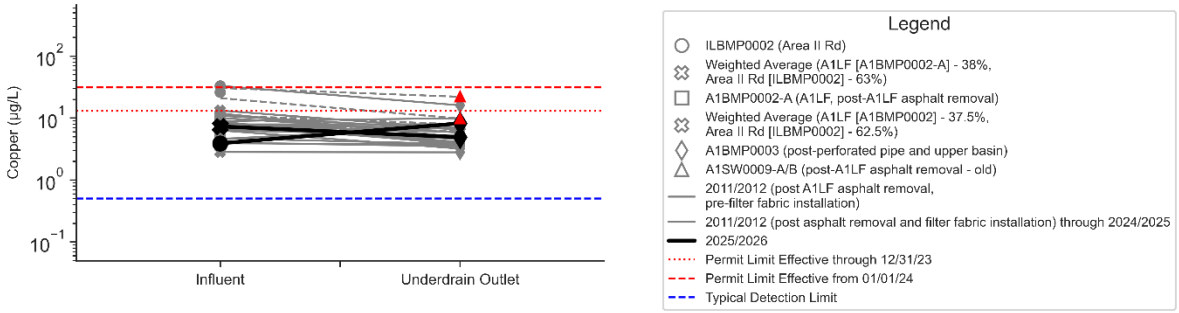
CM-9



Note:

- Open symbols represent non-detect results or at least one non-detect sample in weighted average samples.

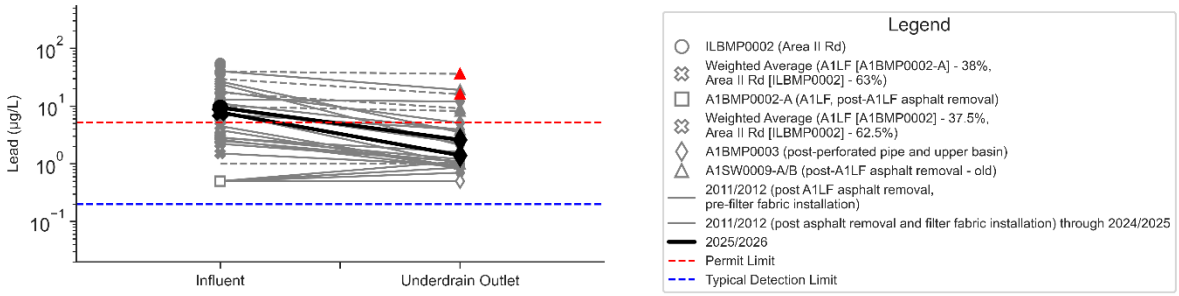
Figure 34: Aluminum at CM-9 Post-Improvements



Note:

- Red markers indicate samples collected during weir board overflow.

Figure 35: Copper at CM-9 Post-Improvements



Note:

- Open symbols represent non-detect results or at least one non-detect sample in weighted average samples.

- Red markers indicate samples collected during weir board overflow.

Figure 36: Lead at CM-9 Post-Improvements

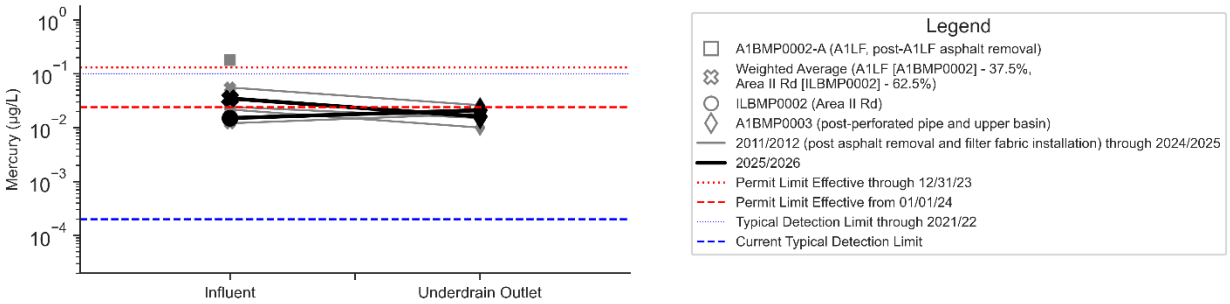
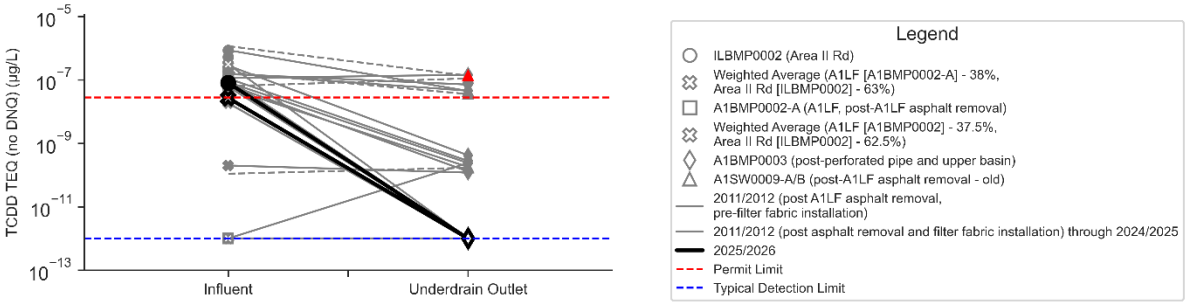


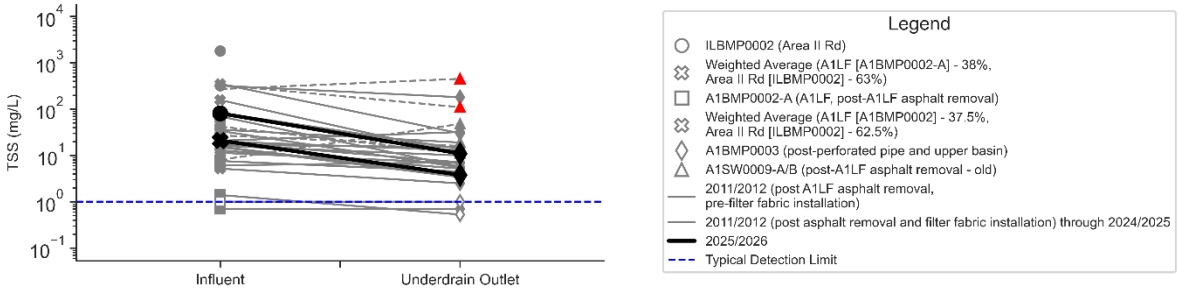
Figure 37: Mercury at CM-9 Post-Improvements



Note:

- 1E-12 ug/L is shown for ND TEQ results as this is in the range of the lowest reported TEQ results with DNQ excluded.
- Open symbols represent non-detect results or at least one non-detect sample in weighted average samples.
- Red markers indicate samples collected during weir board overflow.

Figure 38: Dioxins at CM-9 Post-Improvements

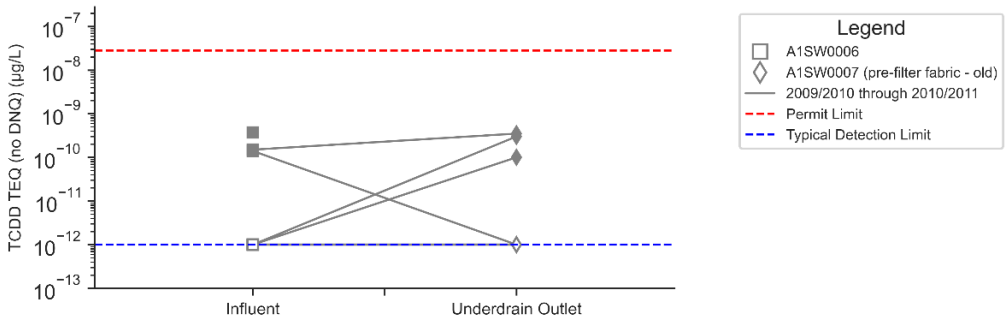


Note:

- There are no Permit Limits designated for TSS therefore there are no Limits shown on this plot.
- Red markers indicate samples collected during weir board overflow.

Figure 39: TSS at CM-9 Post-Improvements

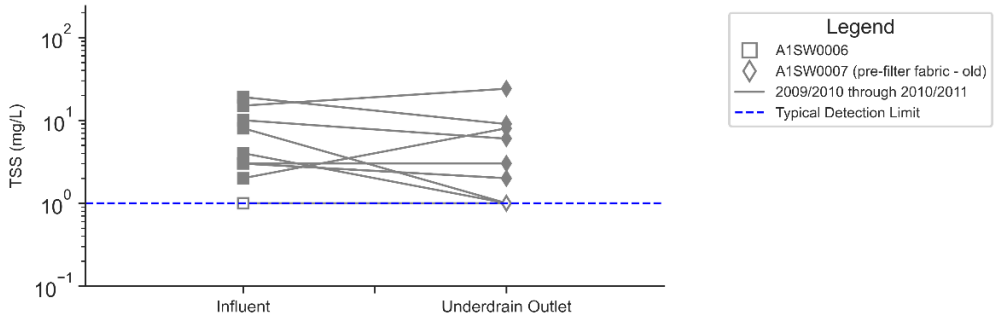
CM-11



Note:

- 1E-12 ug/L is shown for ND TEQ results as this is in the range of the lowest reported TEQ results with DNQ excluded.
- Open symbols represent non-detect results or at least one non-detect sample in weighted average samples.

Figure 40: Dioxins at CM-11



Note:

- There are no Permit Limits designated for TSS therefore there are no Limits shown on this plot.
- Open symbols represent non-detect results or at least one non-detect sample in weighted average samples.

Figure 41: TSS at CM-11

Upper Lot Media Filter

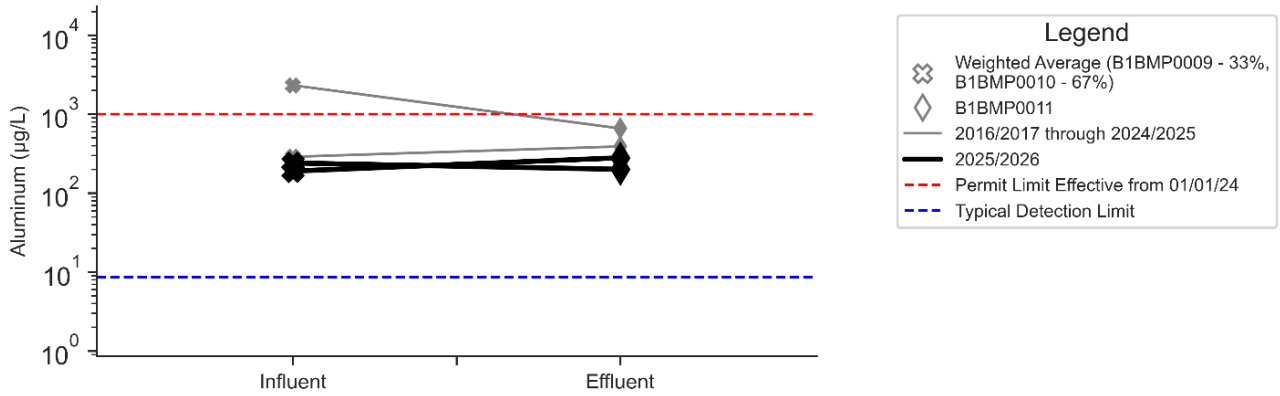


Figure 42: Aluminum at Upper Lot Media Filter

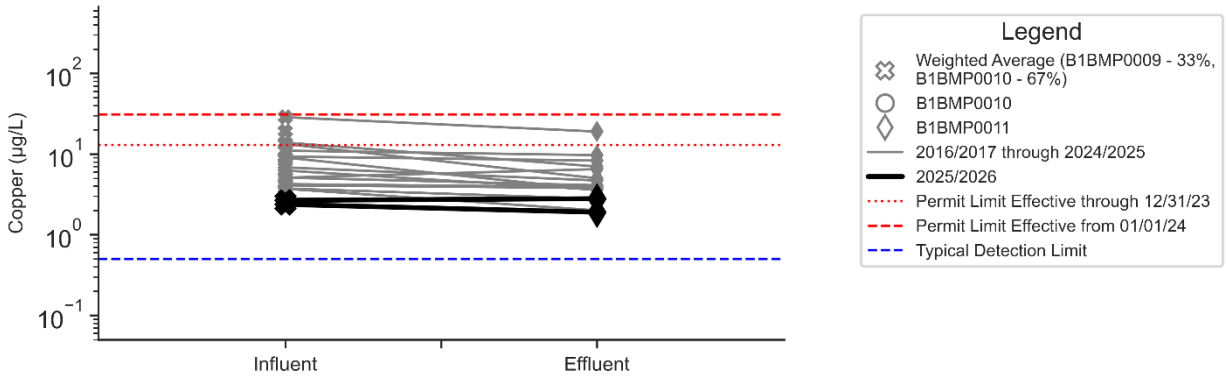
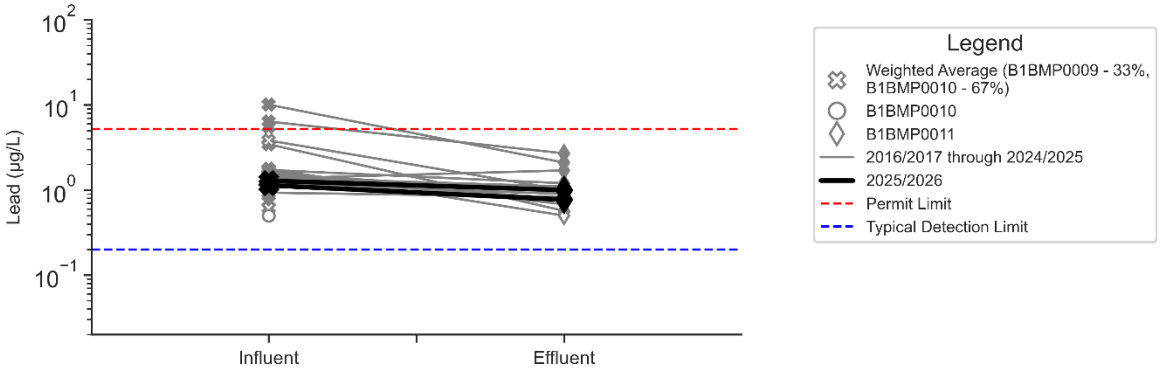


Figure 43: Copper at Upper Lot Media Filter



Note:

- Open symbols represent non-detect results or at least one non-detect sample in weighted average samples.

Figure 44: Lead at Upper Lot Media Filter

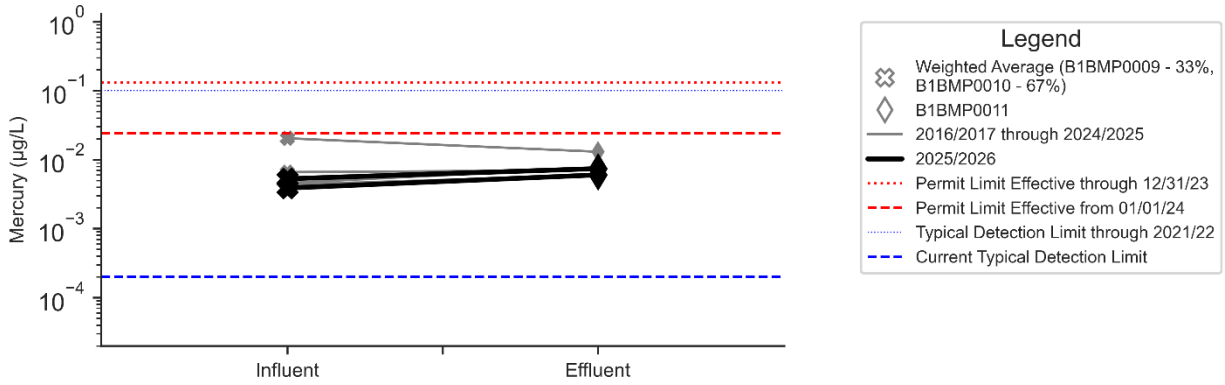
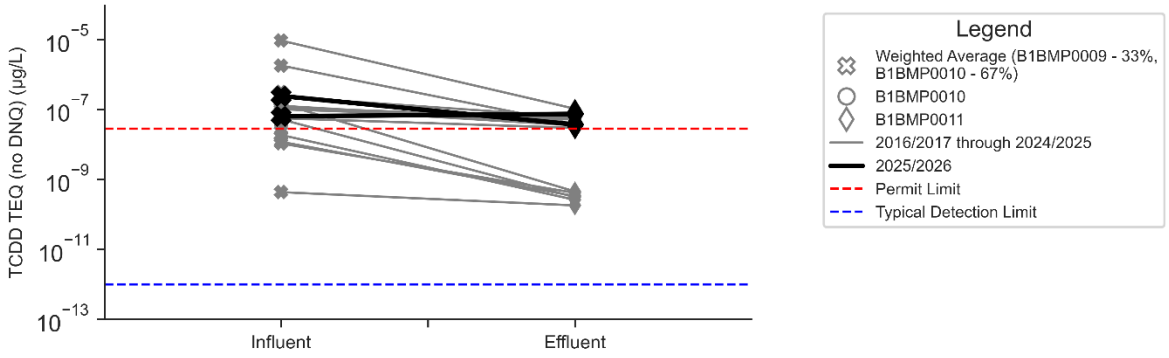


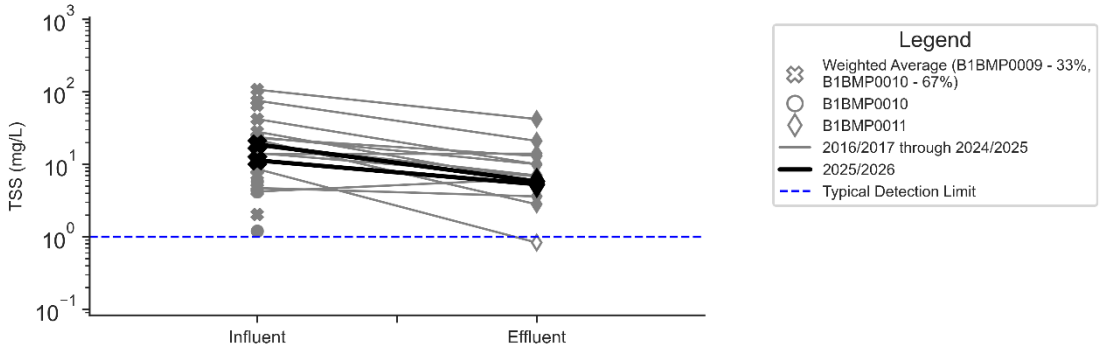
Figure 45: Mercury at Upper Lot Media Filter



Note:

- 1E-12 ug/L is shown for ND TEQ results as this is in the range of the lowest reported TEQ results with DNQ excluded.

Figure 46: Dioxins at Upper Lot Media Filter



Note:

- There are no Permit Limits designated for TSS therefore there are no Limits shown on this plot.

- Open symbols represent non-detect results or at least one non-detect sample in weighted average samples.

Figure 47: TSS at Upper Lot Media Filter

3.2.2 ELV Treatment Control

Statistical Analyses

Table 8, Table 9, and Table 10 summarize respective results of statistical analyses conducted on influent-to-midpoint, midpoint-to-effluent, and influent-to-effluent sample pairs of TSS, dioxins and lead data collected at the ELV Treatment Control.

As shown in Table 10, results indicate that the number of data pairs with decreases in concentration from the influent to the effluent for the overall performance of the ELV Treatment Control, compared to pairs showing increases in concentration, was statistically significant for **dioxins** and **lead** concentrations. However, influent-to-effluent increases were found to be statistically significant for **TSS**, likely due to fines being washed out of the treatment media. Drainage layers and filter media in the media treatment tank were rebuilt in Summer 2021 in an attempt to reduce media washout. TSS concentrations have generally decreased after the treatment control was rebuilt, based on average concentrations, but influent-to-effluent increases are still observed. However, out of eleven sample pairs for the influent and effluent sample locations, four have shown a decrease in concentration since the treatment control was rebuilt, while seven have shown an increase in concentration. There were insufficient data to demonstrate statistically significance concentration changes for **mercury.**

Table 9 shows that statistically significant midpoint-to-effluent reductions due to the treatment media component of the ELV Treatment Control were observed for **dioxins**. However, there was also a statistically significant increase in **TSS** and **lead** from the midpoint to effluent. Table 8 shows statistically significant influent-to-midpoint reductions for **lead**, but insufficient data to show statistically significant reductions for the remaining COPCs.

Table 8. ELV Treatment Control Statistical Analyses: Influent to Midpoint Sample Points

	TSS (mg/L)		Dioxins (µg/L)		Lead (µg/L)		Mercury (µg/L)	
	Influent	**Effluent**	**Influent**	**Effluent**	**Influent**	**Effluent**	**Influent**	**Effluent**
Minimum	0.83	0.83	1.0E-12	1.0E-12	0.12	0.12	0.0032	0.0034
Maximum	80	47	3.4E-08	8.6E-10	50	3.5	0.018	0.019
Average	14	8	4.6E-09	2.2E-10	4.4	1.0	0.0079	0.0078
Median	5.0	4.0	1.1E-10	1.8E-10	1.3	0.54	0.0053	0.0045
Standard Deviation	22	10	1.1E-08	2.5E-10	10	0.9	0.0069	0.0073
Coefficient of Variation (COV)	1.6	1.4	2.4	1.2	2.3	1.0	0.86	0.94
Total pairs of observations	23		23		23		4	
Pairs with influent-to-effluent concentration reductions	13		9		17		1	
Pairs with influent-to-effluent concentration increases	10		7		5		2	
Pairs with equal influent and effluent concentrations	0		7		1		1	
Paired sign test p-value[1]	0.34		0.40		0.008		0.5	
Statistically significant number of data pairs with concentration reductions[1]?	No (data numbers insufficient to indicate significance)		No (data numbers insufficient to indicate significance)		Yes		No (data numbers insufficient to indicate significance)	

[1] Non-parametric, one-tailed binomial sign test; p-values ≤ 0.05 indicate statistical significance.

Table 9. ELV Treatment Control Statistical Analyses: Midpoint to Effluent Sample Points

	TSS (mg/L)		Dioxins (µg/L)		Lead (µg/L)		Mercury (µg/L)	
	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent
Minimum	0.83	1.0	1.0E-12	1.0E-12	0.12	0.14	0.0034	0.0045
Maximum	47	140	8.6E-10	3.0E-10	3.5	3.7	0.019	0.017
Average	7.0	23	2.1E-10	6.6E-11	0.95	1.0	0.0078	0.0076
Median	3.4	13	1.8E-10	1.0E-12	0.54	0.69	0.0045	0.0046
Standard Deviation	10	30	2.5E-10	9.4E-11	0.91	0.87	0.0073	0.0060
Coefficient of Variation (COV)	1.4	1.3	1.2	1.4	1.0	0.87	0.94	0.80
Total pairs of observations	25		25		25		4	
Pairs with influent-to-effluent concentration reductions	2		14		7		1	
Pairs with influent-to-effluent concentration increases	23		0		18		1	
Pairs with equal influent and effluent concentrations	0		11		0		2	
Paired sign test p-value[1]	<0.001		<0.001		0.022		0.75	
Statistically significant number of data pairs with concentration reductions[1]?	No[2]		Yes		No[2]		No (data numbers insufficient to indicate significance)	

[1] Non-parametric, one-tailed binomial sign test; p-values ≤ 0.05 indicate statistical significance.
[2] Data show statistically significant number of pairs with increases in TSS and lead concentration.

Table 10. Overall ELV Treatment Control Statistical Analyses (Influent to Effluent Sample Points)

	TSS (mg/L)		Dioxins (µg/L)		Lead (µg/L)		Mercury (µg/L)	
	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent
Minimum	0.83	1.0	1.0E-12	1.0E-12	0.12	0.14	0.0032	0.0045
Maximum	80	140	1.2E-07	4.4E-08	50	3.7	0.018	0.017
Average	14	23	9.5E-09	1.9E-09	4.4	1.1	0.0079	0.0076
Median	5.2	13	1.3E-10	1.0E-12	1.4	0.68	0.0053	0.0046
Standard Deviation	22	30	2.6E-08	9.0E-09	10	0.91	0.0069	0.0060
Coefficient of Variation (COV)	1.5	1.3	2.8	4.7	2.3	0.86	0.86	0.80
Total pairs of observations	24		24		24		4	
Pairs with influent-to-effluent concentration reductions	5		11		16		2	
Pairs with influent-to-effluent concentration increases	18		2		7		1	
Pairs with equal influent and effluent concentrations	1		11		1		1	
Paired sign test p-value[1]	0.005		0.011		0.047		0.5	
Statistically significant number of data pairs with concentration reductions[1]?	No[2]		Yes		Yes		No (data numbers insufficient to indicate significance)	

[1] Non-parametric, one-tailed binomial sign test; p-values ≤ 0.05 indicate statistical significance.
[2] Data show statistically significant number of pairs with increases in TSS concentration

Comparisons to Permit Limits

Table 11 summarizes the comparison of influent and effluent sample concentrations to applicable Outfall 009 Permit limits at the ELV Treatment Control. Effluent concentrations were observed below the respective Outfall 009 Permit limit more often than corresponding influent concentrations for **lead** and **dioxins**, suggesting reductions from influent to effluent at these locations for these analytes. There were no influent or effluent concentrations above the Permit limit for **mercury** or **aluminum**. Additionally, the maximum and average concentration excess ratio for **dioxins** is lower for effluent results compared to influent results (there were no excess ratios calculated for mercury, aluminum, or lead for effluent samples, since there were no sample results greater than the Permit limit). These trends suggest reductions in lead and dioxins through the ELV Treatment Control.

Table 11. ELV Treatment Control: Summary of Influent and Effluent Results Compared to Reference Outfall 009 Permit Limits, 2013-2026

Parameter	% Above Outfall 009 Permit Limit		Maximum Concentration Excess Ratio[1]		Average Concentration Excess Ratio[1]	
	Influent	Effluent	Influent	Effluent	Influent	Effluent
Lead	13%	0%	9.7	<1	4.6	<1
Dioxins	17%	7.4%	13	6.9	4.8	4.2
Mercury	0%	0%	<1	<1	<1	<1
Aluminum	0%	0%	<1	<1	<1	<1

[1] A cell with "<1" indicates sample results were not observed above the respective Permit limit.

Paired Line Plots

Figure 48 through Figure 53 present paired line plots of the ELV Treatment Control.

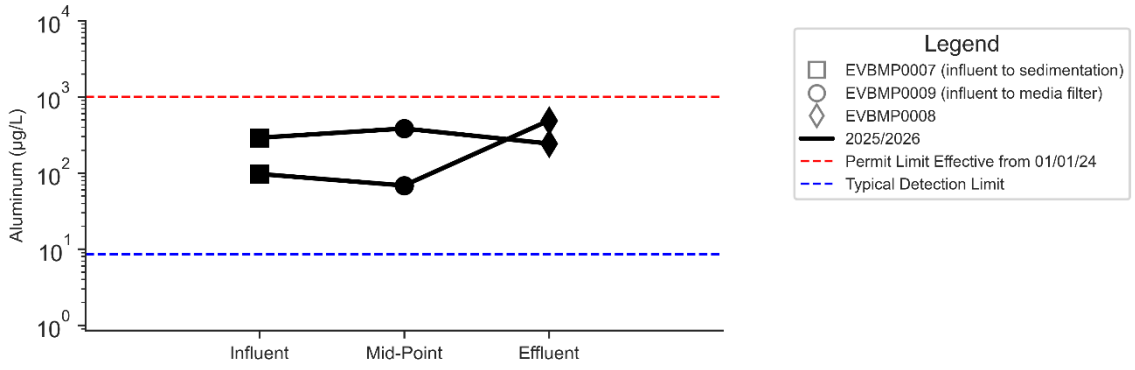
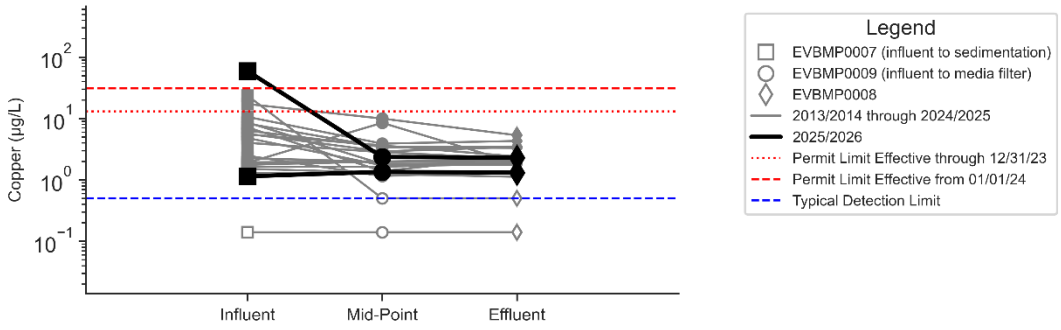


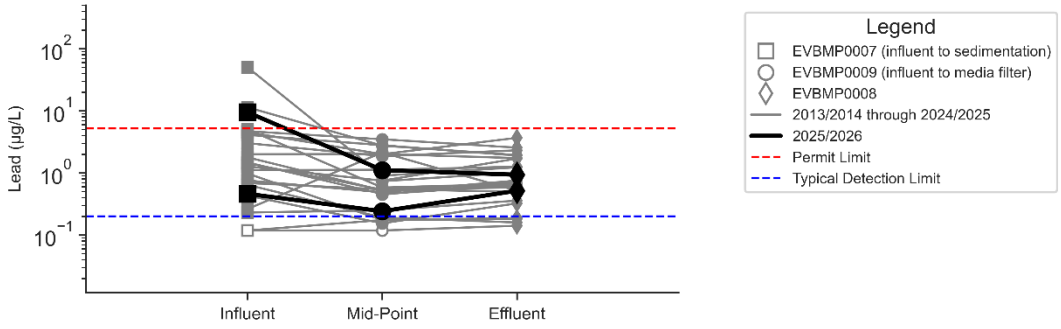
Figure 48: Aluminum at ELV Treatment Control



Note:

- Open symbols represent non-detect results or at least one non-detect sample in weighted average samples.

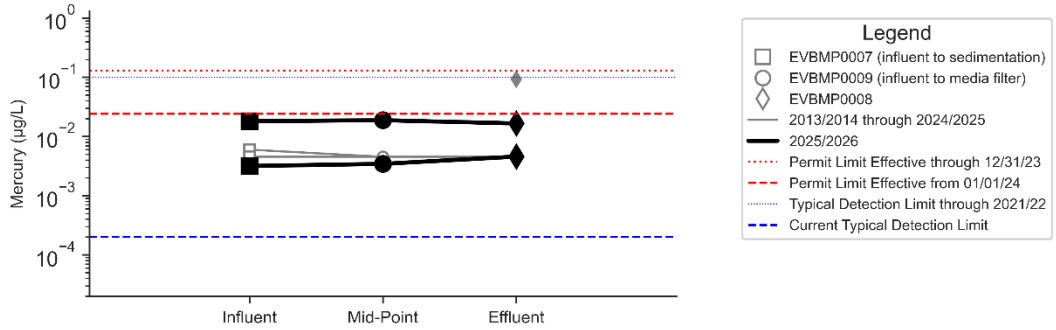
Figure 49: Copper at ELV Treatment Control



Note:

- Open symbols represent non-detect results or at least one non-detect sample in weighted average samples.

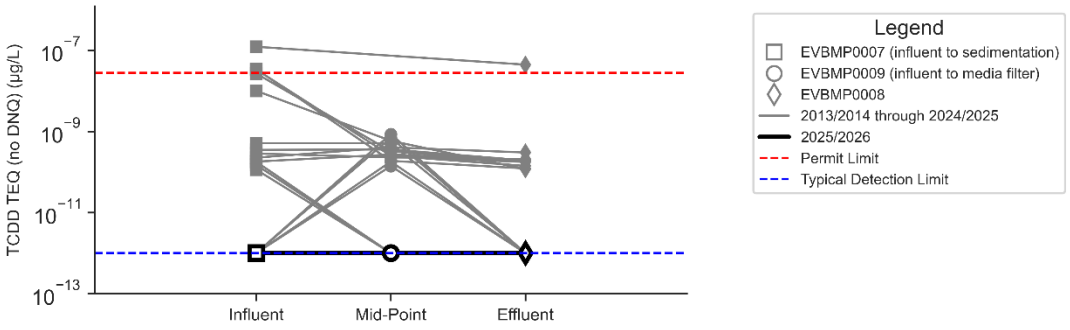
Figure 50: Lead at ELV Treatment Control



Note:

- Open symbols represent non-detect results or at least one non-detect sample in weighted average samples.

Figure 51: Mercury at ELV Treatment Control

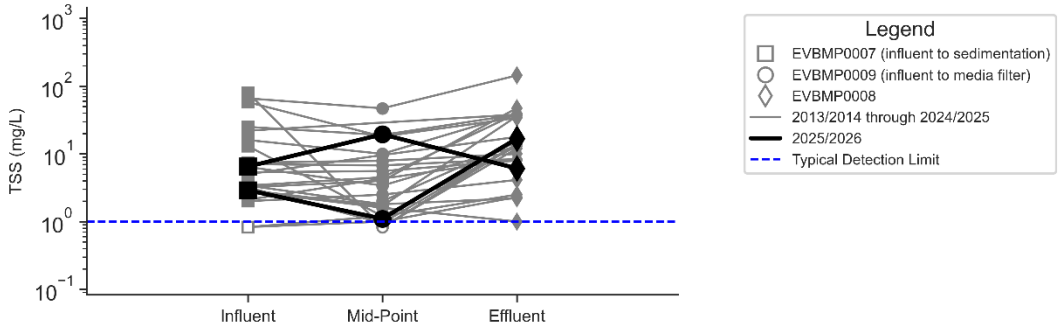


Note:

- 1E-12 ug/L is shown for ND TEQ results as this is in the range of the lowest reported TEQ results with DNQ excluded.

- Open symbols represent non-detect results or at least one non-detect sample in weighted average samples.

Figure 52: Dioxins at ELV Treatment Control



Note:

- There are no Permit Limits designated for TSS therefore there are no Limits shown on this plot.

- Open symbols represent non-detect results or at least one non-detect sample in weighted average samples.

Figure 53: TSS at ELV Treatment Control

3.2.3 Detention Bioswales

Statistical Analyses

The performances of the Southern and Northern Detention Bioswales were evaluated together due to their similarities in design. Results from statistical analyses conducted on paired data collected at the Detention Bioswales are presented in Table 12, indicating that the number of data pairs with decreases in concentration from the influent to the effluent, compared to pairs showing increases in concentration, is statistically significant for **TSS**, **dioxins**, and **lead**. Only seven and five data pairs were available for **mercury** and **aluminum**, respectively; therefore, there were insufficient data to show statistical significance in their concentration changes.

Table 12. Southern and Northern Detention Bioswale Statistical Analyses

	TSS (mg/L)		Dioxins (µg/L)		Lead (µg/L)		Mercury (µg/L)		Aluminum (µg/L)	
	Influent	**Effluent**	**Influent**	**Effluent**	**Influent**	**Effluent**	**Influent**	**Effluent**	**Influent**	**Effluent**
Minimum	0.5	1.1	1.0E-12	1.0E-12	0.50	0.50	0.0049	0.010	640	530
Maximum	220	36	2.1E-05	1.9E-07	23	3.5	0.026	0.037	6,400	1,600
Average	49	12	9.5E-07	1.7E-08	4.6	1.4	0.012	0.019	2,100	920
Median	31	9	9.8E-08	2.3E-10	3.0	1.4	0.013	0.018	1,100	770
Standard Deviation	51	9.3	3.6E-06	4.0E-08	4.4	0.78	0.0074	0.0093	2,400	420
Coefficient of Variation (COV)	1.1	0.80	3.8	2.4	0.95	0.54	0.61	0.50	1.1	0.45
Total pairs of observations	40		41		40		7		5	
Pairs with influent-to-effluent concentration reductions	34		37		32		2		3	
Pairs with influent-to-effluent concentration increases	6		1		7		5		2	
Pairs with equal influent and effluent concentrations	0		3		1		0		0	
Paired sign test p-value[1]	<0.001		<0.001		<0.001		0.23		0.50	
Statistically significant number of data pairs with concentration reductions[1]?	Yes		Yes		Yes		No (data numbers insufficient to indicate significance)		No (data numbers insufficient to indicate significance)	

[1] Non-parametric, one-tailed binomial sign test; p-values ≤ 0.05 indicate statistical significance.

Comparisons to Permit Limits

Sample results compared to respective Outfall 009 Permit limits at the Detention Bioswales are summarized in Table 13, showing fewer effluent results above Permit limits than corresponding influent results for all COPCs assessed. Additionally, ratios comparing the maximum and average effluent concentrations in excess of the Outfall 009 Permit limit to respective Permit limits are notably less than corresponding ratios using bioswales influent concentrations, for **dioxins** and **aluminum** (there was no excess ratio calculated for **lead** for effluent samples, since there were no sample results greater than the Permit limit). These results suggest reduction of the COPC concentrations in stormwater through treatment by the Detention Bioswales.

Table 13. Detention Bioswales: Summary of Influent and Effluent Results Compared to Reference Outfall 009 Permit Limits, 2015-2026

Parameter	% Above Outfall 009 Permit Limit		Maximum Concentration Excess Ratio[1]		Average Concentration Excess Ratio[1]	
	Influent	Effluent	Influent	Effluent	Influent	Effluent
Lead	31%	0%	4.5	<1	1.9	<1
Dioxins	79%	17%	740	6.7	41	2.7
Mercury	14%	10%	1.1	1.8	1.1	1.8
Aluminum	60%	20%	6.4	1.6	3.0	1.6

[1] A cell with "<1" indicates sample results were not observed above the respective Permit limit.

Paired Line Plots

Figure 54 through Figure 64 present paired line plots of the Northern and Southern Detention Bioswales. Performance monitoring sampling was discontinued at the Northern Detention Bioswale after 2016/17. Notably, copper concentrations have increased, potentially contributable to leaching of this COPC from compost included in the bioswales (Chahal, 2016).

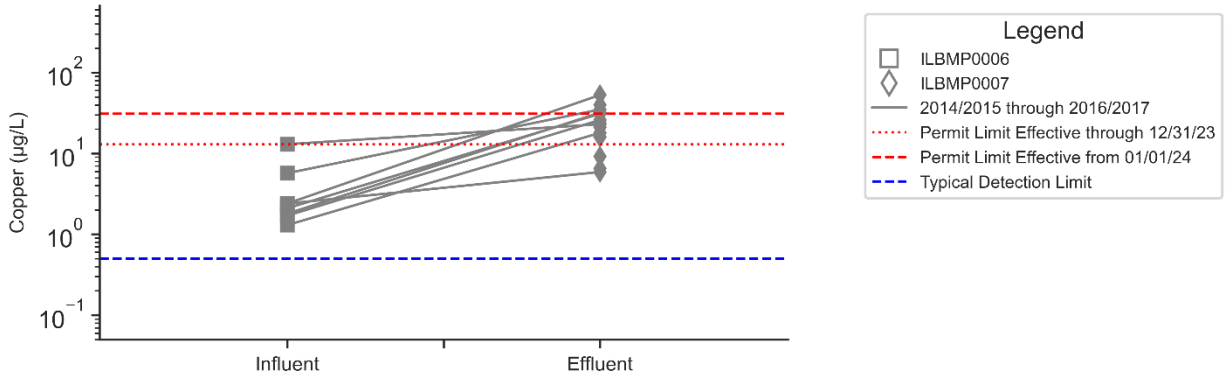
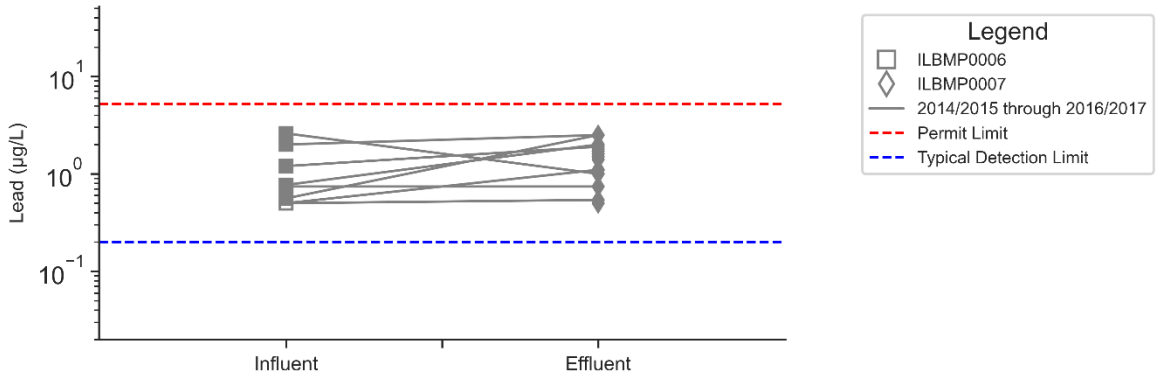


Figure 54: Copper at Northern Detention Bioswale



Note:

- Open symbols represent non-detect results or at least one non-detect sample in weighted average samples.

Figure 55: Lead at Northern Detention Bioswale

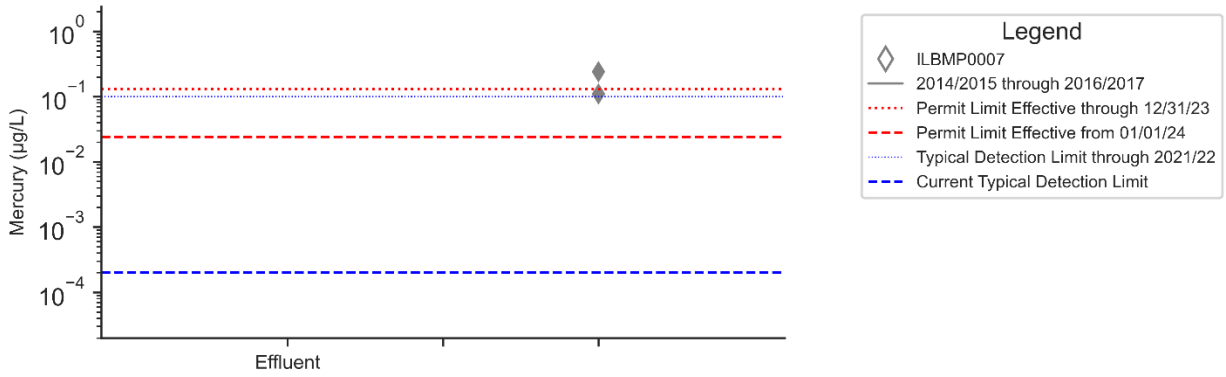
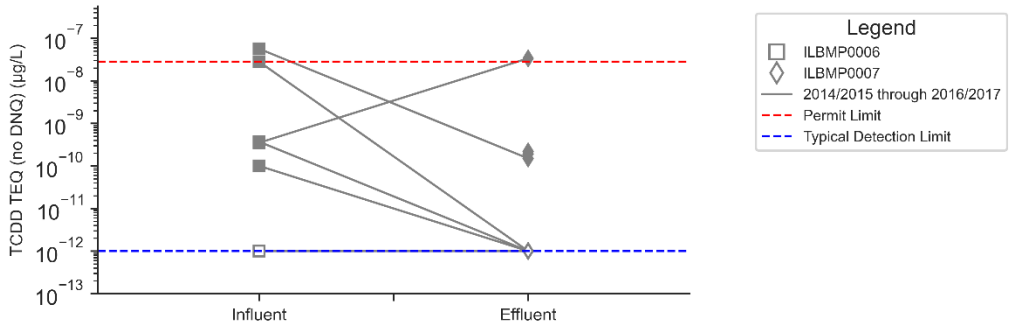


Figure 56: Mercury at Northern Detention Bioswale

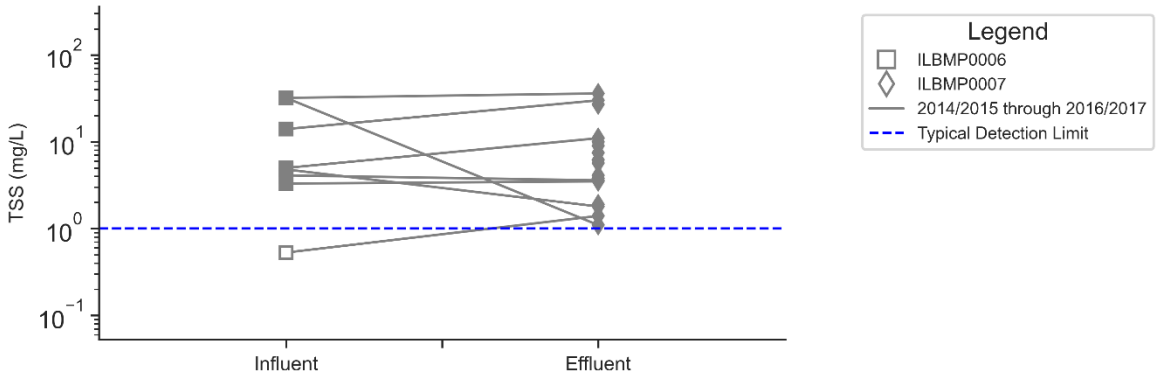


Note:

- 1E-12 ug/L is shown for ND TEQ results as this is in the range of the lowest reported TEQ results with DNQ excluded.

- Open symbols represent non-detect results or at least one non-detect sample in weighted average samples.

Figure 57: Dioxins at Northern Detention Bioswale



Note:

- There are no Permit Limits designated for TSS therefore there are no Limits shown on this plot.
- Open symbols represent non-detect results or at least one non-detect sample in weighted average samples.

Figure 58: TSS at Northern Detention Bioswale

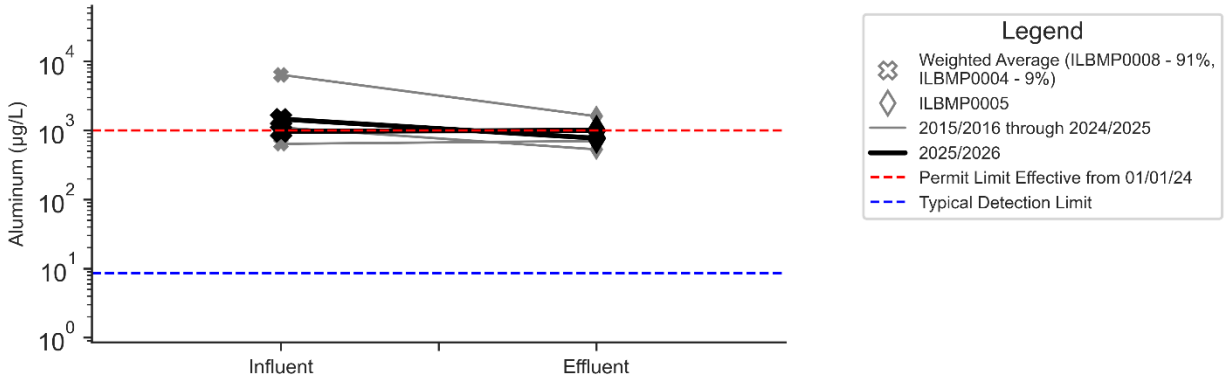


Figure 59: Aluminum at Southern Detention Bioswale

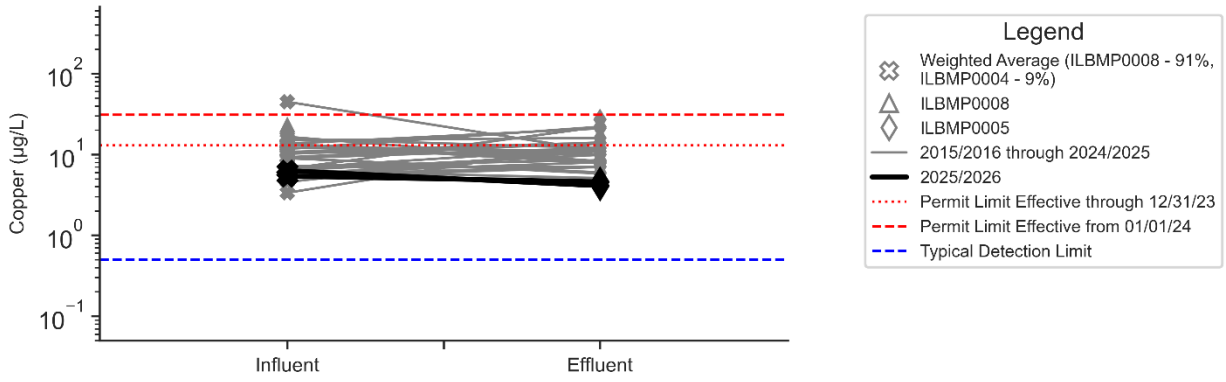
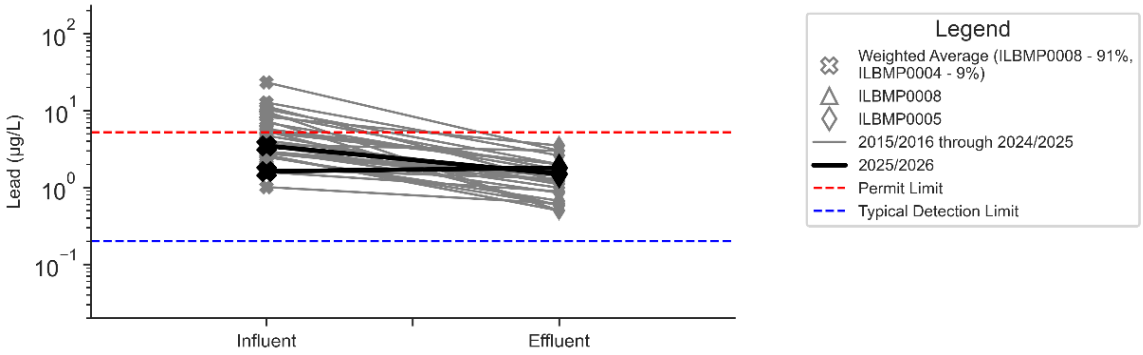


Figure 60: Copper at Southern Detention Bioswale



Note:

- Open symbols represent non-detect results or at least one non-detect sample in weighted average samples.

Figure 61: Lead at Southern Detention Bioswale

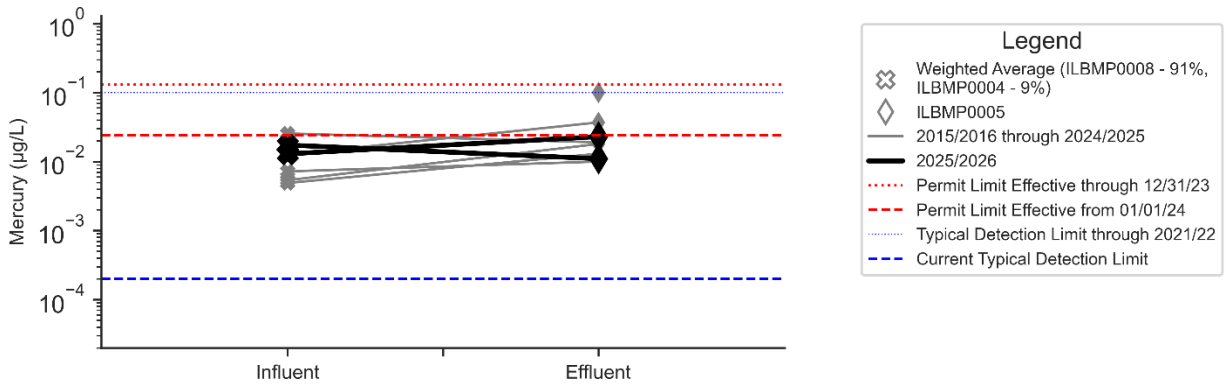
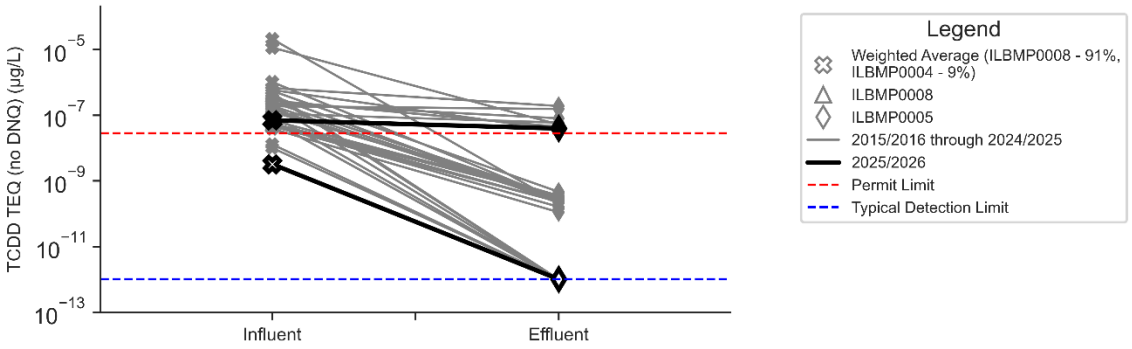


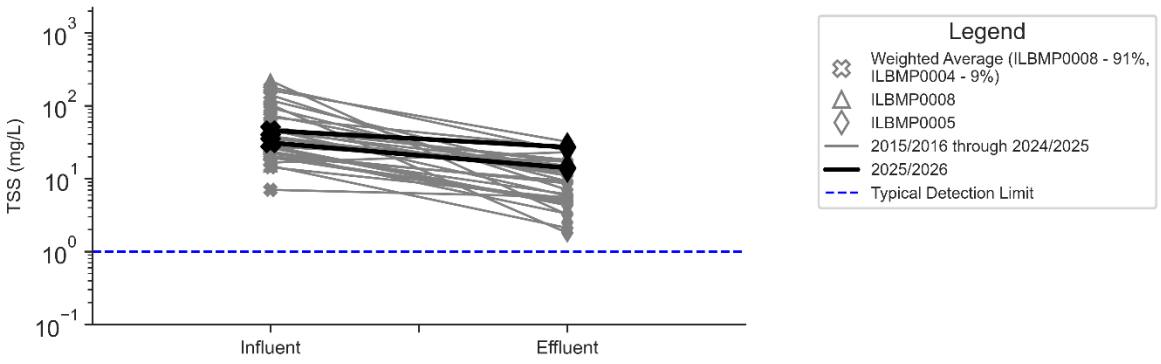
Figure 62: Mercury at Southern Detention Bioswale



Note:

- 1E-12 ug/L is shown for ND TEQ results as this is in the range of the lowest reported TEQ results with DNQ excluded.
- Open symbols represent non-detect results or at least one non-detect sample in weighted average samples.

Figure 63: Dioxins at Southern Detention Bioswale



Note:

- There are no Permit Limits designated for TSS therefore there are no Limits shown on this plot.

Figure 64: TSS at Southern Detention Bioswale

3.2.4 Lower Lot Biofilter

Statistical Analyses

Samples are taken from three locations within the biofilter treatment train: an influent, a midpoint at the sedimentation basin outlet, and a biofilter effluent. However, in the 2025/26 reporting year, no samples were collected due to staff prioritizing sampling of locations that were required by the Permit (whereas the treatment control monitoring is voluntary).

Table 14, Table 15, and Table 16 summarize statistics of influent-to-midpoint, midpoint-to-effluent, and influent-to-effluent, respectively, for TSS, dioxins, lead and mercury. For **TSS**, the majority of data pairs showed a decrease in concentrations for all steps of the treatment train (influent runoff to the sedimentation basin outlet, the sedimentation basin outlet to the biofilter outlet, and overall performance indicated by the influent to the biofilter outlet). However, there were insufficient data to show a statistically significant number of data pairs with concentration decreases for TSS, compared to pairs showing increases in concentration, for the influent runoff to the sedimentation basin outlet and influent runoff to the biofilter outlet. The number of data pairs with decreases in TSS concentrations from the sedimentation basin outlet to the biofilter outlet was statistically significant.

The majority of data pairs also showed decreases in **dioxins** concentrations, and the results were statistically significant for the sedimentation basin outlet to the biofilter outlet (indicating biofilter performance) and influent runoff to the biofilter outlet (indicating overall system performance). Across the system (influent runoff to the biofilter outlet), only one sample pair had effluent dioxins concentrations with higher concentrations than their paired influent sample.

For **lead**, the majority of sample pairs from all steps of the treatment train exhibited decreases in lead concentration. However, the influent to sedimentation basin outlet was the only step of the treatment train to show a statistically significant number of data pairs with a decrease in concentrations for lead.

There are only four sample pairs (influent-midpoint) and two sample pairs (midpoint-effluent and influent-effluent) available for **mercury**. One sample pair shows an increase in concentration from the influent to the biofilter effluent, while both the influent and effluent sample results were detected at the same concentration for the other sample pair. However, available sample pairs (for all legs of the treatment train) are not sufficient to show a statistically significant difference. There is only one influent to midpoint sample pair for **aluminum**, which is not sufficient to draw any meaningful statistically significant difference. Therefore, aluminum is not included in the tables.

Considering the entire system (influent runoff to the biofilter outlet) in Table 16, dioxins were the only COPC to show a statistically significant (p-value ≤ 0.05) number of paired samples that decreased in concentration from the influent runoff to the biofilter outlet. Although the majority of sample pairs showed a decrease in concentration from the influent to effluent, for TSS, lead, and mercury[14], there were insufficient data to show statistically significant reductions.

[14] One sample pair shows an increase in concentration from the influent to the biofilter effluent, while both the influent and effluent sample results were detected at the same concentration for the other sample pair.

Table 14. Lower Lot Biofilter Statistical Analyses: Influent to Midpoint Sample Points

	TSS (mg/L)		Dioxins (µg/L)		Lead (µg/L)		Mercury (µg/L)	
	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent
Minimum	2.7	2.5	1.0E-12	1.0E-12	0.58	0.54	0.0077	0.0081
Maximum	280	110	4.7E-07	2.8E-07	20	7.5	0.14	0.27
Average	30	22	8.1E-08	6.4E-08	2.7	2.2	0.043	0.076
Median	16	12	5.7E-08	4.6E-08	1.8	1.7	0.012	0.013
Standard Deviation	49	25	9.2E-08	6.8E-08	3.4	1.7	0.065	0.13
Coefficient of Variation (COV)	1.7	1.1	1.1	1.1	1.2	0.80	1.5	1.7
Total pairs of observations	34		34		34		4	
Pairs with influent-to-effluent concentration reductions	20		21		24		0	
Pairs with influent-to-effluent concentration increases	14		12		8		3	
Pairs with equal influent and effluent concentrations	0		1		2		1	
Paired sign test p-value[1]	0.20		0.081		0.0035		0.13	
Statistically significant number of data pairs with concentration reductions[1]?	No (data numbers insufficient to indicate significance)		No (data numbers insufficient to indicate significance)		Yes		No (data numbers insufficient to indicate significance)	

[1] Non-parametric, one-tailed binomial sign test; p-values ≤ 0.05 indicate statistical significance.

Table 15. Lower Lot Biofilter Statistical Analyses: Midpoint to Effluent Sample Points

	TSS (mg/L)		Dioxins (µg/L)		Lead (µg/L)		Mercury (µg/L)	
	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent
Minimum	2.5	0.83	1.0E-12	1.0E-12	0.54	0.28	0.0081	0.012
Maximum	110	110	2.8E-07	1.5E-07	6.6	5.6	0.014	0.017
Average	22	19	6.3E-08	9.3E-09	2.0	2.0	0.011	0.015
Median	12	12	4.5E-08	2.0E-10	1.6	1.5	0.011	0.015
Standard Deviation	25	25	6.7E-08	2.7E-08	1.4	1.4	0.0042	0.0035
Coefficient of Variation (COV)	1.2	1.3	1.1	2.9	0.72	0.73	0.38	0.24
Total pairs of observations	35		35		35		2	
Pairs with influent-to-effluent concentration reductions	22		31		19		1	
Pairs with influent-to-effluent concentration increases	11		2		16		1	
Pairs with equal influent and effluent concentrations	2		2		0		0	
Paired sign test p-value[1]	0.040		<0.001		0.37		0.75	
Statistically significant number of data pairs with concentration reductions[1]?	Yes		Yes		No (data numbers insufficient to indicate significance)		No (data numbers insufficient to indicate significance)	

[1] Non-parametric, one-tailed binomial sign test; p-values ≤ 0.05 indicate statistical significance.

Table 16. Overall Lower Lot Biofilter Statistical Analyses (Influent to Effluent Sample Points)

	TSS (mg/L)		Dioxins (µg/L)		Lead (µg/L)		Mercury (µg/L)	
	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent
Minimum	2.7	0.83	1.0E-12	1.0E-12	0.58	0.28	0.0077	0.012
Maximum	280	110	4.7E-07	1.5E-07	20	5.6	0.012	0.017
Average	31	20	9.3E-08	1.0E-08	2.8	2.0	0.0099	0.015
Median	18	13	5.8E-08	2.1E-10	1.9	1.6	0.0099	0.015
Standard Deviation	49	25	1.1E-07	2.8E-08	3.4	1.5	0.0030	0.0035
Coefficient of Variation (COV)	1.6	1.3	1.2	2.8	1.2	0.72	0.31	0.24
Total pairs of observations	34		34		34		2	
Pairs with influent-to-effluent concentration reductions	22		31		20		0	
Pairs with influent-to-effluent concentration increases	12		1		12		1	
Pairs with equal influent and effluent concentrations	0		2		2		1	
Paired sign test p-value[1]	0.06		<0.001		0.11		0.50	
Statistically significant number of data pairs with concentration reductions[1]?	No (data numbers insufficient to indicate significance)		Yes		No (data numbers insufficient to indicate significance)		No (data numbers insufficient to indicate significance)	

[1] Non-parametric, one-tailed binomial sign test; p-values ≤ 0.05 indicate statistical significance.

Comparisons to Permit Limits

Influent and effluent results observed at the Lower Lot Biofilter compared to respective Outfall 009 Permit limits are summarized in Table 17. Effluent concentrations were observed below the respective Outfall 009 Permit limit more often than corresponding influent concentrations for **lead**, **dioxins**, **mercury**, and **aluminum**, illustrating reductions from influent to effluent concentrations. Additionally, the maximum and average concentration excess ratio for **lead** and **dioxins** was lower for effluent results compared to influent results (there was no excess ratio calculated for mercury and aluminum for effluent samples, since there were no sample results greater than the Permit limit), further suggesting effective reduction of these COPCs in stormwater through treatment by the Lower Lot Biofilter.

Table 17. Lower Lot Biofilter: Summary of Influent and Effluent Results Compared to Reference Outfall 009 Permit Limits, 2013-2025

Parameter	% Above Outfall 009 Permit Limit		Maximum Concentration Excess Ratio[1]		Average Concentration Excess Ratio[1]	
	Influent	Effluent	Influent	Effluent	Influent	Effluent
Lead	7.9%	2.8%	3.8	1.1	2.1	1.1
Dioxins	79%	8.3%	17	5.2	3.8	3.3
Mercury	14%	0%	1.1	<1	1.1	<1
Aluminum	33%	0%	1.1	<1	1.1	<1

[1] A cell with "<1" indicates sample results were not observed above the respective Permit limit.

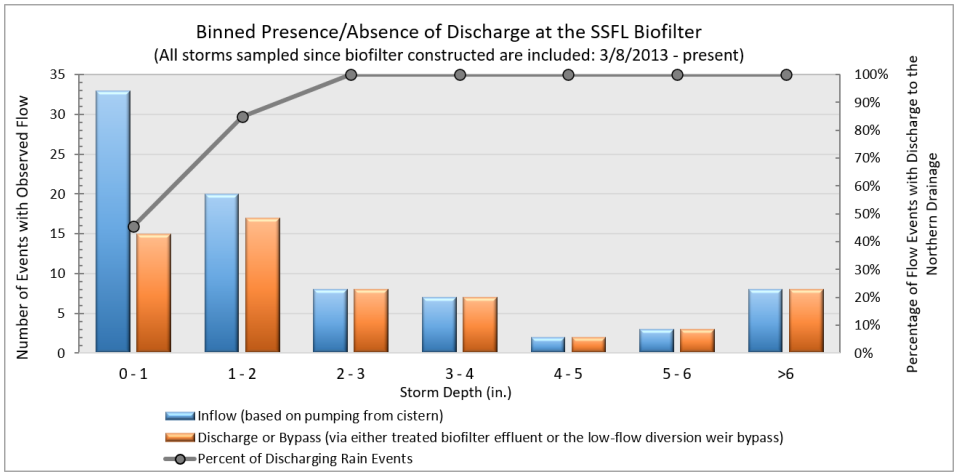
Runoff Flow Rates and Volumes

In addition to water quality performance, the Lower Lot Biofilter is designed to reduce the frequency that runoff discharges to the Northern Drainage and ultimately flows to Outfall 009 by retaining and slowly

reducing flow rates through detention and reducing runoff volumes by evapotranspiration. A 2017 analysis estimated that the average volume of runoff pumped to the biofilter per inch of rainfall increased from 52,000 gallons to 82,000 gallons following implementation of the Detention Bioswales, and the average percent of total runoff captured and treated by the Lower Lot Biofilter from both the 24-inch storm drain and the lower lot drainage areas increased from 22% to 44% following Detention Bioswales implementation. These changes allowed more site runoff to be treated by the Lower Lot Biofilter instead of bypassing it and directly discharging into the Northern Drainage without treatment.

Figure 65 is a plot of discharging and non-discharging rain events for storms since the March 2013 implementation of the biofilter. This figure shows the quantity and types of storms in which the biofilter prevents discharges of stormwater runoff to the Northern Drainage. Storm events resulting in discharge to the Northern Drainage (via either the low-flow diversion weir bypass or treated biofilter effluent) were identified, categorized by total storm depth in one-inch increments, and compared to the total number of storms observed (where pumping from the cistern was recorded). Because stormwater runoff flows into the cistern and is then pumped to the Lower Lot Biofilter, rain events are only counted in this analysis if pumping from the cistern occurred. The vertical axis on the right indicates the percentage of storm events that resulted in discharges to the Northern Drainage.

As shown in Figure 65, it was estimated that the Lower Lot Biofilter has successfully reduced discharges to the Northern Drainage in approximately 55% of storms of an inch or less of rainfall, 15% of storms between 1 and 2 inches of rainfall, and 0% of storms greater than 2 inches of rainfall. Smaller storms occur at a greater frequency than moderate and large-sized storms. Therefore, the Lower Lot Biofilter is significantly reducing the number of rain events that result in runoff directly discharging to the Northern Drainage without treatment.



[1] Discharging percentages of events were estimated based on sums of events with observed or model-predicted discharge.

[2] For one storm event in 2020/2021 and three storm events in 2022/23, with storm depths greater than 6 inches, observations were not made during the rain event or discharge observations are inconclusive. Therefore, discharge was derived from model prediction (as described in Section 4.1).

[3] For rain events on 1/2-1/3/2024 (0.59”), 2/1-2/7/2024 (12.56”), and 2/17-2/21/2024 (4.45”), the Lower Lot Biofilter was undergoing remediation. Therefore, the stormwater control was inoperable, and these rain events were excluded from the analysis.

[4] For rain events on 3/10-3/23/2020 (7.08”), 1/8-1/10/2023 (6.32”), 2/23-3/1/2023 (10.1”), 3/19-3/22/2023 (3.02”), 8/20-8/21/2023 (5.17”), 3/5-3/6/2025 (0.6”), 4/26-4/26/2025 (0.33”), and 2/15-2/19/2026 (4.35”) observations are not available or inconclusive for the Lower Lot Biofilter. Therefore, discharge was derived from model prediction (as described in Section 2.5.1).

Figure 65. Discharging and Non-Discharging Events at the Lower Lot Biofilter

Paired Line Plots

Figure 66 through Figure 71 present paired line plots for concentration observations at the Lower Lot Biofilter. No samples were collected during the 2025/26 reporting year due to staff prioritizing sampling of locations that were required by the Permit (whereas the treatment control monitoring is voluntary).

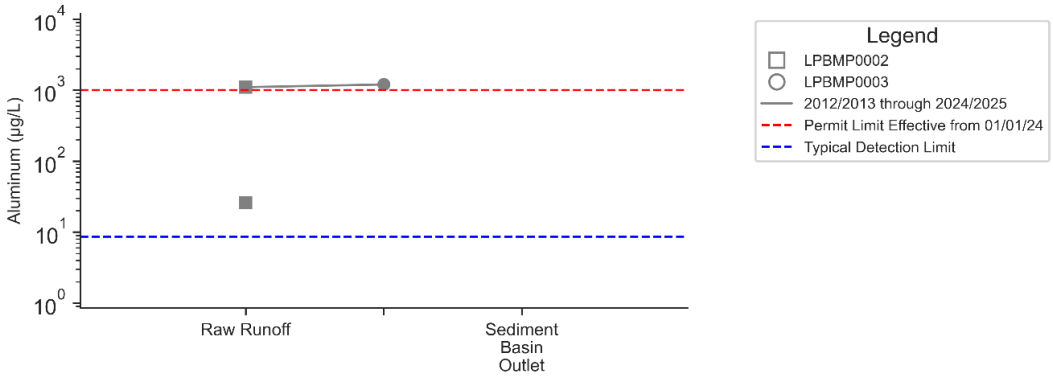


Figure 66: Aluminum at Lower Lot Biofilter

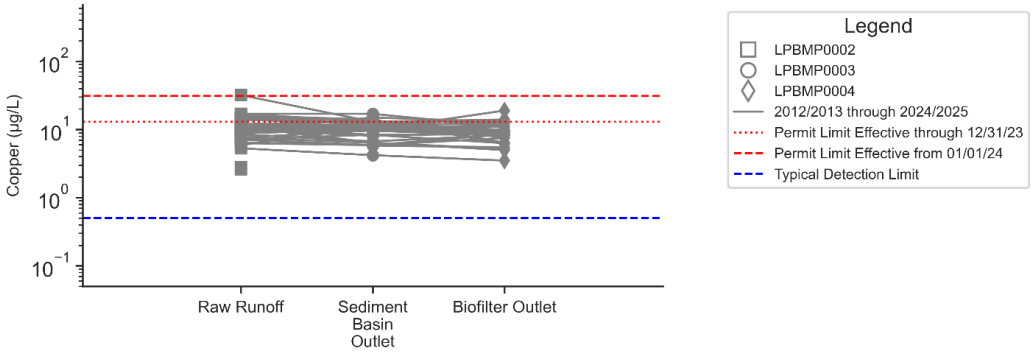
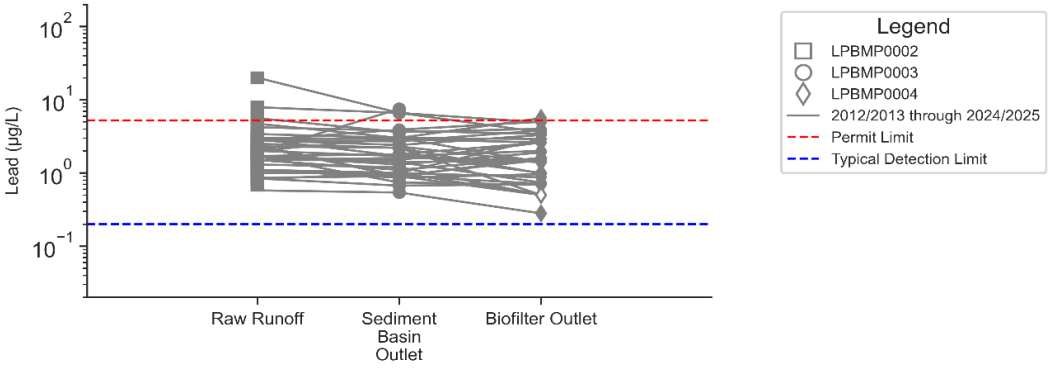


Figure 67: Copper at Lower Lot Biofilter



Note:

- Open symbols represent non-detect results or at least one non-detect sample in weighted average samples.

Figure 68: Lead at Lower Lot Biofilter

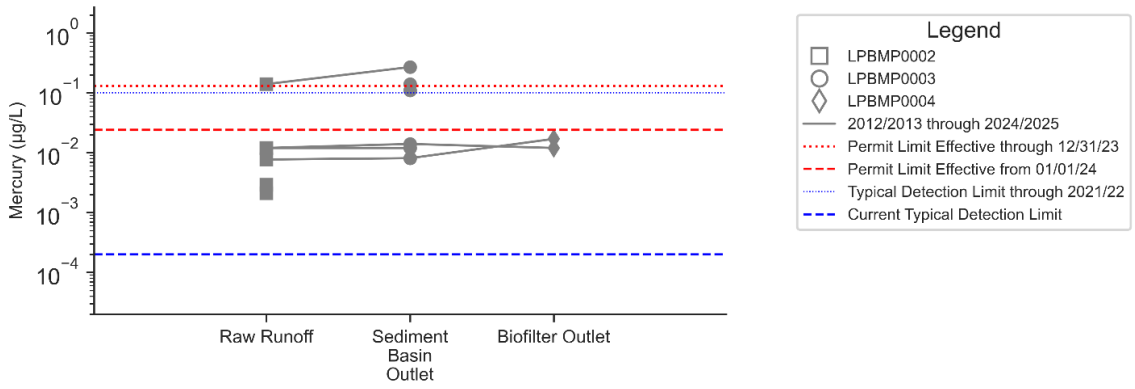
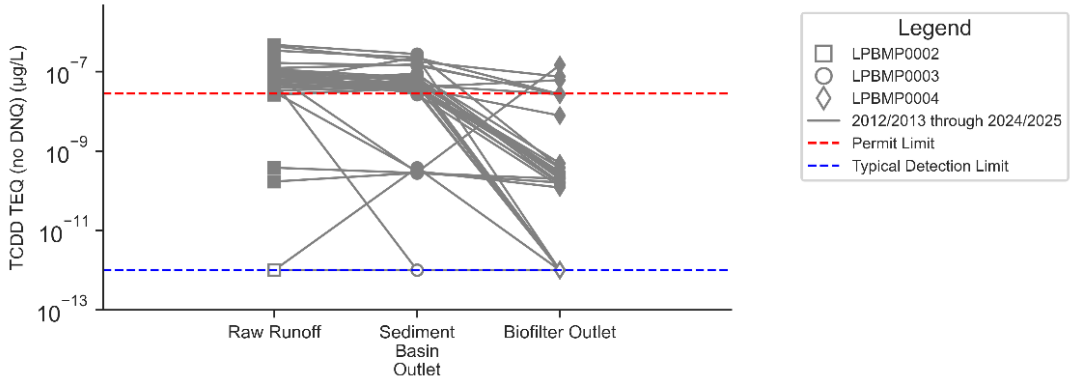


Figure 69: Mercury at Lower Lot Biofilter



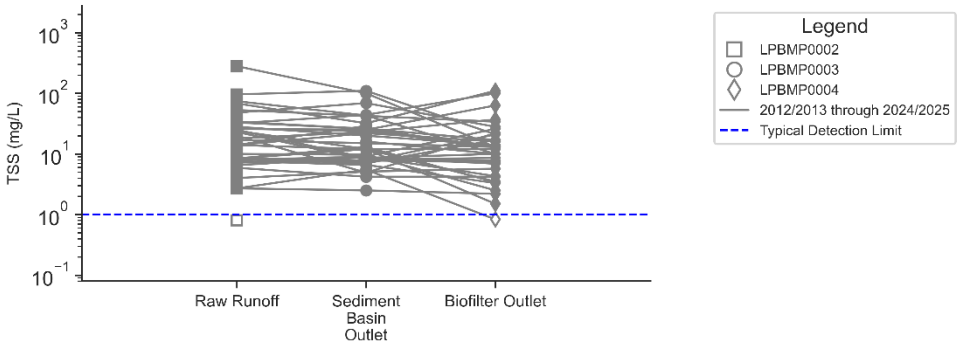
Note:

- 1E-12 ug/L is shown for ND TEQ results as this is in the range of the lowest reported TEQ results with DNQ excluded.

- Open symbols represent non-detect results or at least one non-detect sample in weighted average samples.

Figure 70: Dioxins at Lower Lot Biofilter[15]

[15] Evaluation of the elevated effluent concentration observed in 2018/19 indicated inconsistency with typical treatment performance that has been observed at the Lower Lot Biofilter before and after the isolated event.



Note:

- There are no Permit Limits designated for TSS therefore there are no Limits shown on this plot.

- Open symbols represent non-detect results or at least one non-detect sample in weighted average samples.

Figure 71: TSS at Lower Lot Biofilter

3.2.5 Outfall 011 and Outfall 018 SWTS

Statistical Analyses

The statistical analyses in Table 18 show that the number of data pairs with decreases in concentrations from the SWTS influent (pumped pond water in the treatment facility) to the effluent (i.e., respective outfalls), compared to pairs showing increases in concentration, is statistically significant for **TSS**, **lead**, and **mercury**. For **dioxins**, there were six sample pairs showing a decrease in concentrations from the influent to the effluent, with only one pair showing an increase. The relatively few sample pairs, considering the 13 samples pairs with non-detect concentrations reported as equal influent and effluent concentrations, likely contributed to insufficient data to show a statistically significant reduction. There were also insufficient data to show a statistically significant reduction for **aluminum**.

Table 18. SWTSs Statistical Analyses

	TSS (mg/L)		Dioxins (µg/L)		Lead (µg/L)		Aluminum (µg/L)		Mercury (µg/L)	
	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent
Minimum	0.9	0.80	1.0E-12	1.0E-12	0.12	0.058	45	54	0.0031	0.0011
Maximum	54	1.0	6.1E-08	3.9E-08	3.2	3.5	960	170	0.034	0.0049
Average	10	0.84	7.3E-09	2.0E-09	0.73	0.31	552	110	0.012	0.0024
Median	5.0	0.84	1.0E-12	1.0E-12	0.42	0.12	690	110	0.0085	0.0023
Standard Deviation	14	0.10	1.8E-08	8.8E-09	0.74	0.76	410	38	0.0089	0.00099
Coefficient of Variation (COV)	1.3	0.12	2.5	4.5	1.0	2.5	0.75	0.36	0.76	0.41
Total pairs of observations	16		20		20		7		17	
Pairs with influent-to-effluent concentration reductions	16		6		17		6		17	
Pairs with influent-to-effluent concentration increases	0		1		1		1		0	
Pairs with equal influent and effluent concentrations	0		13		2		0		0	
Paired sign test p-value[1]	<0.001		0.06		<0.001		0.06		0.0017	
Statistically significant number of data pairs with concentration reductions[1]?	Yes		No (data numbers insufficient to indicate significance)		Yes		No (data numbers insufficient to indicate significance)		Yes	

[1] Non-parametric, one-tailed binomial sign test; p-values ≤ 0.05 indicate statistical significance.

Comparisons to Permit Limits

Sample results at the Outfall 011 SWTS compared to respective Outfall 011 Permit limits are summarized in Table 19. There were no influent or effluent concentrations greater than the Outfall 011 Permit limit for **lead**; **mercury** had one influent sample concentration (one of eight) that was greater than the Outfall 011 Permit limit and no effluent concentrations that were above the respective Permit limit. For **dioxins**, 33% (three of nine) influent concentrations were above Outfall 011 Permit limits, while there were no exceedances of Permit limits for effluent samples. For **aluminum**, 25% of influent samples (one of four samples) and 25% of effluent samples (two of eight samples) were greater than the Outfall 011 Permit

limit. However, as noted in Table 19, the two effluent samples exceeding the Outfall 011 Permit limit for aluminum occurred during overflow or bypass conditions.

Sample results at the Outfall 018 SWTS compared to Outfall 018 Permit limits are summarized in Table 20. 17% of the influent samples (three out of 18 samples) for **dioxins** were above the Outfall 018 Permit limit, while none of the effluent samples exceeded the Permit limit. All influent and effluent concentrations were below the Outfall 018 Permit limits for **lead**. **Mercury** and **aluminum** influent and effluent concentrations were below the respective Permit limits, except for one mercury influent sample (one out of 18) and one aluminum effluent sample (one out of 16), which occurred during overflow or bypass conditions.

Table 19. Outfall 011 SWTS: Summary of Influent and Effluent Results Compared to Outfall 011 Permit Limits, 2022-2026

Parameter	% Above Outfall 011 Permit Limit		Maximum Concentration Excess Ratio[1]		Average Concentration Excess Ratio[1]	
	Influent	Effluent	Influent	Effluent	Influent	Effluent
Lead	0%	0%	<1	<1	<1	<1
Dioxins	33%	0%	4.2	<1	2.5	<1
Mercury	13%	0%	1.2	<1	1.2	<1
Aluminum	25%	25%[2]	1.7	2.6	1.7	2.2

[1] A cell with "<1" indicates sample results were not observed above the respective Permit limit.

[2] Two sample results above the Outfall 011 Permit limit occurred during bypass or overflow conditions.

Table 20. Outfall 018 SWTS: Summary of Influent and Effluent Results Compared to Outfall 018 Permit Limits, 2021-2026

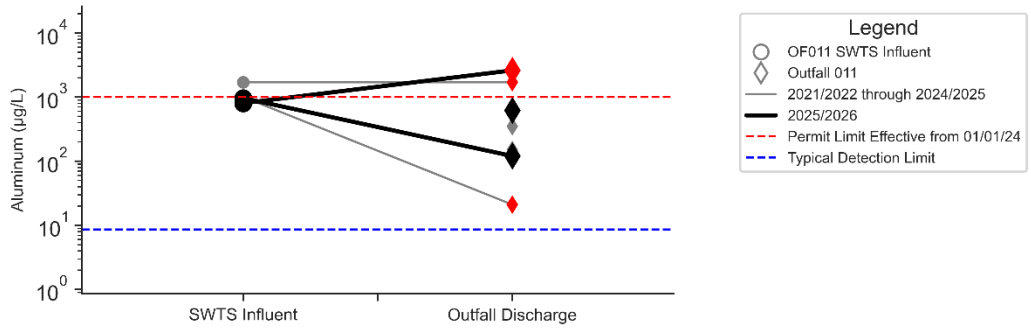
Parameter	% Above Outfall 018 Permit Limit		Maximum Concentration Excess Ratio[1]		Average Concentration Excess Ratio[1]	
	Influent	Effluent	Influent	Effluent	Influent	Effluent
Lead	0%	0%	<1	<1	<1	<1
Dioxins	17%	0%	2.2	<1	1.7	<1
Mercury	6%	0%	1.1	<1	1.1	<1
Aluminum	0%	6%[2]	<1	1.2	<1	1.2

[1] A cell with "-" indicates sample results were not observed above the respective Permit limit.

[2] The one sample result above the Outfall 018 Permit limit occurred during bypass or overflow conditions.

Paired Line Plots

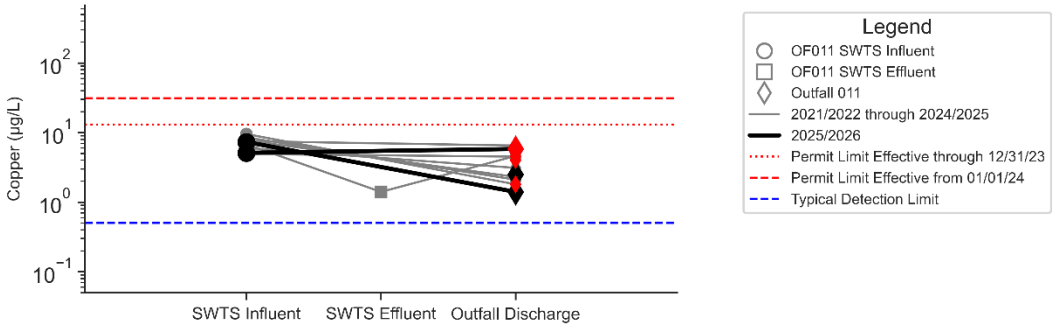
Figure 72 through Figure 83 present paired line plots of the Outfall 011 and Outfall 018 SWTS concentration observations.



Note:

- Red markers indicate samples collected during pond overflow.

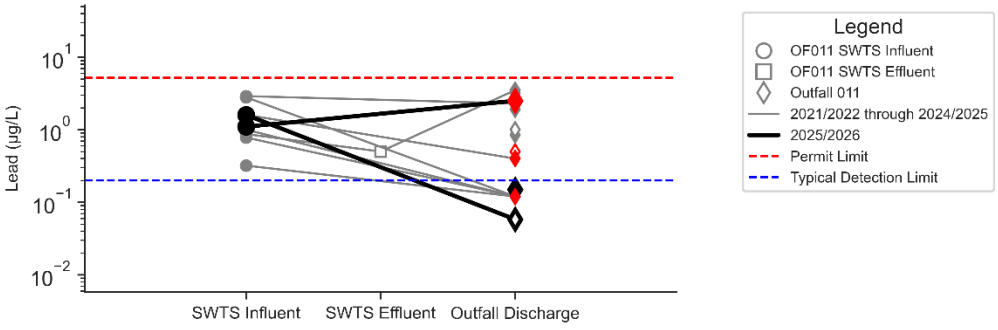
Figure 72: Aluminum at Outfall 011 SWTS



Note:

- Red markers indicate samples collected during pond overflow.

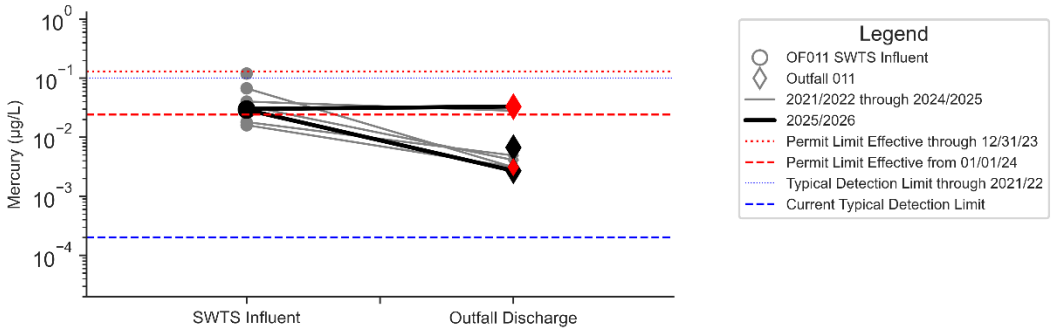
Figure 73: Copper at Outfall 011 SWTS



Note:

- Open symbols represent non-detect results or at least one non-detect sample in weighted average samples.
- Red markers indicate samples collected during pond overflow.

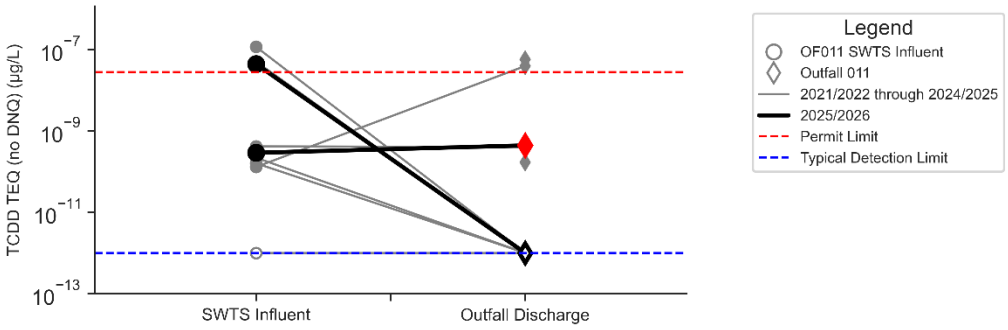
Figure 74: Lead at Outfall 011 SWTS



Note:

- Red markers indicate samples collected during pond overflow.

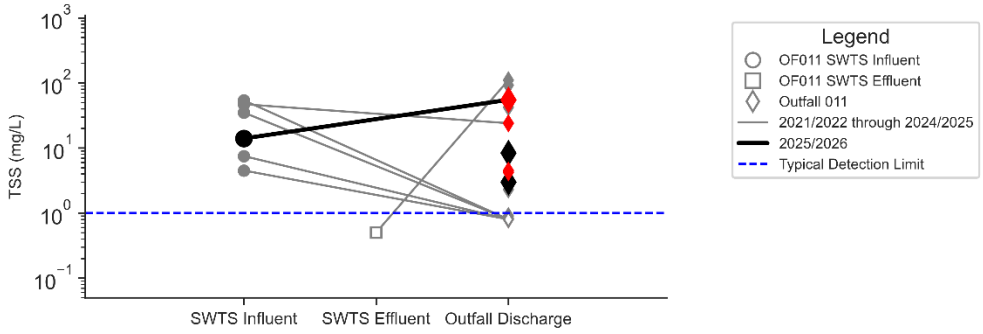
Figure 75: Mercury at Outfall 011 SWTS



Note:

- 1E-12 ug/L is shown for ND TEQ results as this is in the range of the lowest reported TEQ results with DNQ excluded.
- Open symbols represent non-detect results or at least one non-detect sample in weighted average samples.
- Red markers indicate samples collected during pond overflow.

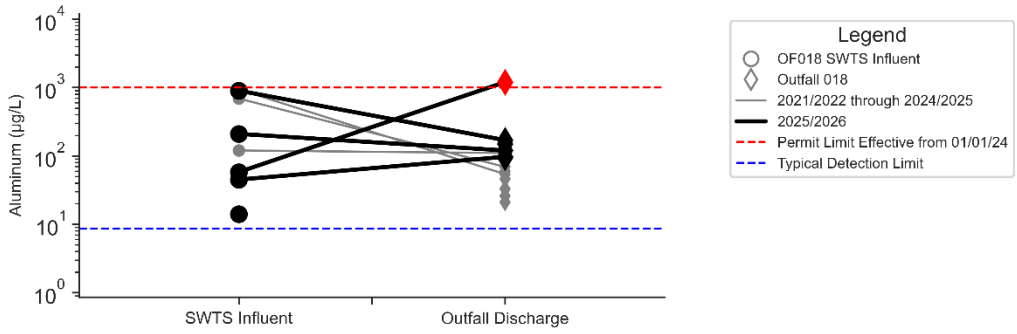
Figure 76: Dioxins at Outfall 011 SWTS



Note:

- There are no Permit Limits designated for TSS therefore there are no Limits shown on this plot.
- Red markers indicate samples collected during pond overflow.

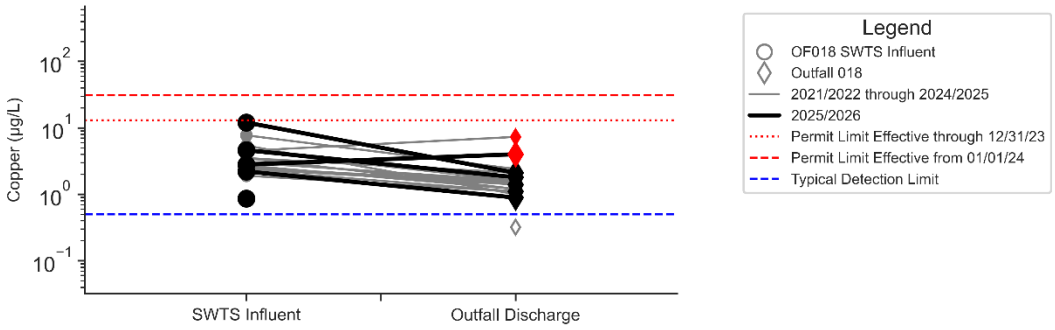
Figure 77: TSS at Outfall 011 SWTS



Note:

- Red markers indicate samples collected during pond overflow.

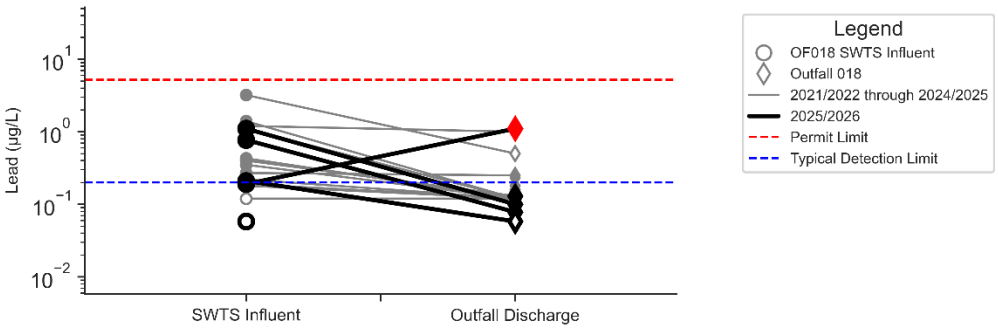
Figure 78: Aluminum at Outfall 018 SWTS



Note:

- Open symbols represent non-detect results or at least one non-detect sample in weighted average samples.
- Red markers indicate samples collected during pond overflow.

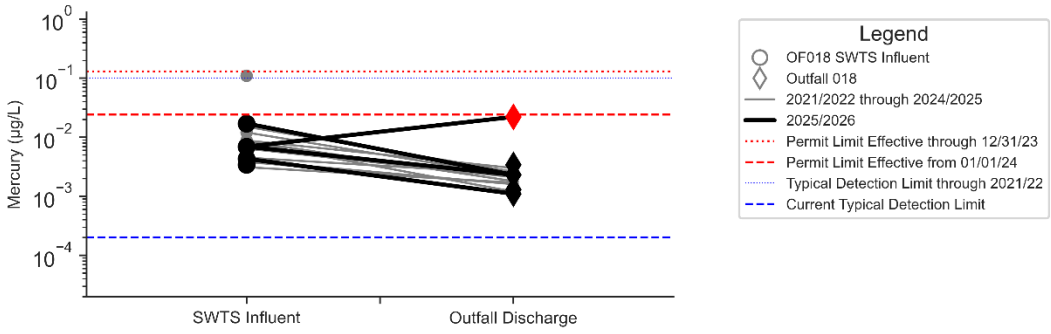
Figure 79: Copper at Outfall 018 SWTS



Note:

- Open symbols represent non-detect results or at least one non-detect sample in weighted average samples.
- Red markers indicate samples collected during pond overflow.

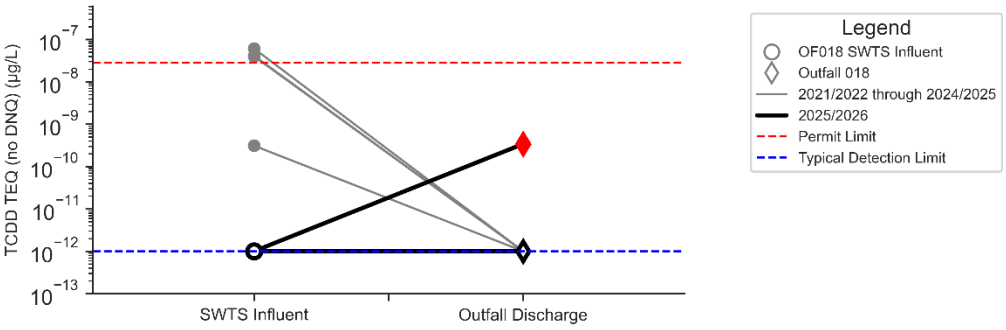
Figure 80: Lead at Outfall 018 SWTS



Note:

- Red markers indicate samples collected during pond overflow.

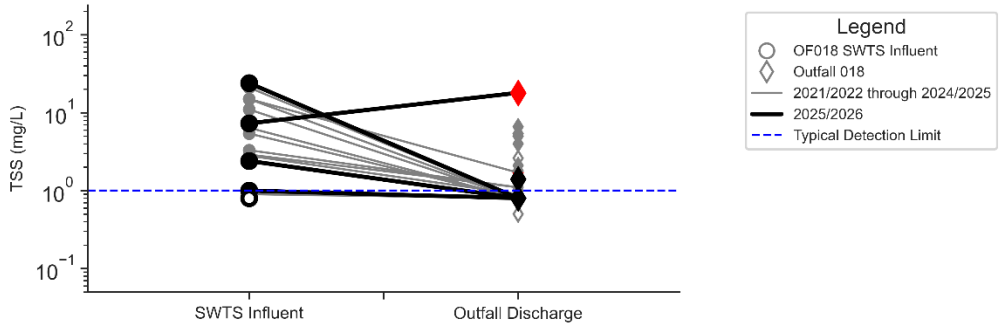
Figure 81: Mercury at Outfall 018 SWTS



Note:

- 1E-12 ug/L is shown for ND TEQ results as this is in the range of the lowest reported TEQ results with DNQ excluded.
- Open symbols represent non-detect results or at least one non-detect sample in weighted average samples.
- Red markers indicate samples collected during pond overflow.

Figure 82: Dioxins at Outfall 018 SWTS



Note:

- There are no Permit Limits designated for TSS therefore there are no Limits shown on this plot.
- Red markers indicate samples collected during pond overflow.

Figure 83: TSS at Outfall 018 SWTS

4. Summary of Stormwater Control Maintenance Findings

4.1 Cumulative TSS Loading

Estimated TSS loads captured per unit media surface area and percent of sediment loading capacity to date is shown by stormwater control in Table 21. The estimated time that effective media performance expected before filter media needs maintenance or replacement, assuming average annual rainfall since 2009/10 (17.8 inches) and the average influent and effluent TSS concentrations from all sampled events, is also shown by stormwater control in Table 21. The maintenance considerations for the CMs and media filters show that additional maintenance may be required for CM-9, based on the TSS loading analysis.

Table 21. Percent of Sediment Loading Capacity Reached Until Maintenance

Stormwater Control	Year of Install or Last Media Replacement	Years Since Install or Media Replacement	Cumulative TSS Captured (kg)	Cumulative TSS Captured per Unit Area (kg/m²)	Estimated % of Sediment Capture Capacity Reached	TSS per Average Annual Rainfall Year (kg/m²)	Estimated Average Years Remaining to Maintenance
Lower Lot Biofilter	2012/13	14	1,100	5.2	11%	0.8	>10
B-1 Media Filter[1]	2025/26	1	32	2	3%[1]	1.6	>10
Upper Lot Media Filter	2016/17	10	290	11	23%	1.2	>10
CM-1[2]	2018/19[3]	8	110	19	39%	2.8	>10
CM-9	2009/10	17	570[4]	96	>100%	7.4	0
ELV Treatment Control[2]	2013/14	13	4.3	0.2	0.4%	<1	>10

[1] Samples for the B-1 Media Filter were collected after the media reconstruction in January 2026.

[2] TSS loading analysis was restarted in 2018/2019 after stormwater control reconstruction and media replacement. Prior to reconstruction (which occurred prior to the 2018/2019 rainy season, in August 2018), CM-1 was estimated to have approximately 400 kg of cumulative TSS loading (which represents approximately 136% of the estimated sediment load until maintenance is needed). CM-1 had been in operation nine rainy seasons before reconstruction occurred.

[3] The drainage layers and filtration media of the stormwater control were rebuilt in Summer 2021. New, clean gravel was installed at the bottom of the tank, a layer of pea gravel was added above the larger gravel, and the existing media was placed back on top of the pea gravel. Following the reconstruction, the system was flushed with potable water to reduce sediment within the system. Although this maintenance was performed, the treatment media itself was not replaced. Therefore, for purposes of this analysis, cumulative TSS loading to the media was estimated since installation of the stormwater control.

[4] The cumulative TSS captured for CM-9 represents a very similar value for the 2025/2026 annual report compared to the 2024/2025 annual report. To assess TSS concentrations during events with predicted discharge, the TSS concentration is represented by the average difference in influent and effluent concentrations observed at the stormwater control within three years before or after the given storm. This representative TSS concentration decreased with the addition of new data, therefore resulting in a lower estimated cumulative TSS capture for CM-9

4.2 Cumulative EBVs Treated

Table 22 presents the results of cumulative EBV analysis as described in section 2.5.2. The greatest cumulative EBV loading is estimated for the ELV Treatment Control, followed by CM-9, CM-5, and CM-1. These values identify the stormwater controls that have experienced the greatest hydraulic throughput relative to their media volumes; however, these results alone do not indicate that media breakthrough or clogging has occurred. For example, the ELV Treatment Control has the greatest estimated cumulative EBV loading while having very low estimated cumulative TSS loading (as shown in Section 4.1), whereas CM-9 has a similar cumulative EBV loading but has exceeded its estimated sediment-loading capacity. The cumulative EBVs treated for stormwater controls are most useful for identifying relatively highly utilized controls for closer evaluation using water quality sample data, sediment loading, and observation during and following rain events.

Table 22. EBVs Treated in an Average Rainfall Year and Since Stormwater Control Installation or Reconstruction

Stormwater Control	Drainage Area (acres)	First Rainy Season in Operation	Approx. Runoff Volumes Treated (ac-ft) (from SWMM modeling)[1]		Filter Media			EBVs Treated per Average Rainfall Year	Total EBVs Treated Since Installation or Reconstruction
			Average Rainfall Year	Since Constructed or Reconstructed	Surface Area (sq ft)	Depth (ft)	Volume (cu ft)		
Upper Lot Media Filter	5.1	2016/17	2.5	30	280	1.7	460	240	2,800
B-1 Media Filter[2]	8.6	2025/26	1.8	2.7	200	1.5	310	260	390
CM-1[3]	44	2018/19	1.1	11	64	2	130	360	3,700
CM-2	15	2009/10	0.06	1.0	64	2	130	21	350
CM-3[4]	17	2019/20	0.26	2.3	64	2	130	90	800
CM-4	15	2009/10	0.27	4.5	64	2	130	90	1,500
CM-5	81	2009/10	0.67	11	64	2	130	230	3,900
CM-6	10	2009/10	0.02	0.37	64	2	130	7.4	130
CM-7	0.95	2009/10	0.003	0.058	64	2	130	1.2	20
CM-8	2.6	2009/10	0.015	0.25	64	2	130	5.0	84
CM-9	10	2009/10	0.68	12	64	2	130	240	4,000
CM-10	7.4	2009/10	0.02	0.27	64	2	130	5.5	93
CM-11	5.7	2009/10	0.16	2.7	68	2	140	52	880
CM-12[5]	20	2024/25	0.05	0.1	68	2	140	17	34
Lower Lot Biofilter	30	2013/14	9.4	130	3,200	1.5	4,800	110	1,600
ELV Treatment Control[6]	6.6	2013/14	2.7	36	185	1.5	280	360	4,900

[1] CM-2, CM-4, CM-5, CM-6, CM-7, CM-10, and CM-12 runoff volumes were calculated using estimated average annual percent capture rates using relationships developed using available data from other CMs with substantially similar hydrologic conditions.

[2] B-1 Media Filter was reconstructed with new treatment media in January 2026. Prior to this reconstruction, the B-1 Media Filter had treated approximately 3,400 EBVs since it was installed.

[3] CM-1 was reconstructed and outfitted with new treatment media in August 2018. Prior to this reconstruction, CM-1 had treated approximately 2,500 EBVs since it was installed.

[4] CM-3 was rebuilt with a modified configuration in 2019/20. Prior to this reconfiguration, CM-3 had treated approximately 770 EBVs since it was installed.

[5] CM-12 was reconstructed and outfitted with new treatment media in October 2024. Prior to this reconstruction, it is not known how many EBVs CM-12 had treated since it was initially installed.

[6] ELV Treatment Control was rebuilt to add a geotextile between the filter media and gravel layers in September 2021, however, the same media was reused so the EBV count was not reset.

4.3 Stormwater Control Observations During and After Storm Events

In 2025/26, observations collected during qualifying storm events noted **stormwater control overflow/bypass** and **ponding** for multiple stormwater controls during multiple storm events, summarized in Table 23. Excessive ponding was indicated if the depth of ponded runoff upgradient of the stormwater control was observed to be greater than one foot, within 72-hours after a storm event.

Table 23. Summary of Stormwater Control Rain Event Observations in 2025/26

Stormwater Control	Number of Rain Events (out of 6 rain events with observations) with the following Observations:			
	Ponding (from 72-hour post-storm observations >1ft)	Overflow/Bypass	Sediment Accumulation[2]	Stormwater Control Damage
ELV Treatment Control	0	0	0	0
Lower Lot Biofilter	0	3	0	0
B-1 Media Filter	NA[3]	0	4	0
CM-1[1]	0	1	0	0
CM-2	1	1	2	0
CM-3[1]	1	2	6	0
CM-4[1]	1	1	3	0
CM-5	2	1	5	0
CM-6	0	0	2	0
CM-7	NA[3]	0	0	0
CM-8	0	1	5	0
CM-9[1]	1	1	4	0
CM-10	0	1	2	0
CM-11[1]	1	1	0	0
CM-12	0	0	3	0
Lower Lot Sediment Basin	1	0	0	0
Upper Lot Media Filter	0	1	5	0
Northern Detention Bioswale	0	0	0	0
Southern Detention Bioswale	0	0	4	0

[1] CM-1, CM-3, CM-4, CM-9, and CM-11 were observed to have more than one foot of ponded depth after the 8.42" storm event from 12/23-12/27/2025, however, the date and time of these observations was not recorded. Therefore, it is unknown if the observations for post-storm event ponding were conducted 72 hours following the rain event.

[2] Accumulation is indicated when sediment build-up is observed, ranging from minor leaf debris to sediment and tree debris, which may impact stormwater control performance.

[3] No observation was completed at this stormwater control.

An example of sediment accumulation from a prior reporting year (at CM-4) is shown in Figure 84.



Figure 84. CM-4 on 11/08/2022

4.4 Treatment Stormwater Control Maintenance Conclusions

Recommendations resulting from this assessment occasionally include filter media replacement or reconstruction of the treatment device to improve capture and treatment of stormwater. Recommendations for filter media replacement or reconstruction have been previously issued and implemented at CM-1, CM-3, and the ELV Treatment Control. CM-12 and B-1 Media Filter were also rebuilt in 2024/25 and 2025/26, respectively. Typically, the prerequisite for recommending media scarification or replacement is either the observation of extended post-rain ponding (i.e., long drain time), suggesting media is clogged, *or* increasing effluent COPC concentrations, suggesting chemical breakthrough is occurring through the media[16]. It is recommended to improve the documentation of the stormwater control observations collected for each qualifying storm event, to allow for proper analysis of the stormwater control conditions during and 72-hours after the storm events. This includes adding details such as the amount and approximate depth of sediment accumulation observed and the date and time the observations occurred. Additionally, it is recommended to verify the stormwater control ponding observations are collected at the appropriate location at each stormwater control.

The TSS loading analysis suggested that CM-9 has reached its lab-based total TSS capture capacity. However, since sample results demonstrate that CM-9 is still reducing concentrations from the influent to the effluent[17], no media reconstruction is recommended at this time. Additionally, as influent concentrations of mercury have been observed above the Outfall 009 Permit limit at CM-9, mercury removal efficiency may be considered if CM-9 is recommended for media replacement, including potential enhancement with sulfur-impregnated GAC (similar to the recent B-1 Media Filter media replacement).

Sediment removal from the ponding areas of the control measures was previously recommended and was completed for CM-2, CM-3, CM-4, CM-5, CM-6, CM-8, CM-9, CM-11, and CM-12 in 2026. This activity will remain part of routine maintenance. As shown in Table 23, sediment accumulation was observed at multiple stormwater controls during the 2025/26 reporting year. It is recommended to continue the periodic inspections at each stormwater control observed with sediment accumulation to assess the

[16] A prior study by Pitt et al. (2022) concluded that there were no significant performance or effluent concentration differences at the stormwater controls over time, and therefore it is not likely that chemical breakthrough has occurred at the media-based treatment controls. However, this analysis has not been updated to incorporate stormwater control performance sampling data collected since then.

[17] Additionally, ponding was only observed following one very significant rain event in 2025/26 (and the timing of the ponding observation is unknown).

impact on overall stormwater control performance and complete sediment removal activities when appropriate. Since CM-2, CM-3, CM-4, CM-5, CM-9 and CM-11 were observed with ponding greater than 1 foot in depth 72 hours following a storm event in 2025/26, as well as sediment accumulation, these stormwater controls are especially considered for continued inspections and sediment removal, if needed, to improve drainage capabilities.

During the 2024/25 reporting year, dioxin was documented as an exceeding parameter at Outfall 009—which was the constituent specifically targeted by the Outfall 009 watershed stormwater control designs. To further investigate and address potential sources of exceedances for dioxins, the Expert Panel conducted a visual inspection of the Lower Lot Biofilter in June 2025. Based on these observations, a detailed field assessment was recommended to confirm whether the elevation difference between the fence-line berm and the top of the spillway grate meets the minimum four-inch requirement. The elevation was found to be insufficient across the entire berm, so the berm along the northwestern fence-line was raised using sandbags to minimize the risk of overflow from the biofilter basin into the Northern Drainage. The sandbags will be observed during the upcoming year to evaluate performance; additional sandbags will be added if necessary.

5. Conclusions and Recommendations

The following performance conclusions and maintenance recommendations are based on an evaluation of the aforementioned data summary charts and tables.

1. **Are the CMs and other media filters continuing to reduce the concentrations of lead, dioxins, TSS, aluminum, and mercury between the untreated influent and the treated effluent?**

   Yes. The CMs were originally installed as provisional (pending further evaluation), and rapidly deployable, stormwater controls that could be installed in areas where existing culverts carried the stormwater below the roads. As a result, they handle a wide range of flows during a typical rain year and provide relatively short treatment residence times, with stormwater overflowing the weirs during average to large storms.

   However, performance monitoring results indicate statistically significant reductions of TSS, dioxins, and lead concentrations through treatment by non-background CMs/media filter, including CM-1, CM-9, CM-3 post-2016/17, B-1, and the Upper Lot Media Filter, as a result of sedimentation and media filtration unit processes. Performance monitoring has not shown a statistically significant reduction of mercury or aluminum by the CMs/media filter. Mercury and aluminum concentrations increased in the effluent compared to influent in a number of sample pairs (11 out of 19 for mercury and five out of 11 for aluminum).

   Reductions in concentrations of TSS, dioxins, and lead were also observed at background CMs (CM-8 and CM-11) (having no historical industrial activity and having low stormwater COPC concentrations). TSS and lead removal was found to be statistically significant at the background CM locations. Although there was not a statistically significant reduction for dioxins at the background CMs, 64% of paired samples included influent and effluent concentrations below the detection limit, indicating low concentrations of dioxins in the influent runoff which reduced the statistical significance of the concentration reductions through these CMs.

2. **Are the Detention Bioswales, Lower Lot Biofilter, and ELV Treatment Controls continuing to reduce the concentrations of lead, dioxins, TSS, aluminum, and mercury between the untreated influent and the treated effluent?**

   Generally, yes. Data collected at Detention Bioswales show substantial and statistically significant reductions of TSS, dioxins, and lead concentrations. There are only seven data pairs available at the Detention Bioswales for mercury; however, five of these data pairs had increases in concentration from the influent to the effluent. Growing this dataset in future years will give more insight into the mercury concentration changes of the Detention Bioswales. There are five data pairs available at the Detention Bioswales for aluminum, and three of these data pairs had decreases in concentration from the influent to the effluent.

   Statistically significant dioxins reductions were observed at the Lower Lot Biofilter from the influent runoff to the biofilter effluent, in addition to the majority of data pairs showing overall reductions of TSS and lead concentrations, though not with statistical significance. One available data pair showed a reduction in concentrations from the influent to the effluent for mercury, with the other available pair showing equal influent and effluent concentrations. There are currently

no data pairs available for aluminum. The Lower Lot Biofilter receives runoff that is pretreated by the Detention Bioswales. Additional significant influent-to-effluent reductions of lead (mostly associated with stormwater particulates) and TSS concentrations may be difficult to achieve through the Lower Lot Biofilter treatment due to the lowered influent concentrations of these constituents.

Statistically significant reductions of dioxins and lead concentrations have been observed at the ELV Treatment Control. However, a statistically significant increase in TSS concentrations was also observed at the ELV Treatment Control (out of 24 TSS sample pairs collected, 18 pairs had increases in TSS concentrations). The ELV Treatment Control was rebuilt in Summer 2021 in an attempt to address the TSS increases likely due to media fines washout, and the rebuild resulted in generally lower concentrations. There were insufficient data for statistical interpretation of sample results for aluminum and mercury at the ELV.

3. **Are the treatment controls within Outfall 009 continuing to aid in compliance with NPDES Permit limits at Outfall 009?**

   Yes. Collectively, the treatment controls have achieved water quality improvements toward reliable NPDES compliance at Outfall 009 (Pitt, et al. 2026a and b). Treatment stormwater controls in the Outfall 009 watershed have been observed to reduce the frequency of stormwater control effluent concentrations in excess of Permit limits (compared to influent concentrations) for all COPC-stormwater control combinations, with the exception of mercury. Most COPC-stormwater control combinations also showed lower average and maximum concentrations in effluent results compared to the influent results[18]. There were three compliance samples for aluminum and one sample for mercury that exceeded Permit limits at Outfall 009 in 2025/26. Stormwater controls included in this performance report were not originally designed for effective mercury removal due to the lack of previous exceedances. As a result of prioritization methods discussed in 2024/25 Annual Report, Appendix E (Subarea Prioritization Analysis), the Expert Panel recommended media modification at the B-1 Media Filter to improve mercury removal. The B-1 Media Filter reconstruction was completed during January of 2026. One sample pair was collected after the construction was completed, and the results showed an influent to effluent reduction in concentration and effluent concentration below the Permit limit. The performance of mercury removal at this stormwater control will continue to be monitored and this media mix may be added to other stormwater controls with mercury-impacted drainage areas.

   Large sediment and lead loadings from the shooting range contaminated soil removal project affected Outfall 009 during the 2023/24 and 2024/25 reporting periods. However, by the 2025/26 winter season, the project area was stabilized through extensive erosion and sediment controls and revegetation and there were no lead exceedances at Outfall 009 during the 2025/26 reporting period.

[18] The only exceptions include the average exceedance ratio for lead at B-1, the average and maximum exceedance ratios for mercury at B-1, and the average and maximum exceedance ratios for mercury at the Detention Bioswales

These observations show that the treatment controls are improving stormwater quality prior to reaching Outfall 009. This not only demonstrates that the treatment controls are reducing COPC concentrations in stormwater upstream of Outfall 009, but that the treatment control drainage areas (which include paved roads) are pollutant generating source areas that, without treatment, would have worsened water quality at the downstream NPDES compliance location.

4. **Is the Lower Lot Biofilter continuing to reduce stormwater runoff volumes from the paved Boeing administrative areas and lots to the Northern Drainage?**

   Yes. Monitoring data at the Lower Lot Biofilter were examined to determine its ability to prevent smaller storms from directly discharging to the Northern Drainage with limited reductions and ultimately to Outfall 009. The Lower Lot Biofilter successfully prevented discharge of stormwater runoff to the Northern Drainage in approximately 55% of storms of an inch or less of rainfall, 15% of storms between 1 and 2 inches of rainfall, and 0% of storms greater than 2 inches of rainfall, considering data through 2025/26 (although some degree of treatment was still provided in these large storms). During 2025/26, the Lower Lot Biofilter prevented discharge from one storm event, of the seven rain events where stormwater runoff was pumped from the cistern. However, four of the six rain events that resulted in discharge to the Northern Drainage had greater than 2 inches of rainfall, one had between 1 and 2 inches of rainfall, and only one event had less than 1 inch of rainfall.

5. **Has an adequate number of samples been collected to evaluate the stormwater control performance?**

   Mostly yes, following the 2016/17 reporting year, the Expert Panel evaluated the need for continued sampling at the treatment stormwater controls in the context of the planned decrease in construction and demolition activities within the Outfall 009 drainage area in 2017/18 and after. The resulting Expert Panel recommendation outlined a reduction of sampling to two events per year at the Upper Lot Media Filter, Southern Detention Bioswale, Lower Lot Biofilter, CM-1 (west influent and effluent), and the ELV Treatment Control. Sampling at the ELV Treatment Control temporarily increased following reconstruction in 2021, but once again decreased to two events per year in 2023/24. Influent sampling frequency of the active SWTSs is in accordance with the NPDES permit.

   Starting in the 2026/27 reporting year, it is recommended to resume sampling at the Northern Detention Bioswale. This recommendation is based on historic elevated mercury concentrations that warrant confirmation, mercury-impacted surface soils located nearby such that additional data may be valuable for ongoing source-tracking efforts, and limited data available at this stormwater control. As a result of recommending resuming sampling at the Northern Detention Bioswale, it is recommended to cease sampling at the Southern Detention Bioswale in 2026/27.

   Continued collection of monitoring data at the stormwater controls (CM-1, CM-3, CM-9, CM-12, B-1 Media Filter, Upper Lot Media Filter, Lower Lot Biofilter, Northern Detention Bioswale, ELV Treatment Control, and SWTSs) is recommended, twice per year, and is expected to benefit long-term monitoring efforts, including assessments that help inform media replacement and other stormwater control maintenance needs not easily identified via visual inspection. Additional data

are needed to characterize mercury and aluminum at the SSFL stormwater systems. Continued performance monitoring will also aid in further evaluating mercury removal effectiveness and identifying potential source areas within the Outfall 009 watershed.

The Expert Panel plans to revisit the monitoring frequency when site remediation activities resume in the Outfall 009 Watershed.

6. **Is significant maintenance currently required for any of the treatment stormwater controls?**

No. No stormwater control performance-based maintenance recommendations beyond regular routine maintenance are being issued at this time. Media replacement is anticipated to be needed soon at CM-9, due to the TSS loading analysis showing that CM-9 has reached its lab-based total TSS captured capacity. However, since sample results demonstrate that CM-9 is still reducing concentrations from the influent to the effluent, no media reconstruction is recommended at this time. Future CM-9 media replacement considerations will also be evaluated alongside performance results from the reconstructed B-1 Media Filter media mix, to potentially enhance COPC removal. Extended ponding of greater than 1 ft in depth was observed at the following stormwater controls during the current reporting year: CM-2, CM-3, CM-4, CM-5, CM-9, CM-11, and the sediment basin to the Lower Lot Biofilter. Of these stormwater controls, CM-2, CM-3, CM-4, CM-5, CM-9, and CM-11 were also observed with sediment accumulation, potentially contributing to the extended ponding. Removal of accumulated sediment, prioritizing stormwater controls with both sediment accumulation and ponding greater than 1 ft in depth, will continue as an ongoing maintenance activity to improve stormwater control performance in 2026/27.

The Expert Panel also continues to recommend that observations of clogging, overflow, and underdrain flows continue to be conducted during storms to verify that the underdrains are functioning properly and no bypasses are occurring through the weir boards. Observations following storm events are also recommended to be continued, to assess whether any extended ponding is occurring and to continue to inform the timing of stormwater control maintenance and media replacement needs, especially for lack of post-storm ponding. Routine maintenance, such as weed and erosion control, sediment removal, etc., will also continue to be performed. Additionally, it is recommended that the stormwater control observation forms be improved for the upcoming 2026/27 sampling period, to allow for proper analysis of the post-storm event ponding observations.

7. **Are the SWTSs reducing COPC concentrations?**

Yes. Available data for lead, TSS, and mercury indicate statistically significant reductions in the concentrations from the influent to the effluent samples at the SWTSs. Although there were more sample pairs showing a decrease in dioxins concentration from the influent to the effluent, compared to an increase, the signficiant number of sample pairs with equal influent and effluent concentrations (which are all non-detected results reported as the detection limit) contributed to insufficient data to show a statistically significant reduction. Available data did not show a statistically significant reduction in aluminum concentrations.

Since influent sampling began in 2021/22 at the Outfall 011 and 018 SWTSs, samples had influent concentrations greater than Permit limits for several parameters. At the Outfall 011 SWTS,

influent samples were greater than Permit limits for iron (6 samples), manganese (2), oil & grease (1), pH (1), aluminum (1), mercury (1), and dioxins (2). The Outfall 018 SWTS influent samples were greater than Permit limits for indeno(1,2,3-cd)pyrene (1), iron (2), manganese (11), mercury (1), pH (1), and dioxins (3).

Effluent samples from Outfall 011 since 2021/22 showed exceedances of Permit limits for aluminum (2), iron (6), manganese (4), and dioxins (2); however, 12 of the 14 exceedances occurred during storm events where bypass of the SWTS occurred. Outfall 018 effluent samples exceeded Permit limits for aluminum (1), biological oxygen demand (1) and iron (1); one of the three exceedances occurred when the SWTS was bypassed. Fewer concentrations greater than Permit limits at the effluent of the SWTSs compared to the influent suggests reduction of the constituent concentrations in stormwater through treatment by the SWTSs.

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Appendix D: 2025/26 Exceeding Constituent Source Investigation

Prepared for

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Acronyms

AB	Above Background Onsite Surface Soils
AS	Ambient Stormwater
BEF	Bioaccumulation Equivalency Factor
BS	Background Soils/Stormwater
BT	Background Threshold
COPC	Constituents of Potential Concern
DNQ	Detected not Quantified
DTSC	Department of Toxic Substances Control
EC	Enrichment Coefficient
ISE	Imminent and Substantial Endangerment
ISRA	Interim Source Removal Action
LOE	Lines of Evidence
MCL	Maximum Contaminant Level
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
NPDES	National Pollutant Discharge Elimination System
PS	Particulate Strength
PV	Pavement Solids
RFI	RCRA Facility Investigations
RCRA	Resource Conservation and Recovery Act
SRAM	Standardized Risk Assessment Methodology
SSFL	Santa Susana Field Laboratory
SWTS	Stormwater Treatment System
TCDD	Tetrachlorodibenzo-p-dioxin
TEF	Toxic Equivalency Factor
TEQ	Toxic Equivalency
TSS	Total Suspended Solids
TWP	Treated Wood Pole
USL	Upper Simultaneous Limit
USL95	95% Upper Simultaneous Limit

Executive Summary

This technical report systematically investigates the sources of stormwater permit limit exceedances observed at the Santa Susana Field Laboratory (SSFL) during the 2025/26 reporting year. It serves as a technical supplement to the annual report, providing a detailed, evidence-based analysis of whether stormwater concentrations exceeding permit limits for aluminum, manganese, mercury, and dioxins/furans were caused by onsite soils above background that were influenced by former industrial operations, background soils, other non-industrial sources, or some combination thereof.

To support this analysis, the document compares stormwater samples collected during this reporting year to multiple reference datasets including: onsite soil samples, results from onsite special studies on solids from potential sources, and stormwater and soil samples from offsite reference locations unaffected by onsite legacy industrial materials. The investigation applies independent lines of evidence (LOEs)—such as soil concentration mapping, particulate strength comparisons, and chemical fingerprinting—to develop a scientifically grounded assessment of exceedance sources. This approach is intended to provide transparency for regulators, stakeholders, and local communities to guide treatment, source control recommendations, and inform future permit changes.

During the 2025/2026 reporting year, National Pollutant Discharge Elimination System (NPDES) Permit Limit exceedances were observed at Outfalls 001, 002, 004, 009, 011, and 018 for one or more of the following constituents: aluminum, manganese, mercury, and dioxins/furans. At outfalls where surface soils above background concentrations were present and a likely source of any of these constituents, recommendations are provided to address the identified sources.

Approach

The various LOEs considered were:

- Presence of Surface Soils Above Background: Onsite soils within the top 6 inches were assessed to identify areas with concentrations above soil background thresholds. Assessment of surface soil concentrations above background thresholds is used to determine where soils may be affected by legacy industrial operations or non-industrial materials that are exposed to stormwater. **This is the most important line of evidence, in combination with looking at areas of former operations, for determining whether legacy industrial activity impacts have the potential to contribute to an exceedance.**
- Spatial Patterns: Evaluating similarities in stormwater concentrations across outfalls and offsite background stormwater to evaluate if exceeding samples are similar to other samples indicating likely non-industrial contributions that are ubiquitous (like background soils) or whether the exceeding samples are unique indicating a localized contribution.
- Stormwater Particulate Strengths vs Background Stormwater Particulate Strengths: Comparing the particulate strength of exceeding stormwater samples at outfalls to that of stormwater particulate strengths at offsite background locations. Particulate strength is the concentration of the constituent on suspended sediment particles in the stormwater sample.
- Stormwater Particulate Strengths vs. Solid Source Material Samples: Comparing the particulate strength of exceeding stormwater samples to potential solid source materials (like soils or pavement solids), adjusted to consider particle size differences in the stormwater vs. source area samples.

- Metal Ratio Fingerprinting: Quantifying the ratios of exceeding constituents to known naturally occurring soil-derived elements, such as iron, to evaluate whether exceeding samples have similar or elevated concentrations of constituents relative to natural background soils.

Potential sources evaluated include onsite surface soils, offsite background soils, offsite background stormwater (no history of industrial activity and < 1% developed), offsite background ambient stormwater (no history of industrial activity and < 25% developed), pavement solids, treated wood utility poles and adjacent soils, and atmospheric deposition solids.

Results

Weight-of-evidence forensic investigations identified likely contributing sources for all permit limit exceedances:

- Aluminum and manganese exceedances were very likely attributable to naturally occurring background soils. For these constituents, there is no evidence of elevated surface soil concentrations and observed stormwater concentrations all fell within the range of background stormwater conditions.
- The Outfall 004 mercury exceedance was very likely attributable to legacy impacted surface soils.
- The Outfall 009 mercury exceedance was likely attributable to legacy impacted surface soils, with contributions from naturally occurring background soils.
- The Outfall 002 TCDD TEQ (no DNQ) exceedance was likely attributable to legacy impacted surface soils and contributions from treated wood poles.

Based on these findings, the Expert Panel and Geosyntec have issued new treatment or source control recommendations to address exceedances of mercury at Outfalls 004 and 009 and dioxin at Outfalls 002, which can be found in the main Annual Report.

1. Introduction

This investigation was conducted to evaluate potential industrial and non-industrial sources that may have contributed to effluent limit exceedances at the Santa Susana Field Laboratory (SSFL) National Pollutant Discharge Elimination System (NPDES) outfalls during the 2025/26 reporting period. Stormwater discharges from SSFL are regulated by NPDES Permit No. CA0001309 for the Boeing Company, SSFL, Canoga Park, CA, Order No. R4-2023-0359 (NPDES Permit). The twelve active and regulated SSFL NPDES Outfall locations are shown in Figure 1.

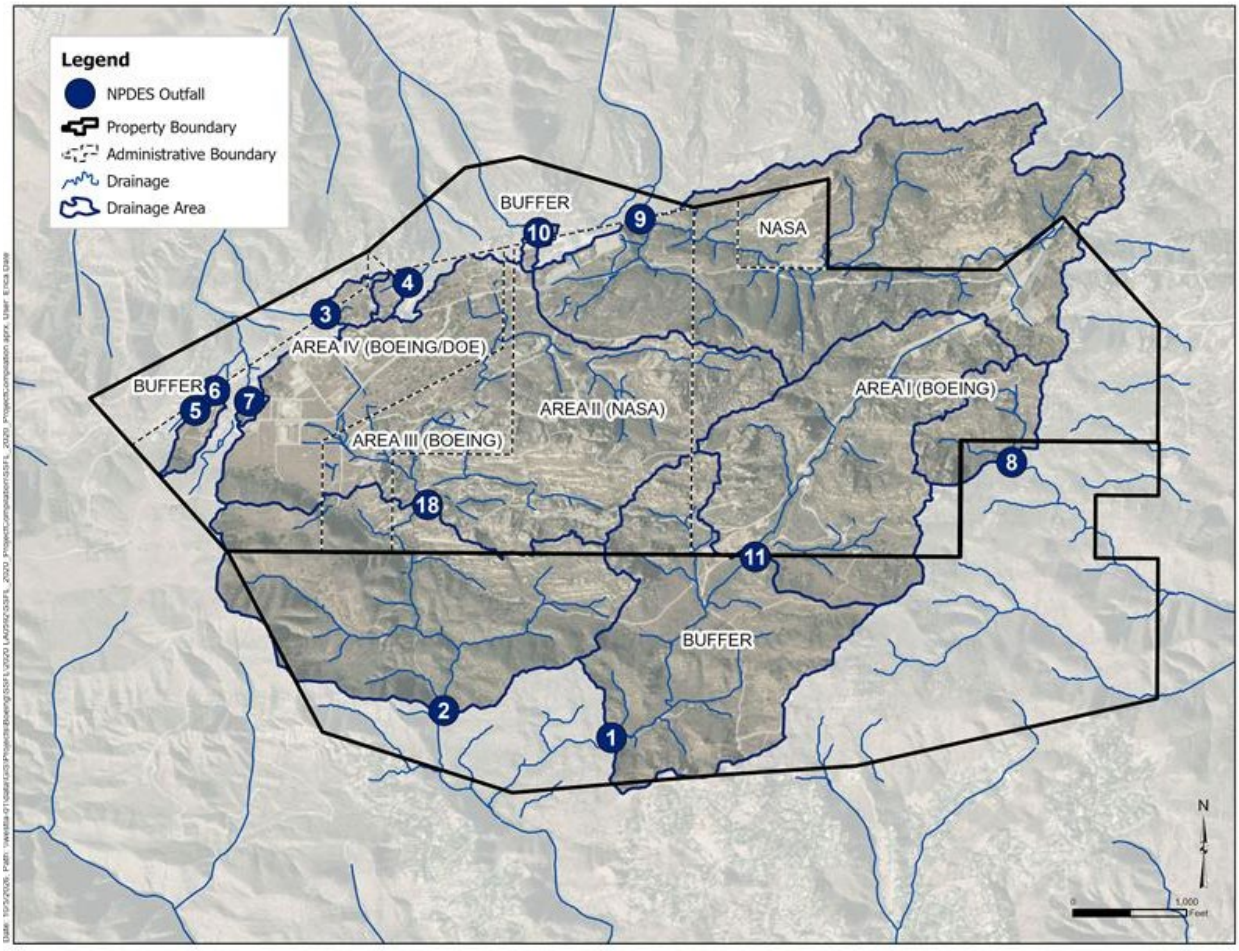


Figure 1. Santa Susana Field Laboratory (SSFL) Watersheds, Drainages, and Outfalls

1.1. 2025/2026 Rainfall and Exceedance Summary

The long-term average annual rainfall at SSFL from 1959 to 2026 is 17.8 inches[1], occurring primarily in winter storms from October through April. Highly variable periods of above or below-average rainfall are common. Little rainfall typically occurs during the dry season from May to September. A total of 27.81 inches of precipitation was measured in the 2025/26 reporting year (July 1, 2025 – June 30, 2026), which

[1] Data from the Simi Hills – Rocketdyne Lab gauge (Ventura County Watershed Protection District site 249) was used to determine annual rainfall from 1958/59 through 1977/78 and from 1984/85 through 2000/01. Rainfall data from 2001/02 through 2025/26 was recorded at the Area 4 gauge, which was relocated to Area 1 on January 1, 2013), resulting in a combined period of record of 25 years.

is about 10 inches more than the long-term average annual rainfall for the period of record. A total of ten qualifying rain events occurred in 2025/26, where a "rain event" is defined by the NPDES Permit as greater than 0.1 inches of rainfall in 24 hours, preceded by at least 72 hours of dry weather. Of the ten rain events, seven produced discharges at one or more NPDES outfalls, and four events had at least one permit limit exceedance at one or more outfalls.

Constituents that exceeded an effluent limit at least once in the 2025/26 rainy season were: aluminum (11 exceedances); manganese (2 exceedance); mercury (2 exceedances); and dioxins/furans (2 exceedances). The greatest number of exceedances were observed during the very large 8.42-inch rain (25-year return interval storm for 12-hour duration) occurring between December 23 and 27, 2025. A summary of each exceedance and maximum storm return interval is shown in Table 1, along with the associated total suspended solids (TSS). Notably, exceedances of manganese limits are based on secondary MCLs for drinking water (i.e., taste/odor, not health-based), and mercury and dioxins/furans limits are based on human health for fish consumption (however, neither fish nor fishing are known to occur at or near SSFL outfalls or drainages). Aluminum is based on the primary MCL for drinking water.

Different dioxin and furan congeners have different potencies; Toxic Equivalency (TEQ) allows comparison to a single reference compound, Tetrachlorodibenzo-p-dioxin (TCDD). The TEQ metric for stormwater, TCDD TEQ (no DNQ), is calculated using only quantified congener values (excludes detected not quantified (DNQ) concentrations below the reporting limit and applies Toxicity Equivalency Factors (TEFs) and Bioaccumulation Equivalency Factors (BEFs) that express each congener's toxicity and bioaccumulation potential in relation to TCDD. TEQ is a weighted measure that expresses the total toxicity of a mixture of dioxins and furans as the equivalent concentration of TCDD. For the remainder of the report, dioxins/furans will be referred to as TCDD TEQ (no DNQ).

Table 1. 2025/2026 Effluent Limit Exceedances

Outfall	Number of Outfall Discharges (Year Total)	Exceedances						
		Max Return Interval (duration)	Sample Date and Total Rain Event Depth (inches)	Parameter	Unit	Result	Permit Limit	TSS (mg/L)
001	3	25 yr (12-hr)	12/27/2025 (8.42)	Aluminum	mg/L	3.3	1.0	38
		<1	1/2/2026 (3.32)	Aluminum	mg/L	1.1	1.0	34
		2 yr (6-hr)	2/18/2026 (4.35)	Aluminum	mg/L	6.4	1.0	120
		2 yr (6-hr)	2/18/2026 (4.35)	Manganese	µg/L	110	50	120
002	6	2 yr (24-hr)	11/16/2025 (7.64)	Aluminum	mg/L	4.5	1.0	98
		2 yr (24-hr)	11/16/2025 (7.64)	TCDD TEQ (No DNQ)	µg/L	3.4E-08	2.8E-08	98
		25 yr (12-hr)	12/25/2025 (8.42)	Aluminum	mg/L	4.1	1.0	120
		25 yr (12-hr)	12/25/2025 (8.42)	TCDD TEQ (No DNQ)	µg/L	7.2E-08	2.8E-08	120
		2 yr (6-hr)	2/17/2026 (4.35)	Aluminum	mg/L	3.5	1.0	97

Outfall	Number of Outfall Discharges (Year Total)	Exceedances						
		Max Return Interval (duration)	Sample Date and Total Rain Event Depth (inches)	Parameter	Unit	Result	Permit Limit	TSS (mg/L)
004	1	25 yr (12-hr)	12/26/2025 (8.42)	Mercury	µg/L	0.046	0.024	6
009	5	25 yr (12-hr)	12/25/2025 (8.42)	Aluminum	mg/L	1.1	1.0	27
		25 yr (12-hr)	12/25/2025 (8.42)	Mercury	µg/L	0.025	0.024	27
		<1	1/2/2026 (3.32)	Aluminum	mg/L	1.3	1.0	9.8
		2 yr (6-hr)	2/17/2026 (4.35)	Aluminum	mg/L	1.2	1.0	22
011	3	25 yr (12-hr)	12/26/2025 (8.42)	Aluminum	mg/L	2.6	1.0	55
		25 yr (12-hr)	12/26/2025 (8.42)	Manganese	µg/L	52	50	55
018	6	25 yr (12-hr)	12/26/2025 (8.42)	Aluminum	mg/L	1.2	1.0	18

1.2. Potential Sources

A variety of natural and anthropogenic sources present at the SSFL were evaluated to determine their potential to contribute to surface water exceedances. The majority of these sources reflect pollutants that are predominantly in particulate form; hence, an investigative focus is on *solid* sources rather than aqueous ones. This source evaluation was conducted by performing various data analyses to establish a "weight-of-evidence" approach for source hypothesis testing. Multiple lines of evidence (LOEs), as described in the sections below, were evaluated to determine the likelihood that a source was a major contributor to constituents exceeding the effluent limits at the outfalls. The potential sources evaluated, and the associated sampling performed for each, include:

- **Onsite Surface Soils:** Soils were characterized for the Resource Conservation and Recovery Act (RCRA) program, including the RCRA Facility Investigations (RFI) conducted across the site. Sample locations included areas both within and outside of potential cleanup areas, however, most samples are concentrated in regions of former site activity. **The surface soil data presented herein are limited to soil samples remaining in-place after completion of the Interim Source Removal Action (ISRA) or other pre-final clean up or remediation efforts, however, the recent ISE cleanup efforts at the shooting range and Area I Burn Pit have not been reflected. Therefore, some soil samples in the Outfall 009 and 011 watersheds that are included herein may have been removed prior to the 2025/26 winter season.** Additionally, only soil samples collected within the top six inches from the surface were used, as surface soil is typically what would be susceptible to mobilization in stormwater runoff. **Also note that soil samples are collected as bulk in-place soils, including all particle sizes, not just the finer fractions that are preferentially transported in stormwater. Therefore, adjustments are occasionally made and clearly stated in this report to facilitate an apples-to-apples comparison between constituent concentrations on bulk soil samples vs on stormwater suspended solids**.

- **Offsite Background Surface Soils:** Natural background soils were evaluated using monitoring results from offsite soils evaluated in the California Department of Toxic Substances Control (DTSC) SSFL Background Soils Study (DTSC 2012). Similar to the onsite soils, only the top soil profile data area used, and adjustments to estimate the particulate strengths of the fine soil particle sizes mobilized by stormwater are considered.
- **Offsite Background Stormwater:** Background stormwater samples were collected from offsite reference sites, which are natural undeveloped areas with no known infrastructure or historical industrial activities. These sites receive no runoff from SSFL or drainages that border SSFL and are more than 99% undeveloped. Geosyntec Consultants selected the sites in collaboration with the Expert Panel and acceptance by the Los Angeles Regional Water Quality Control Board.
- **Offsite Ambient Stormwater:** Offsite ambient (non-industrial) stormwater is intended to represent slightly more developed conditions including paved roads, utility poles, and sparse residences, but excluding any industrial or heavy commercial activities. These ambient, or non-industrial background areas are of particular interest for dioxins since treated wood utility poles are known to be a source of dioxins/furans. The offsite ambient stormwater sampling location is 75% undeveloped and 25% residential. Geosyntec Consultants selected the site in collaboration with the Expert Panel and acceptance by the Los Angeles Regional Water Quality Control Board.
- **Pavement Solids:** Solids on pavement were vacuumed from paved surfaces from six sites throughout the Outfall 009 watershed quarterly from 2016-2017 and once at six sites in Outfall 009 and 011 watersheds in 2018. Concentrations in the fine fraction (< 75 µm), which represent the most common size fraction mobilized in stormwater, were included for evaluation.
- **Treated Wood:** Treated wood utility poles and adjacent soils were evaluated by collecting samples of the treated wood utility pole material itself and the soil adjacent to treated wood at 28 locations in 2016, 2020, and 2021. Both the fine fraction (< 75 µm) and bulk concentration were considered.
- **Atmospheric Deposition Solids:** Dry atmospheric deposition solid samples were collected monthly from the roof at the SSFL Fire Station and on top of a baker tank at the Helipad for one year from 2016-2017. Atmospheric deposition was evaluated to determine whether typical dry atmospheric deposition solids at the site, which can mobilize during wet weather, may have contributed to exceedances.

Each of these sources was evaluated through multiple lines of evidence, as described in detail in the following section, to determine the source of the exceeding concentrations in each exceeding outfall sample or, at a minimum, to rule out whether background soils could be the sole source source, leaving legacy impacted soils or non-industrial sources as the likely explanation for the concentration measured in stormwater. If legacy impacted soils above background cannot be ruled out as a source of exceedance, new investigations and/or implementation recommendations are made to identify and/or control those sources before the final soil cleanup is completed.

2. Lines of Evidence

Multiple lines of evidence (LOE)s were considered when investigating potential sources of exceedances. This approach utilizes independent assessments and findings to determine if they concur in identifying the potential source(s) for each exceedance. Each LOE and how it was used to support a particular source conclusion is summarized in Table 2 and described below. Where more than one LOE supports

that a source may be a contributor for a particular constituent, then there is a greater likelihood that the hypothesized source contributed to or caused an exceedance.

Table 2. Questions and Lines of Evidence

Questions	Line of Evidence	Criteria to Answer 'Yes' & Implication	Criteria to Answer 'No' & Implication
Are surface soils below background thresholds?	Soil Concentrations	If surface soil concentrations are below background thresholds then the source is likely natural background soils.	If there are soil samples above background levels, legacy industrial activity or non-industrial impacts to soil may be contributing to exceedances.
Are concentrations similar to background and ambient concentrations?	Spatial Patterns	If exceeding samples are similar to ambient and background samples, then the source is likely natural background soils or ambient contributions (pavement or treated wood poles).	If the exceeding sample is markedly higher than background and ambient samples, then there is likely a local non-background source.
Are the PS metal ratios in exceeding samples within the range of background stormwater PSs and soil?	Reference Metal Ratios	If exceeding sample ratio plots within the 95th percentile lines of background stormwater or background soil ratios, then the source is likely natural background soils.	If the exceeding sample plots are above the 95th percentile lines of background stormwater ratios, then there are likely other sources.
Could the exceedance be the caused by one or more of the potential solid sources investigated?	Particulate Strengths	If the stormwater particulate strength is less than or equal to the solids concentration of potential sources and the potential source is physically present in the watershed, then that is a likely source.	If the PS is above all tested solids, then there may be other sources, or the exceeding sample may have a higher fraction of fines than the solid sample which is resulting in a higher concentration on solids.

2.1. Soil Concentrations

Concentrations of soil samples from Boeing's soil database that remain[2] onsite and within the top 6 inches of the ground surface were mapped across the watersheds to identify areas of surface soils that are above the BT due to impacts from prior site activities or non-industrial sources. The BT used here is the Upper simultaneous limit (USL) based upon an established background dataset (DTSC 2013). It is expected that all observations (present and future) comparable to the background population will be less than or equal to a 95% USL (USL95) with a confidence coefficient of 0.95. The use of USL tends to provide a balance between false positives and false negatives provided the USL is based on a background data set and when many observations need to be compared with the BT. The resulting soil maps are presented in the results section for each analyte below. Surface soil concentrations are colored by whether they are above or

[2] The surface soil data presented herein are limited to soil samples remaining in-place after completion of the Interim Source Removal Action (ISRA) or other pre-final clean up or remediation efforts, however, the recent ISE cleanup efforts at the shooting range and Area I Burn Pit have not been reflected. Therefore, some soil samples in the Outfall 009 and 011 watersheds that are included herein may have been removed prior to 2025/26.

below the BT. **These maps are for source investigation purposes only and should not be used for soil cleanup planning.**

Table 3. Background Soil Thresholds Used for Soil Concentration Mapping (DTSC, 2013)

Analyte	Unit	BT	Basis
Aluminum	mg/kg	50,300	USL95
Manganese	mg/kg	959	USL95
Mercury	mg/kg	0.0411	USL95
TCDD TEQ (No BEF 2005 TEF)	mg/kg	5.49E-07	USL95

2.2. Spatial Patterns

Spatial patterns were used to evaluate whether there are sources unique to specific watersheds that were responsible for effluent limit exceedances. Box plots of stormwater concentrations, particulate strengths, and potential source solids (i.e., pavement, treated wood poles, and atmospheric deposition) were used to illustrate the basic relationships of each watershed's water quality. As shown in Figure 2, the box plots reflect the median, 25th percentile, 75th percentile, and 1st and 99th percentile values. The individual sample results are shown as points over the box plots to differentiate between detected (black border) and non-detected (gray border) results. A difference in concentration or particulate strengths between outfalls may indicate there was a unique source within a particular watershed (particulate strengths are described in more detail in Section 2.3). Background and ambient stormwater were also compared in this analysis, and results from outfalls vs background and ambient areas are colored accordingly in the plots for each constituent with an effluent limit exceedance in the past rainy season.

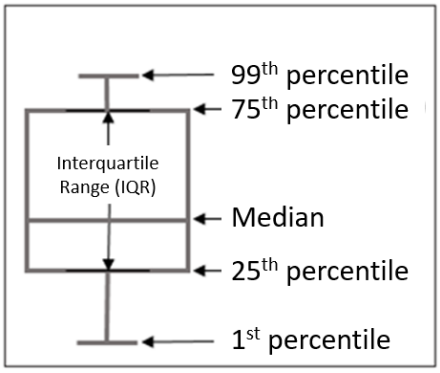


Figure 2. Box Plot Key

2.3. Particulate Strengths

The particulate strength (PS) was calculated for each stormwater sample to evaluate whether solids from potential sources could account for observed effluent limit exceedances in stormwater. PS quantifies the concentration of a constituent associated with particulate matter in stormwater, normalized by the total suspended solids (TSS) concentration, thereby enabling direct comparison between stormwater and solid source concentrations.

The PS for each sample was determined using the following equation:

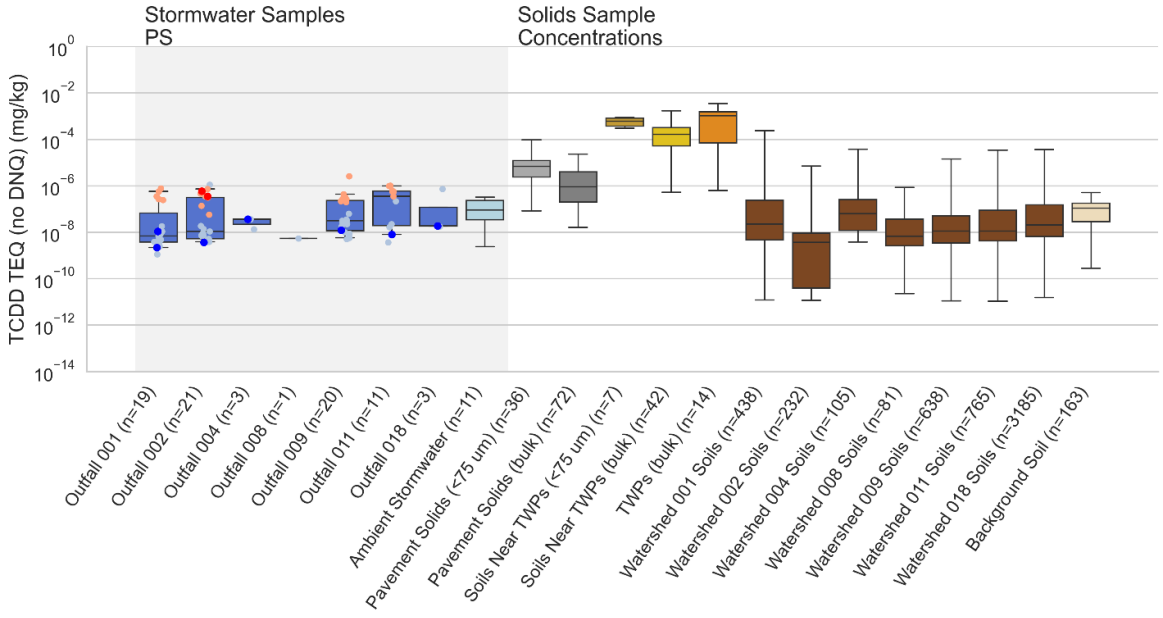
$$PS = \frac{(\text{total concentration} - \text{filtered concentration})}{\text{total suspended solids concentration}} \qquad \textit{Equation (1)}$$

Samples with non-detect total concentrations, dissolved concentrations, or TSS concentrations, or non-quantified TSS concentrations, were excluded from PS calculations. For TCDD TEQ (no DNQ), the filtered fraction was assumed to be zero due to the congeners' negligible solubility and strong affinity for solids.

The particulate strengths of stormwater samples are plotted next to the solids concentration of potential sources to enable an evaluation of potential sources of exceeding samples. In addition to showing solid sources that were sampled, the BTs are shown.

When comparing the adjusted PS of stormwater to soils and other potential sources, the following criteria were utilized to evaluate if the source material may be contributing to exceedances (see Figure 3):

- **Very Likely Source**: The 75th percentile of solids concentration is greater than the EC-adjusted PS of stormwater samples exceeding permit limits.
- **Likely Source**: The 99th percentile of solids concentration is greater than the EC-adjusted PS of stormwater samples exceeding permit limits.
- **Not A Likely Source**: Fewer than the upper 1% of solids concentrations overlap the EC-adjusted PS of stormwater samples exceeding the permit limit.



Note: Treated Wood Poles shown as 'TWPs' and soils readily mobilized in the top 6 inches are shown for soil solids.
Whiskers represent the 5th and 95th percentiles.
Red markers indicate PS values of outfall exceeding samples and blue non-exceeding samples in the past year.
Orange markers represent exceedances and light gray markers non-exceedances from the past ten years.

Figure 3. Example PS Plot

Particle Size Fraction Effects

Solid source samples typically represent bulk material encompassing all particle sizes. However, for pavement solids and soils adjacent to treated wood utility poles, the fine fraction (<75 µm) was analyzed separately to account for the fine fraction having preferential mobilization in runoff and greater relevance to stormwater quality. The concentration within the fine fraction is generally higher than that of bulk soil samples. Stormwater samples contain a higher proportion of fine particles compared to bulk soil sources, due to the preferential mobilization of fine particles, resulting in stormwater PS that is higher than bulk soil solid concentrations.

For example, Figure 4 shows sediment collected from the main drainage in the Outfall 009 watershed and the median lead concentration in the fine fraction (<75 µm) of sediments was 46.9 mg/kg, over four times greater than the concentrations observed in medium (10.2 mg/kg) and coarse (10.7 mg/kg) fractions (Figure 4). Furthermore, the median concentration in the fine fraction exceeded the median bulk concentration calculated from the weighted average of all size fractions by a similar margin. This pattern was consistent across other analytes and sample types, including soils near potential contaminant sources, treated wood poles, and onsite reference soils.

Particle size fractionation boxplots for iron, manganese, and TCDD TEQ (no DNQ) (see Figures 5–7, note that the concentration values are shown on log scales on these plots) illustrate that smaller particle sizes tend to exhibit higher constituent concentrations than larger particle sizes or the bulk concentration. Accordingly, particle size distribution must be considered when comparing PS values between bulk source materials and outfall samples, which contain a larger fraction of fines. This consideration is addressed in subsequent analyses through the application of the enrichment coefficient described below.

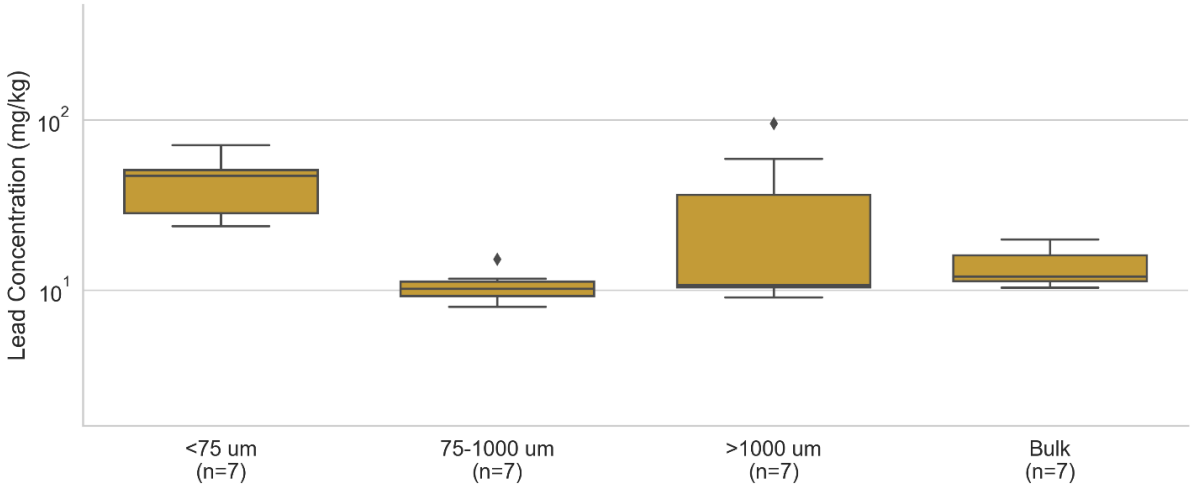


Figure 4. Lead Concentration in Northern Drainage Sediment by Sediment Size Fraction and Calculated Bulk Concentration

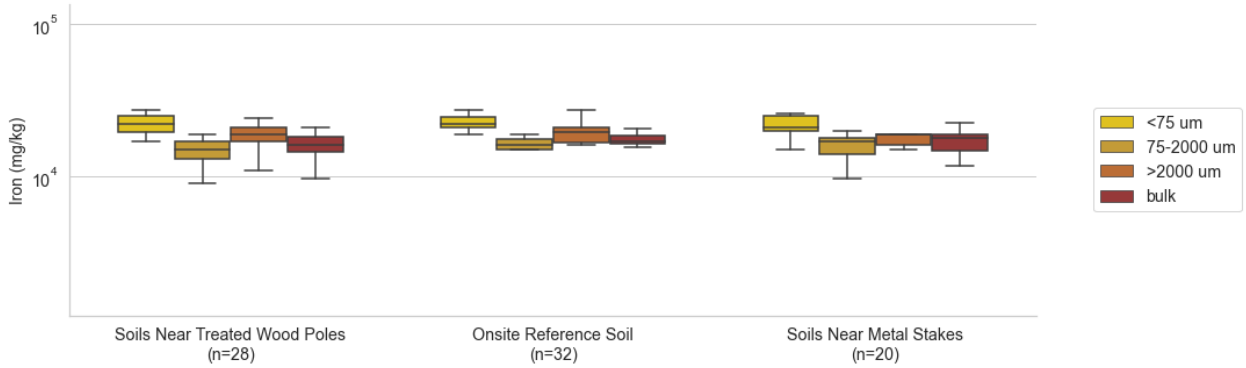


Figure 5. Iron Concentration In Bulk Soil Samples by Particle Size Fraction and Calculated Bulk Concentration

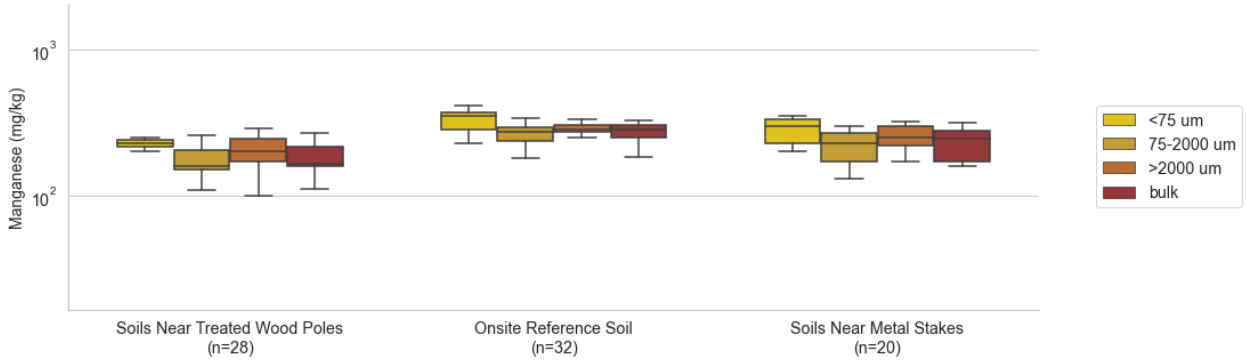


Figure 6. Manganese Concentration In Soil Samples by Particle Size Fraction and Calculated Bulk Concentration

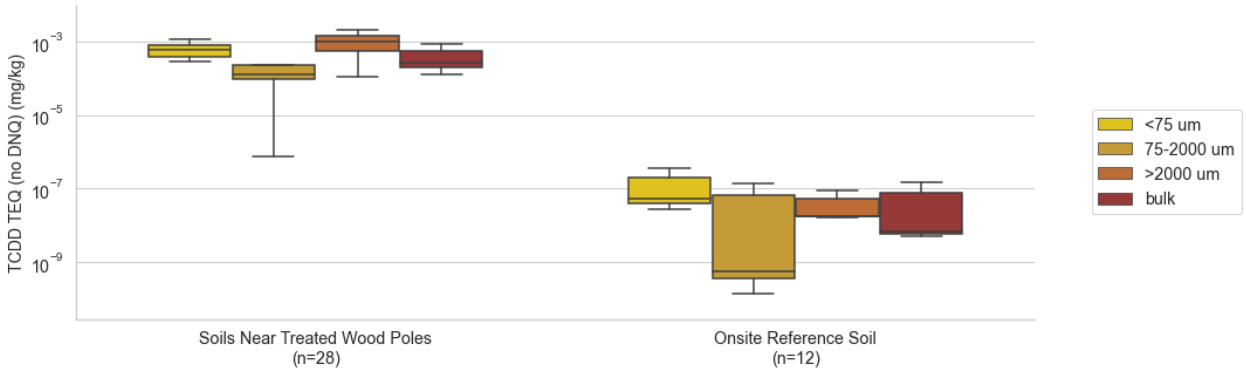


Figure 7. TCDD TEQ (no DNQ) Concentration in Soil Samples by Particle Size Fraction and Calculated Bulk Concentration

This effect of size fractions is further complicated by stormwater from different drainage areas having different suspended sediment size distributions based on grain size mobilization that varies based on ground surface slope and roughness, vegetation, flow velocity, drainage length, rainfall patterns, etc. (Table 4). This can result in a watershed that produces more coarse-grain mobilization having a lower particulate strength in stormwater compared to a watershed with more fine-grain mobilization, even if the bulk soil concentrations within both watersheds are similar.

Table 4. Average Percent Suspended Solids Mass in SSFL Stormwater Samples, by Particle Size

Watershed			Average Percent Mass by Particle Size		
Category	Sample Count	Median TSS (mg/L)	Clay <3.91 um	Silt 3.91-62.5-um	Sand 62.5-1000-um
Onsite Paved Subareas	33	34	10%	58%	32%
Onsite Unpaved Subareas	21	19	12%	61%	27%
Offsite Background/ Ambient Subareas	31	260	21%	69%	10%
NPDES Outfalls (001, 002, 008, 009)	10	4.35* (n=46)	38%	57%	5%

*Not analyzed concurrently with particle size distribution samples.

Enrichment Coefficient

To account for the higher concentration of constituents on fine solids which are preferentially transported in runoff and to enable a comparison of stormwater particulate strengths to bulk solids, an enrichment coefficient (EC) is calculated as:

$$\mathrm{EC} = \frac{mean(PS\ of\ outfall\ stormwater)}{mean(outfall\ upland\ surface\ soil\ concentration)} \qquad \textit{Equation (2)}$$

To improve the comparison of suspended fines in outfall effluent to bulk soils and other source solids (e.g., pavement), the PS in stormwater was divided by the observed enrichment coefficient:

$$adjusted\ PS\ of\ stormwater = \frac{PS\ of\ stormwater}{\mathrm{EC}} \qquad \textit{Equation (3)}$$

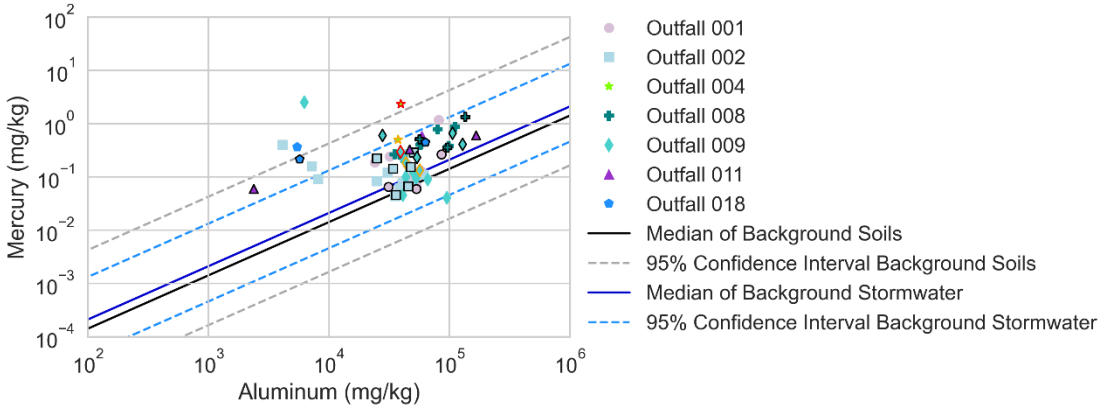
The EC-adjusted PS of stormwater samples was applied on a watershed-by-watershed basis to all outfall samples.

Where no data are available to calculate an EC for a specific Outfall, but stormwater PS is observed at other site outfalls, the mean EC of all outfalls was used as the EC for outfalls with missing data to calculate the EC of constituents. Notably, the EC of constituents was calculated based on the mean PS , which are highly variable depending on the upland areas contributing to suspended sediment loads at an outfall during an event. Not all upland areas will contribute to sediment loads at the outfall for small events. Moreover, the PS of samples at the outfall will vary depending on the sizes of particles transported during events (e.g., large events may contribute to a higher percentage of large particles and reduce the observed PS).

2.4. Fingerprinting: Metal Ratios

Metal ratio fingerprinting was used as a fourth LOE, in addition to soil concentrations, spatial patterns, and PS, to determine if background soils could have caused effluent limit exceedances. Metal ratios were used to identify potential constituent sources by comparing the ratios of concentrations of multiple constituents in source material samples with the ratios of particulate strengths of stormwater samples. Aluminum, iron, and manganese were chosen as reference analytes because they are primarily natural, soil-derived, and are not known to be soil cleanup drivers at SSFL (and therefore not known to have

contributed to soil contamination at SSFL). They are present at relatively consistent concentrations in most soils, and stormwater PS results confirm this general understanding by matching levels in natural background soils. The ratios of each exceeding constituent to the soil reference analytes are presented in plots showing the median ratio and 95th percentile confidence interval for natural background soils compared to individual stormwater PS results. Figure 8 shows an example plot for an exceeding analyte compared against aluminum, with black and gray lines showing the median ratio and 95th percentile confidence interval for background soils, respectively. Similarly, the median ratio and 95th percentile confidence interval for background stormwater is represented by the dark blue and light blue lines, respectively. The individual stormwater PS results are plotted as points where a black outline indicated a detected sample and a red outline indicates an exceeding sample. Where stormwater PS results exceeded the 95th percentile ranges found for natural background soils or background stormwater, as is the case for the exceeding sample outlined in red below for Outfall 004, this suggests that the exceedance is not solely due to background soils, but from other potential source solids (e.g., surface soils above background, pavement, etc.). Note that not all samples have concurrent aluminum, iron, and manganese PS results because the monitoring frequency in the permit varies for these constituents and additionally, PS is not calculated where results are non-detect for the total phase, dissolved phase, or for total suspended solids, or where the total suspended solids result is not quantified.



Note: Black borders indicate PS detections in the current water year, while red borders indicate an exceedance. Markers with no border indicate detections and orange borders non-detects in the last 10 years.

Figure 8. Example Analyte-to-Aluminum Metal Ratio Plot

3. Results

This section presents the Outfall stormwater results for each constituent that exceeded effluent limits in 2025/26 according to the LOE approaches described above.

3.1. Total Suspended Solids (TSS)

TSS is useful for interpreting other sediment-associated constituents and their general trends in SSFL stormwater samples although it doesn't have a permit limit itself. TSS is useful to locate erosion problems and to evaluate restoration progress. For many SSFL COPC, high TSS concentrations are closely related to high contaminant concentrations. TSS concentrations at SSFL outfalls and offsite reference watersheds are shown over time in Figure 9. Onsite TSS typically ranges from 1-100 mg/L with exception of the 2018-2019 year following the Woolsey Fire which burned most of the site. In contrast, the offsite TSS concentrations typically range from 10-1,000 mg/L, which is characteristic of stormwater runoff in undeveloped watersheds.

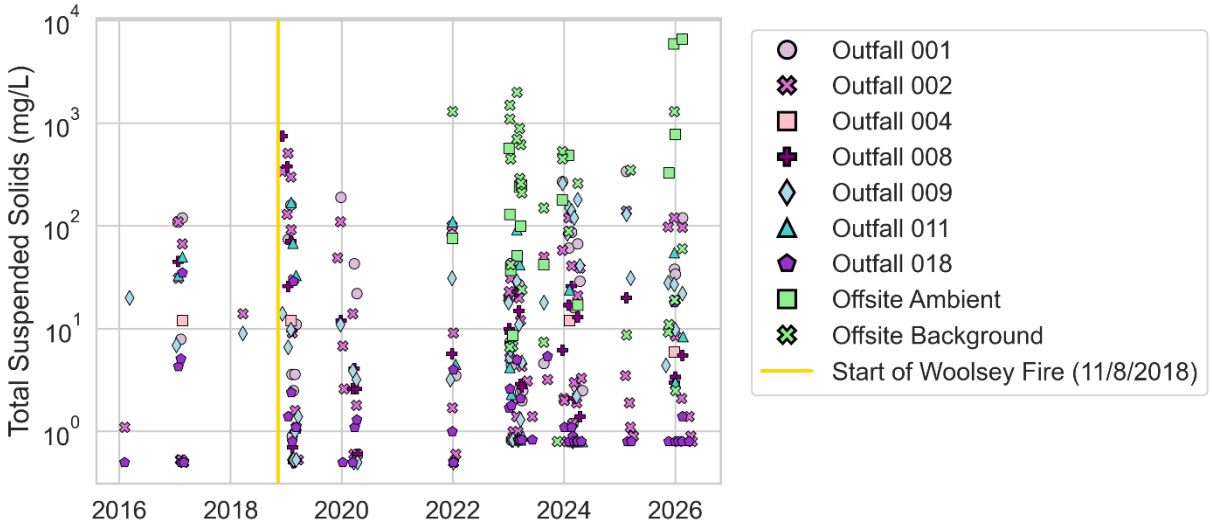
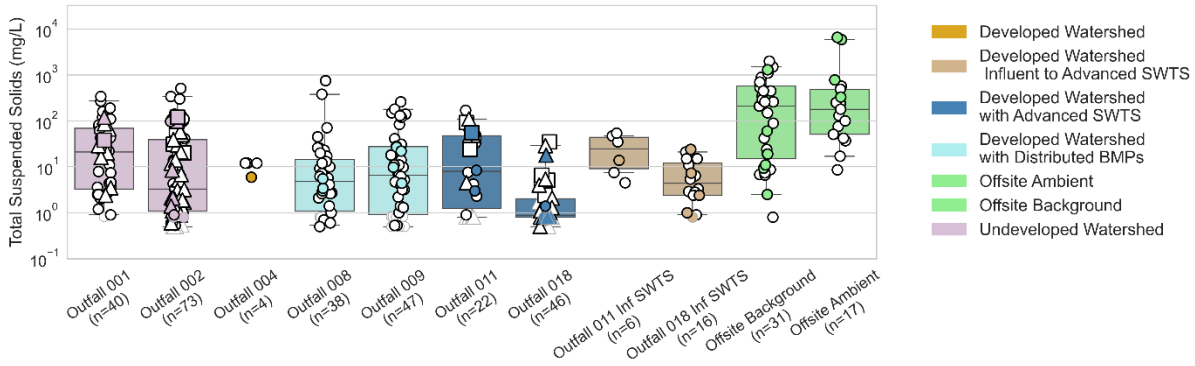


Figure 9. Time Series of TSS Concentrations During the Permit Term 2015/16-2025/26

As shown in Table 5 and Figure 10, the highest concentrations of TSS during 2025/2026 were observed at Outfalls 001, 002, and 011. Outfalls 001 and 002 are largely undeveloped watersheds where relatively high TSS loads are typically observed but often receive stormwater from an upstream developed watershed with an advanced stormwater treatment system (Outfalls 011 and 018, respectively). The highest TSS concentrations observed for 2025/26 were at Outfall 002 (120 mg/L) on 12/25/2025 during a 8.42-inch rain event (Table 5), which had a recurrence interval of 25 years, and at Outfall 001 (120 mg/L) on 2/18/2026 during a 4.35-inch rain event (Table 5), which had a recurrence interval of 2 years. During the 8.42-inch rain event on 12/26/2025, the maximum measured TSS at Outfall 011 (55 mg/L) was in a sample collected during pond overflow and in the absence of the Stormwater Treatment System (SWTS) discharge, which explains the relatively high concentration. **This pattern suggests that undeveloped watersheds (including offsite reference watersheds) contribute higher TSS concentrations may be associated with soil erosion in undeveloped watersheds, where significant structural treatment controls are absent, particularly during high-intensity storms**.

Table 5. TSS Results Summary Permit Year 2025/2026

Outfall	Max TSS (mg/L)	Mean TSS (mg/L)	Samples
Outfall 001	120	64	3
Outfall 002	120	37	9
Outfall 004	6	6	1
Outfall 008	5.5	4.0	3
Outfall 009	28	18	5
Outfall 011	55	22	3
Outfall 018	18	3.3	7
Offsite Background	1,300	203	7
Offsite Ambient	6,600	3,400	4



Note: Filled markers indicate samples from the current reporting year and markers without fill represent samples collected in the past 10 years.
Black marker borders signify detected results and grey signify non-detected results shown as method detection limit.
Triangle markers signify samples collected during fully treated SWTS discharge at Outfalls 011 or 018.
Square markers signify samples collected during untreated bypass and treated SWTS discharge at Outfalls 011 or 018.
Circle markers signify the sample was collected absent from SWTS discharge.

Figure 10. 2025/26 TSS Concentrations by Outfall

The TSS concentration observed at outfalls is also used to compute the particulate strengths of constituents of concern. Particulate strength is only a valuable metric for evaluating sources of exceedance for constituents that are primarily sediment-associated. Therefore, the constituent-TSS relationships were checked to evaluate which pollutants are primarily associated with particulates. Figures 11 through 14 show the concentration of exceeding constituents compared to the TSS concentration in each sample. The TSS correlation plots below display a best-fit line and 95% confidence intervals for detected results, indicated by dashed lines. The slope of the best-fit line was further investigated to determine if it was a statistically significant non-zero value (a slope of zero would indicate no relationship between a given analyte and TSS). The Wald Test with t-distribution of the test statistic was used to find the two-sided p-value test whose null hypothesis is that the slope is zero. A p-value of less than 0.05 indicates a statistically significant relationship between the constituent and TSS concentrations.

A positive and significant (p-value < 0.05) correlation was observed for all exceeding analytes, aluminum, manganese, mercury, and TCDD TEQ (no DNQ), indicating that TSS concentrations and soil mobilization strongly influence stormwater concentrations of most exceeding constituents. The strongest and most

direct evidence of a constituent's suspended solids association is the filtered result as a percent of the total concentration. Based on outfall and offsite stormwater sample results, aluminum and manganese are more than 80% particulate associated and mercury is about 40% particulate. Dioxin samples are not filtered, but given its very high partitioning coefficient and low solubility the congeners that make up TCDD TEQ (no DNQ) are assumed to be almost entirely particulate-associated. The TSS relationship for TCDD TEQ (no DNQ) is statistically significant (see Figure 14), but with a stratification due to the binning of values when calculating the TEQ excluding DNQ. This stratification is because the 17 individual congener concentrations that make up TCDD TEQ (no DNQ) are often near or below the reporting limit which results in many being excluded from the sum, and TEFs and BEFs are applied to these congeners which stratify the resulting concentration distribution.

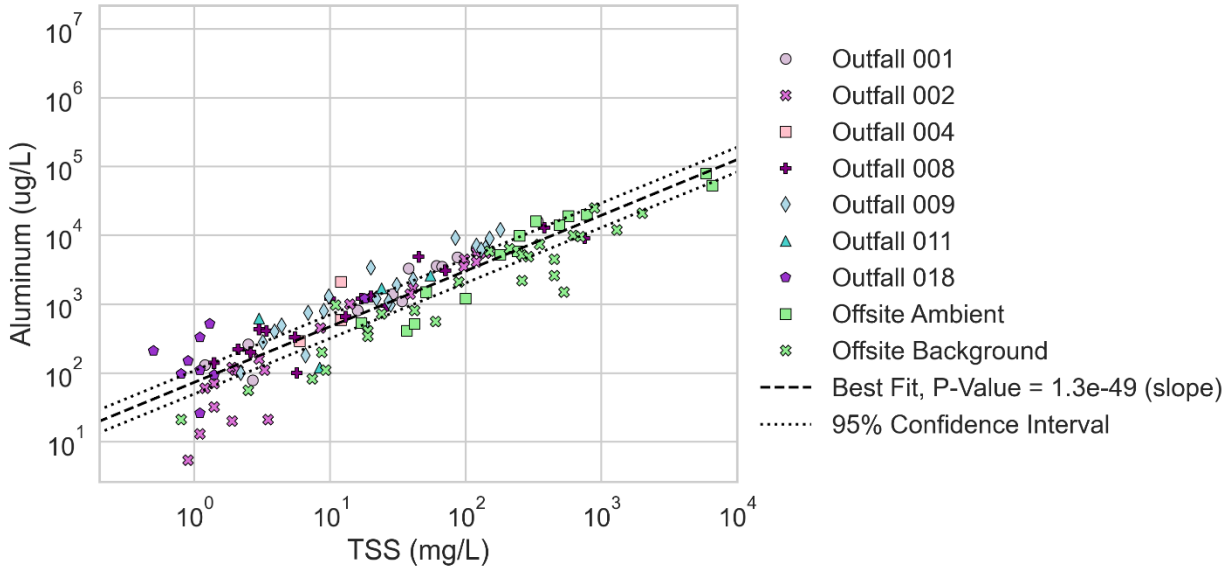


Figure 11. Aluminum vs TSS Concentrations at SSFL NPDES Outfalls from 2004-2026

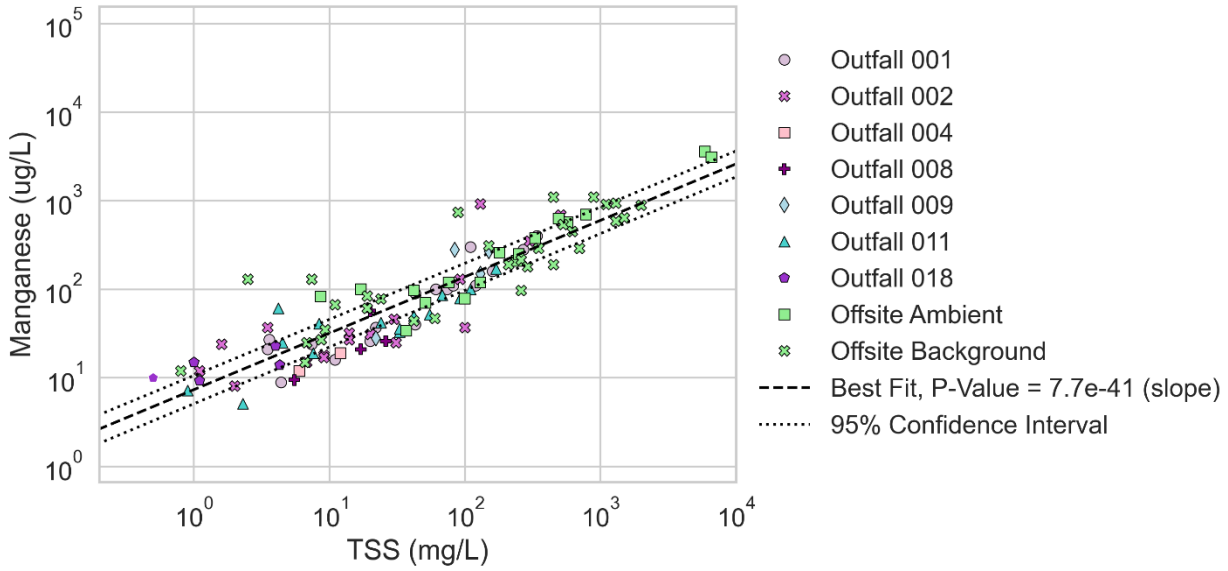


Figure 12. Manganese vs TSS Concentrations at SSFL NPDES Outfalls from 2015-2026

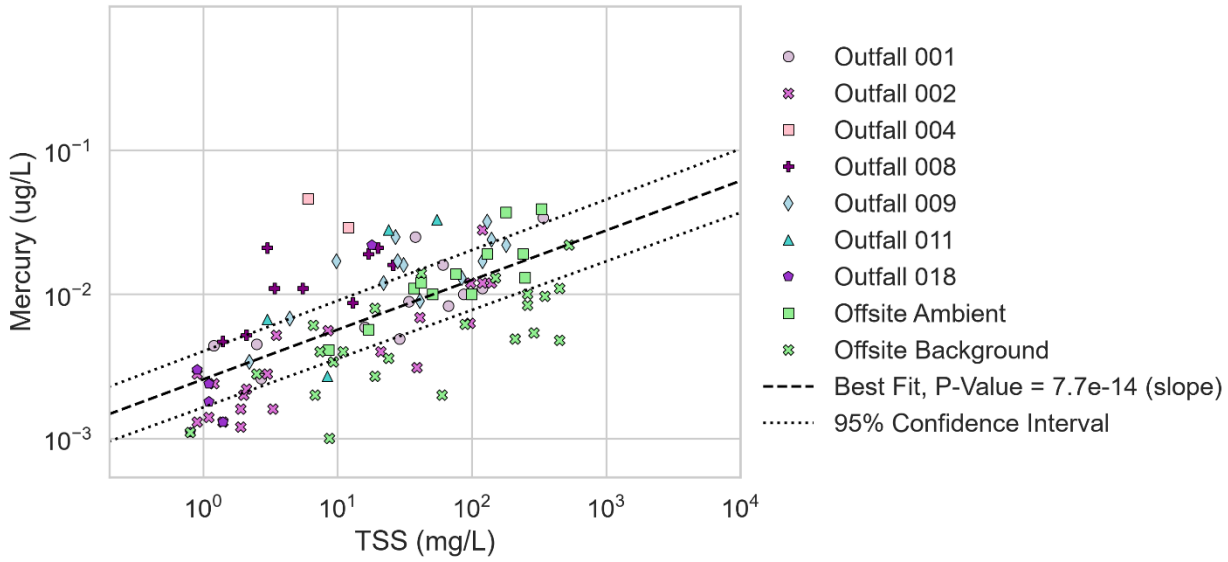


Figure 13. Mercury vs TSS Concentrations at SSFL NPDES Outfalls from 2015-2026

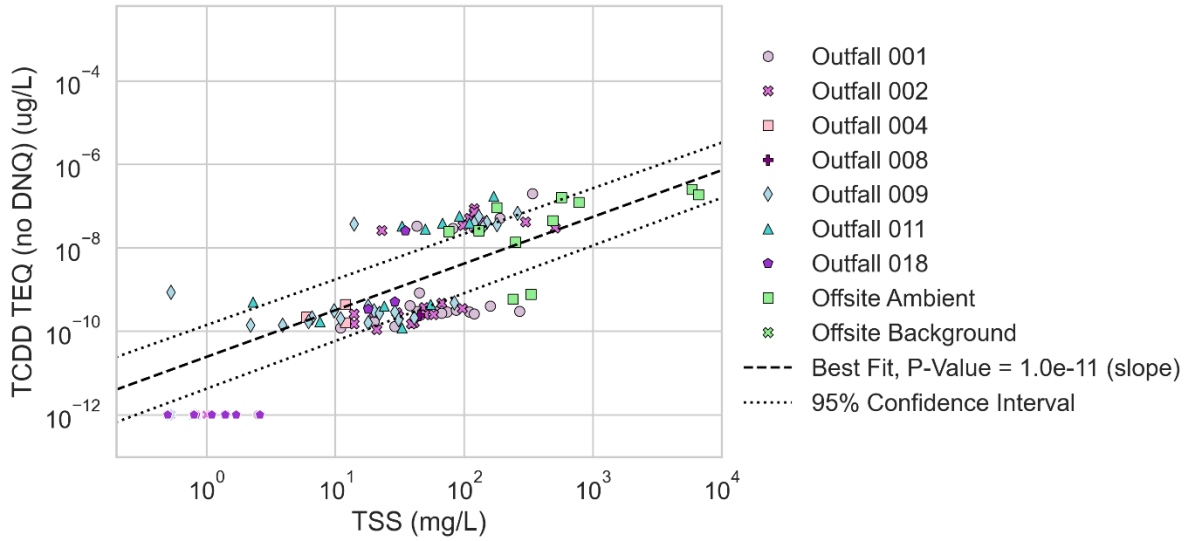


Figure 14. TCDD TEQ (no DNQ) vs TSS Concentrations at SSFL NPDES Outfalls from 2015-2026

3.2. Aluminum

Aluminum was detected above its daily maximum 2023 Permit Limit of 1 mg/L eleven times, with exceeding results ranging from 1.1 mg/L to 6.4 mg/L. During the 2025/26 period, aluminum had the highest number of exceedances among all monitored constituents. The aluminum limit is based on California's primary drinking water standard. No drinking water supply locations exist onsite or nearby offsite, and incidental exposure through recreational contact with stormwater is the more likely pathway near SSFL (see Section 3.5 Human Health Risk Analysis in the main report). Concentrations of aluminum in surface soils across the site are relatively homogenous and below the BT (0% of 5,775 samples above BT), see Figure 15. For BT values, refer to Table 3.

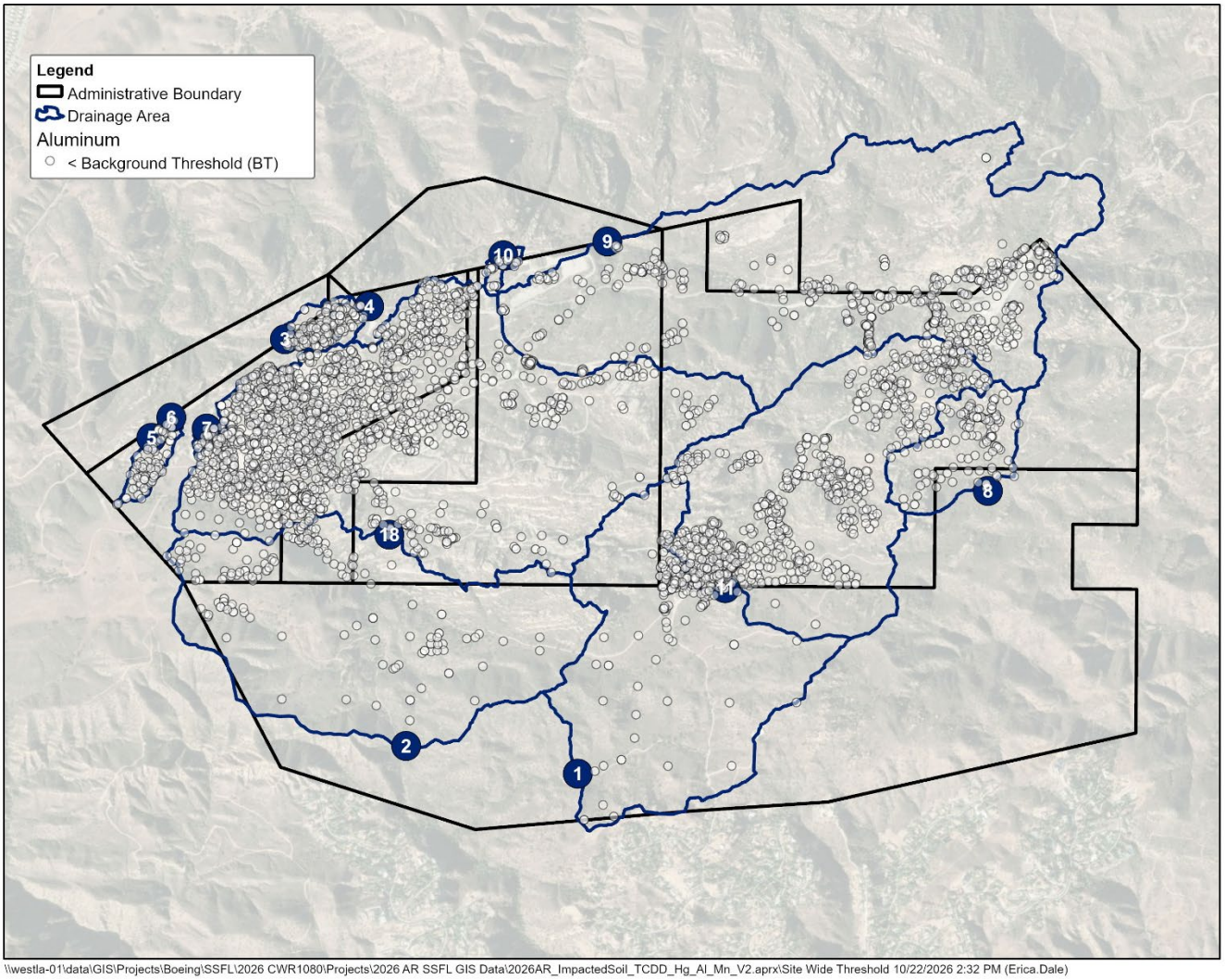
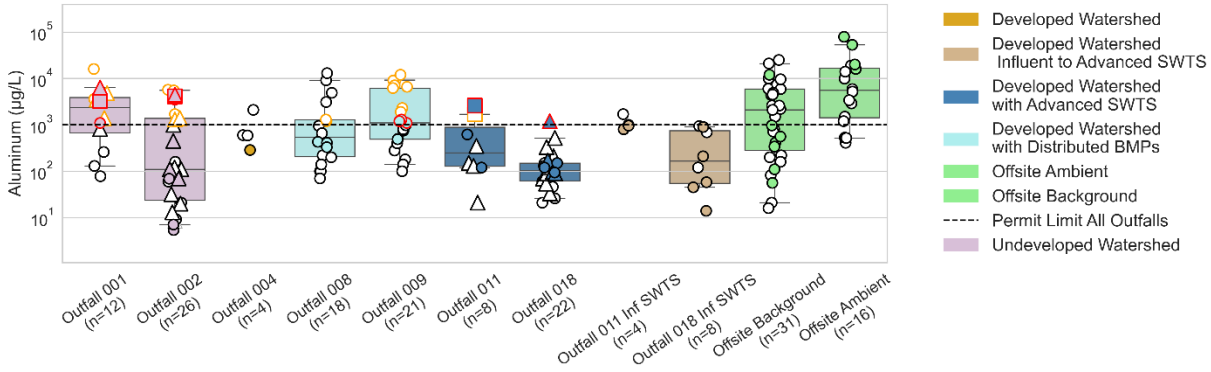


Figure 15. Surface Soil Concentrations of Aluminum Relative to USL95 Background Thresholds
These maps are for source investigation purposes only and are not to be used for soil clean-up planning.

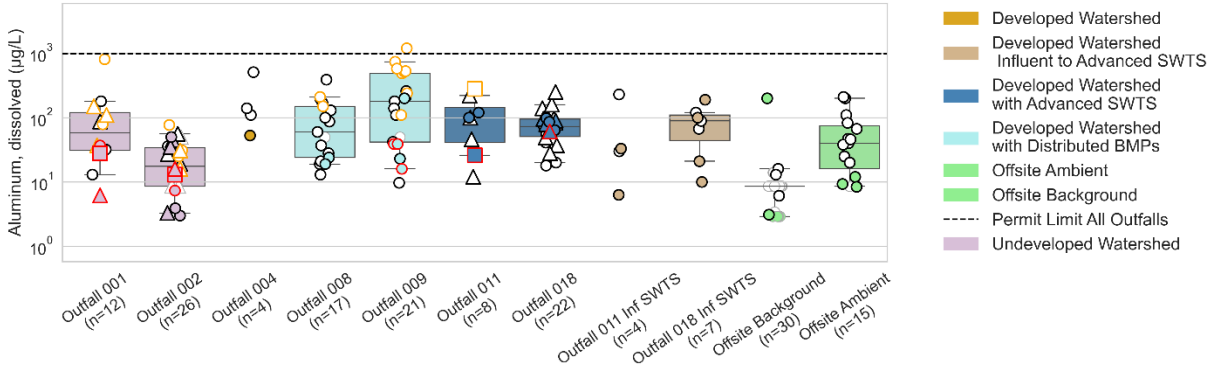
Exceedances of aluminum were observed at Outfalls 001, 002, 009, 011, and 018 during the 2025/2026 monitoring period. As shown in Figure 16a, the exceeding aluminum concentrations fell within the range of background and ambient stormwater concentrations.

Figures 16c indicates that aluminum PS in stormwater at onsite outfalls were at the upper end of background stormwater PS. These higher onsite PSs are likely attributable to the elevated suspended solids observed offsite relative to onsite (see Figure 10).



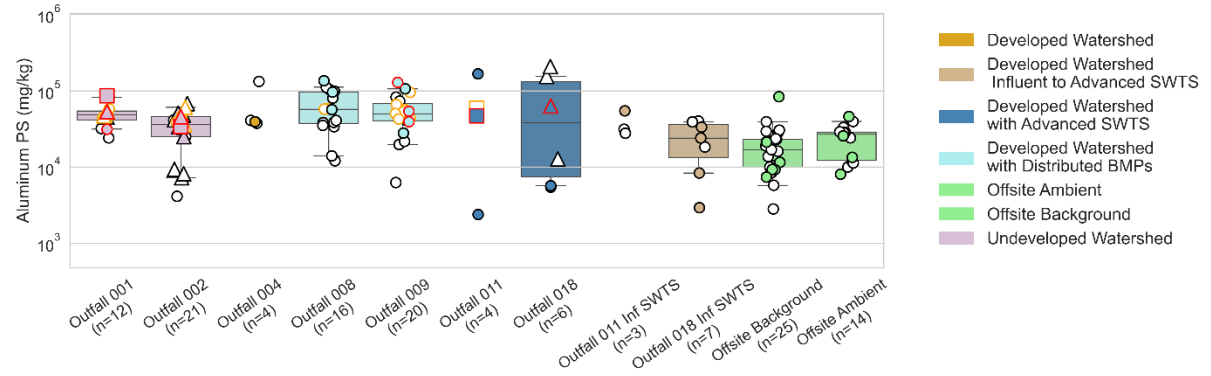
Note: Filled markers indicate samples from the current reporting year and markers without fill represent samples collected in the past 10 years.
Red borders indicate the total concentration exceeded permit limits in the current reporting year and orange borders indicate a previous year's exceedances.
Black marker borders signify detected results and grey signify non-detected results shown as method detection limit.
Triangle markers signify samples collected during fully treated SWTS discharge at Outfalls 011 or 018.
Square markers signify samples collected during untreated bypass and treated SWTS discharge at Outfalls 011 or 018.
Circle markers signify the sample was collected absent from SWTS discharge.

a)



Note: Filled markers indicate samples from the current reporting year and markers without fill represent samples collected in the past 10 years.
Red borders indicate the total concentration exceeded permit limits in the current reporting year and orange borders indicate a previous year's exceedances.
Black marker borders signify detected results and grey signify non-detected results shown as method detection limit.
Triangle markers signify samples collected during fully treated SWTS discharge at Outfalls 011 or 018.
Square markers signify samples collected during untreated bypass and treated SWTS discharge at Outfalls 011 or 018.
Circle markers signify the sample was collected absent from SWTS discharge.

b)

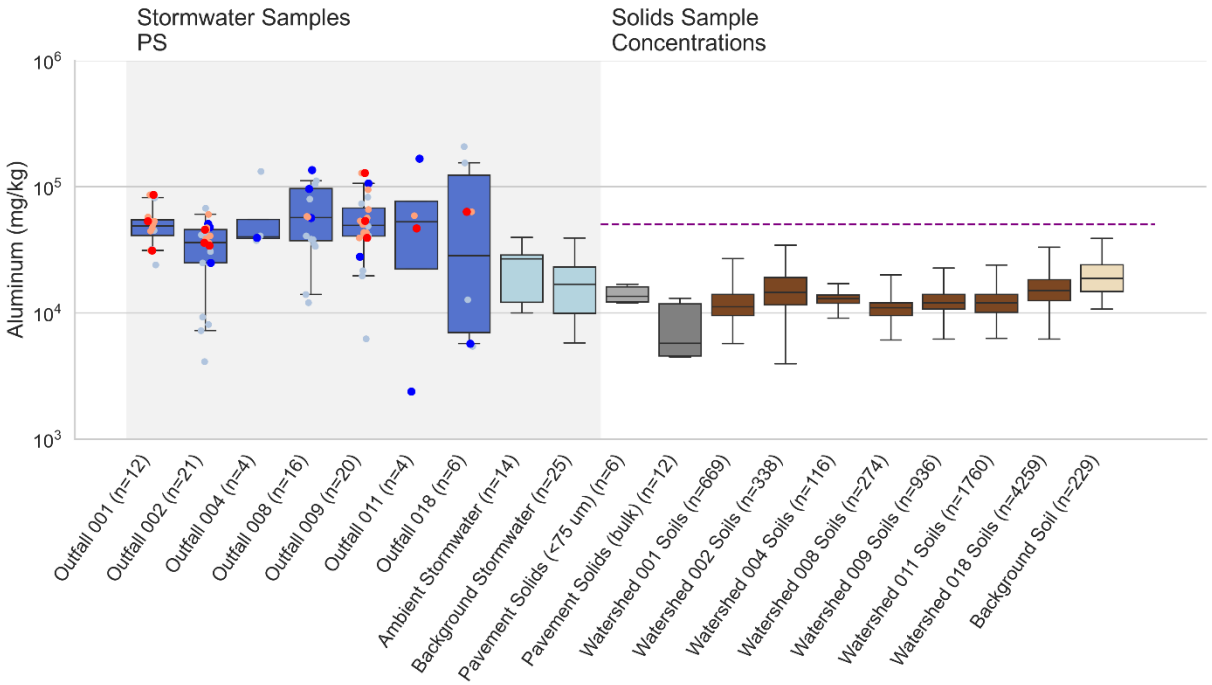


Note: Filled markers indicate samples from the current reporting year and markers without fill represent samples collected in the past 10 years.
Red borders indicate the total concentration exceeded permit limits in the current reporting year and orange borders indicate a previous year's exceedances.
Black marker borders signify detected results and grey signify non-detected results shown as method detection limit.
Triangle markers signify samples collected during fully treated SWTS discharge at Outfalls 011 or 018.
Square markers signify samples collected during untreated bypass and treated SWTS discharge at Outfalls 011 or 018.
Circle markers signify the sample was collected absent from SWTS discharge.

c)

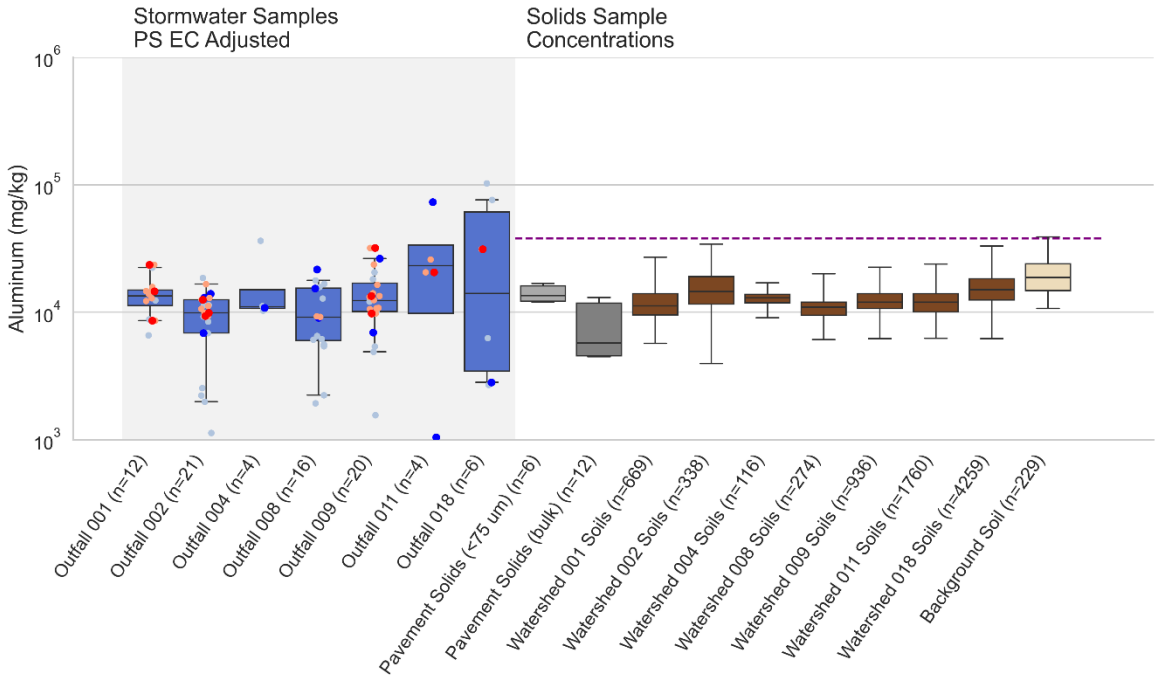
Figures 16 a, b, and c. 2025/26 Aluminum (a) Total Concentrations, (b) Dissolved Concentrations, and (c) Particulate Strengths by Outfall

Stormwater PSs were also compared with bulk surface soil concentrations to confirm sources of aluminum (Figures 17a). The PSs were then adjusted downward by an EC to account for the enrichment of aluminum from bulk surface soils to stormwater samples (*Equation 3*). EC-adjusted stormwater PS were in line with background soils and did not exceed the BT, shown in Figures 17b. Ranges for Outfalls 011 and 018 are wider than others due to low TSS in the SWTS effluent, resulting in more variable PS values (since TSS is the denominator in the PS calculation).



Note: Red markers indicate PS values of outfall exceeding samples and blue non-exceeding samples in the past year.
Orange markers represent exceedances and light gray markers non-exceedances from the past ten years.
The purple line represents the soil background threshold (DTSC 2012a, DTSC 2012b).
Whiskers represent the 1st and 99th percentiles.
Treated Wood Poles shown as 'TWPs' and soils readily mobilized in the top 6 inches are shown for soil solids.

a)



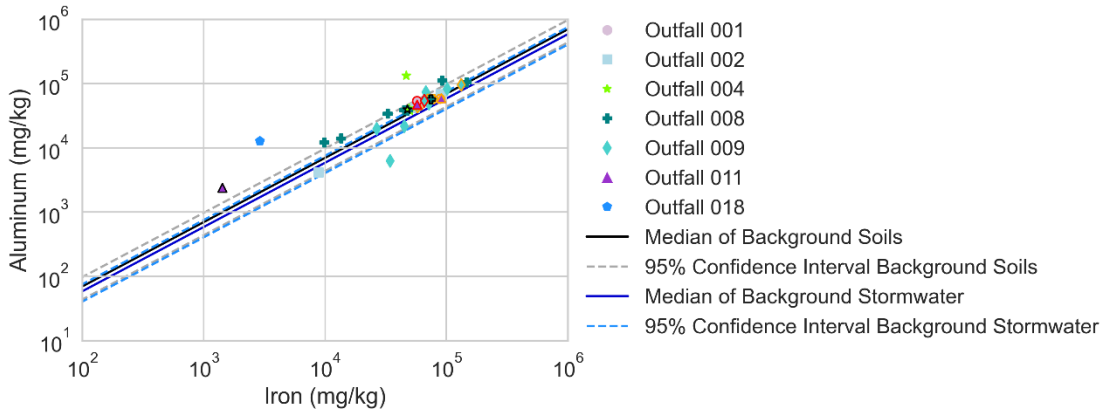
Note: Treated Wood Poles shown as 'TWPs' and soils readily mobilized in the top 6 inches are shown for soil solids. Whiskers represent the 5th and 95th percentiles, and purple line represents the soil BTV (DTSC 2012a, DTSC 2012b). Red markers indicate PS values of outfall exceeding samples and blue non-exceeding samples in the past year. Orange markers represent exceedances and light gray markers non-exceedances from the past ten years.

b)

Figures 17 a and b. a) Aluminum Particulate Strength in Outfall Stormwater Samples vs. Solid Source Materials and b) Aluminum Particulate Strength in Outfall Stormwater Samples Adjusted by the Average Observed Enrichment Coefficient.

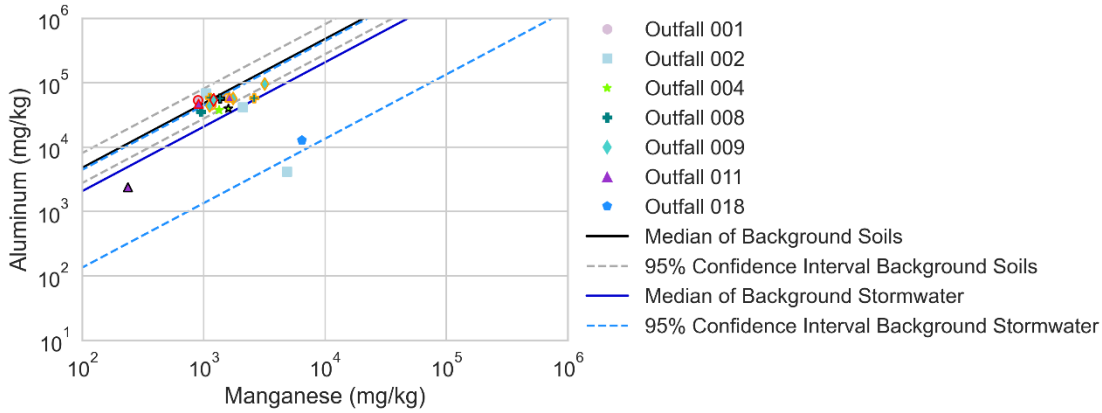
As an additional line of evidence, aluminum-to-iron and aluminum-to-manganese ratios in outfall stormwater PS – where paired samples were available – were compared with ratios in offsite background stormwater PS and natural background soil. Figures 18a and b show that the metal ratios of exceeding samples were similar to or within the 95% confidence intervals for both background soils and offsite background stormwater. This provides further evidence that natural background soils were the predominant source of aluminum exceedances in the 2025/26 season.

Collectively, the LOEs demonstrate **this year's permit exceedances of aluminum are very likely due to natural background soils.**



Note: Black borders indicate PS detections in the current water year, while red borders indicate an exceedance. Markers with no border indicate detections and orange borders non-detects in the last 10 years.

a)



Note: Black borders indicate PS detections in the current water year, while red borders indicate an exceedance. Markers with no border indicate detections and orange borders non-detects in the last 10 years.

b)

Figures 18 a and b. a) Aluminum vs Iron and b) Aluminum vs Manganese Metal Ratio Plots.

3.3. Manganese

Manganese was detected above its daily maximum 2023 Permit Limit of 50 µg/L two times, with exceeding concentrations detected at 52 µg/L at Outfall 011 and 110 µg/L at Outfall 001. The exceedance at Outfall 011 occurred during pond overflow conditions during the largest storm of the year (i.e. not during SWTS-treated discharge) on 12/26/2025, and the exceedance at Outfall 001 occurred during the 4.35-inch rain event on 2/18/2026. The limit is a secondary MCL for drinking water and is not based on protection of human or aquatic life, but rather on aesthetic considerations (such as color or taste). No drinking water supply locations exist onsite or nearby offsite. Similar to aluminum, manganese surface soil concentrations are relatively homogeneous across the site and almost entirely below the BT (0.2% of 4,146 samples above BT), as shown in Figure 19.

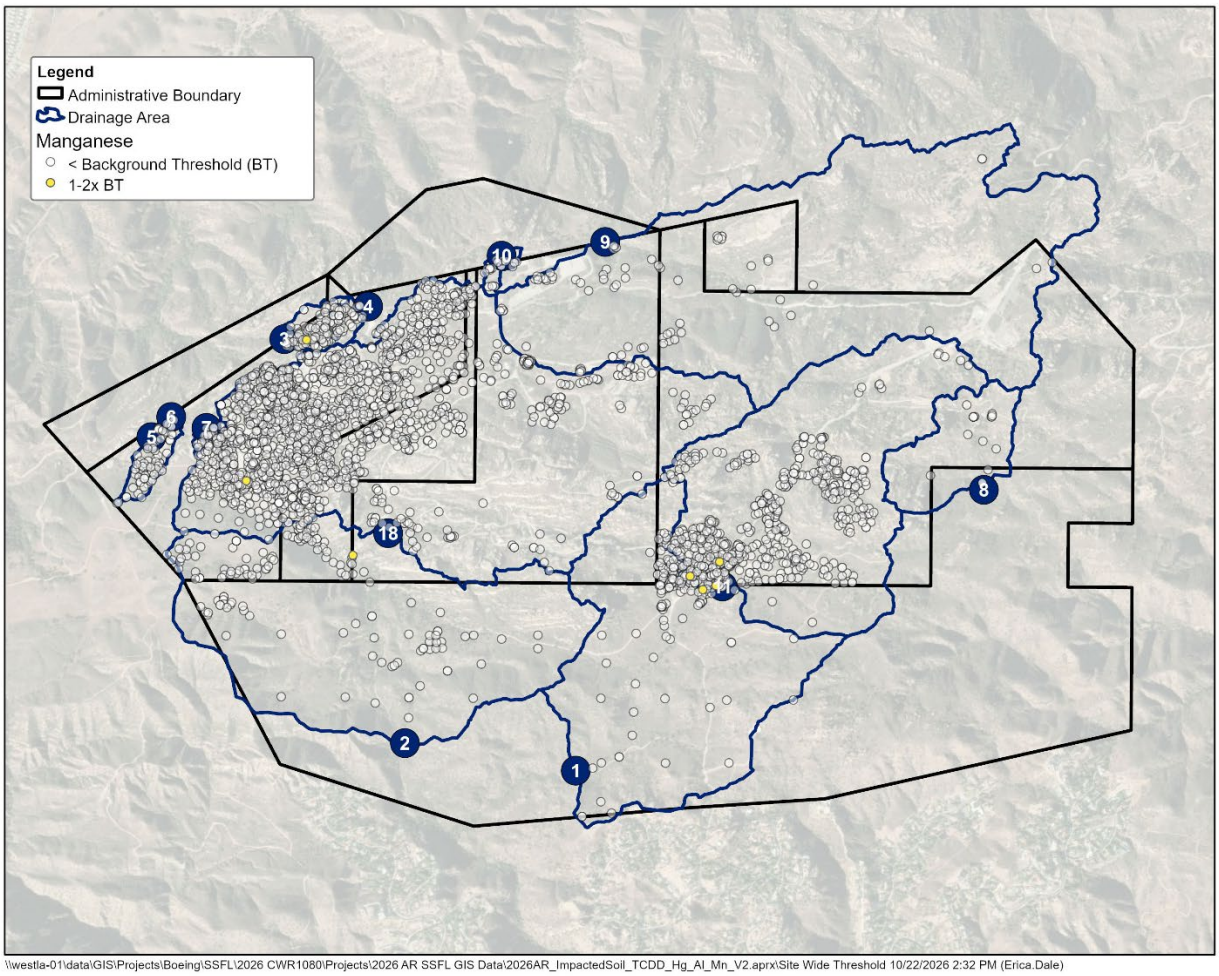
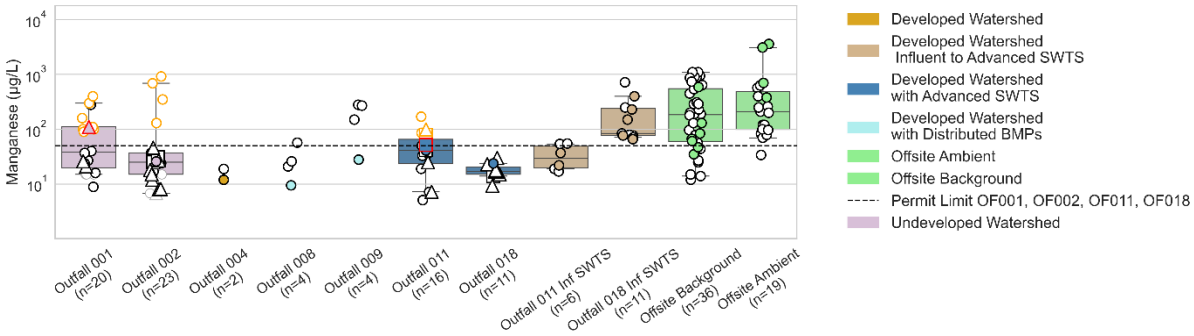


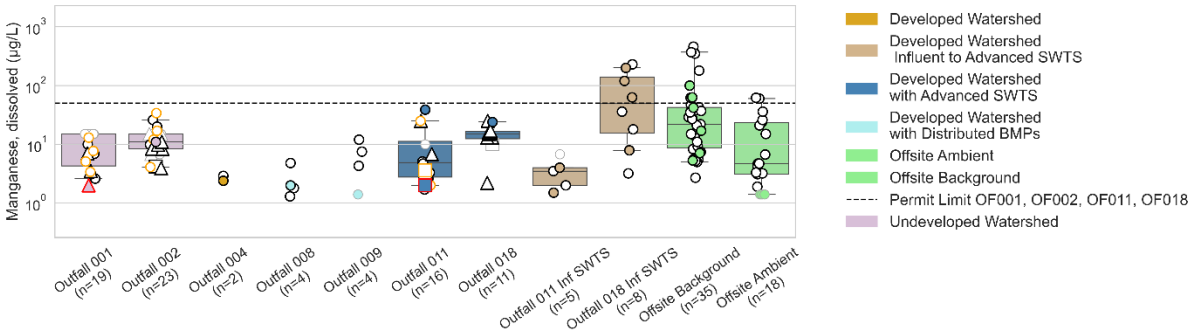
Figure 19. Surface Soil Concentrations of Manganese Relative to USL95 Background Thresholds.
These maps are for source investigation purposes only and are not to be used for soil clean-up planning.

Manganese is permitted for Outfalls 001, 002, 011, and 018. Manganese concentrations are generally consistent across the site and within the range observed at background monitoring sites (Figures 20a and b). Particulate concentrations were relatively uniform across all outfalls (Figures 20c). Collectively, these lines of evidence support that manganese exceedances are derived from a diffuse, sitewide source such as background soils.



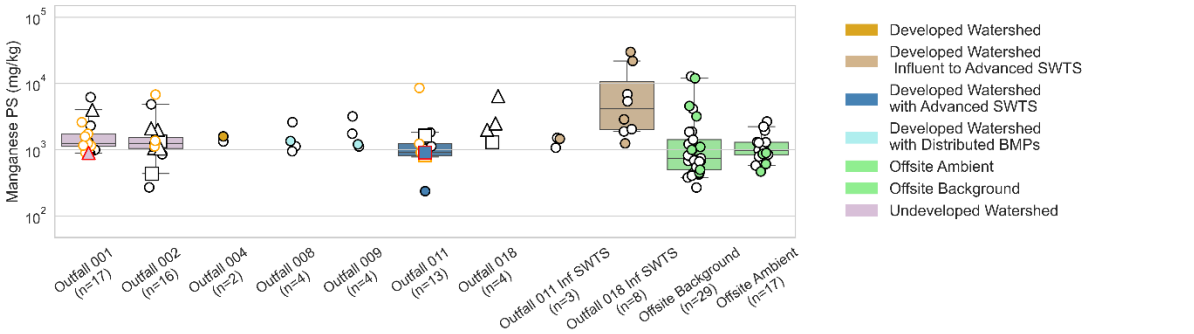
Note: Filled markers indicate samples from the current reporting year and markers without fill represent samples collected in the past 10 years.
Red borders indicate the total concentration exceeded permit limits in the current reporting year and orange borders indicate a previous year's exceedances.
Black marker borders signify detected results and grey signify non-detected results shown as method detection limit.
Triangle markers signify samples collected during fully treated SWTS discharge at Outfalls 011 or 018.
Square markers signify samples collected during untreated bypass and treated SWTS discharge at Outfalls 011 or 018.
Circle markers signify the sample was collected absent from SWTS discharge.

a)



Note: Filled markers indicate samples from the current reporting year and markers without fill represent samples collected in the past 10 years.
Red borders indicate the total concentration exceeded permit limits in the current reporting year and orange borders indicate a previous year's exceedances.
Black marker borders signify detected results and grey signify non-detected results shown as method detection limit.
Triangle markers signify samples collected during fully treated SWTS discharge at Outfalls 011 or 018.
Square markers signify samples collected during untreated bypass and treated SWTS discharge at Outfalls 011 or 018.
Circle markers signify the sample was collected absent from SWTS discharge.

b)

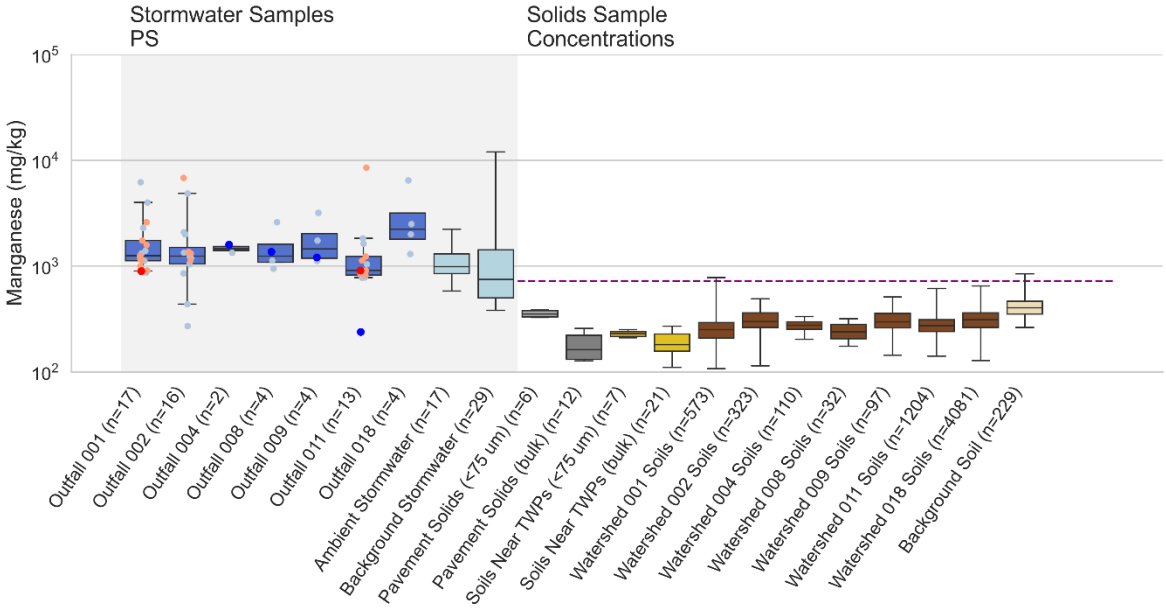


Note: Filled markers indicate samples from the current reporting year and markers without fill represent samples collected in the past 10 years.
Red borders indicate the total concentration exceeded permit limits in the current reporting year and orange borders indicate a previous year's exceedances.
Black marker borders signify detected results and grey signify non-detected results shown as method detection limit.
Triangle markers signify samples collected during fully treated SWTS discharge at Outfalls 011 or 018.
Square markers signify samples collected during untreated bypass and treated SWTS discharge at Outfalls 011 or 018.
Circle markers signify the sample was collected absent from SWTS discharge.

c)

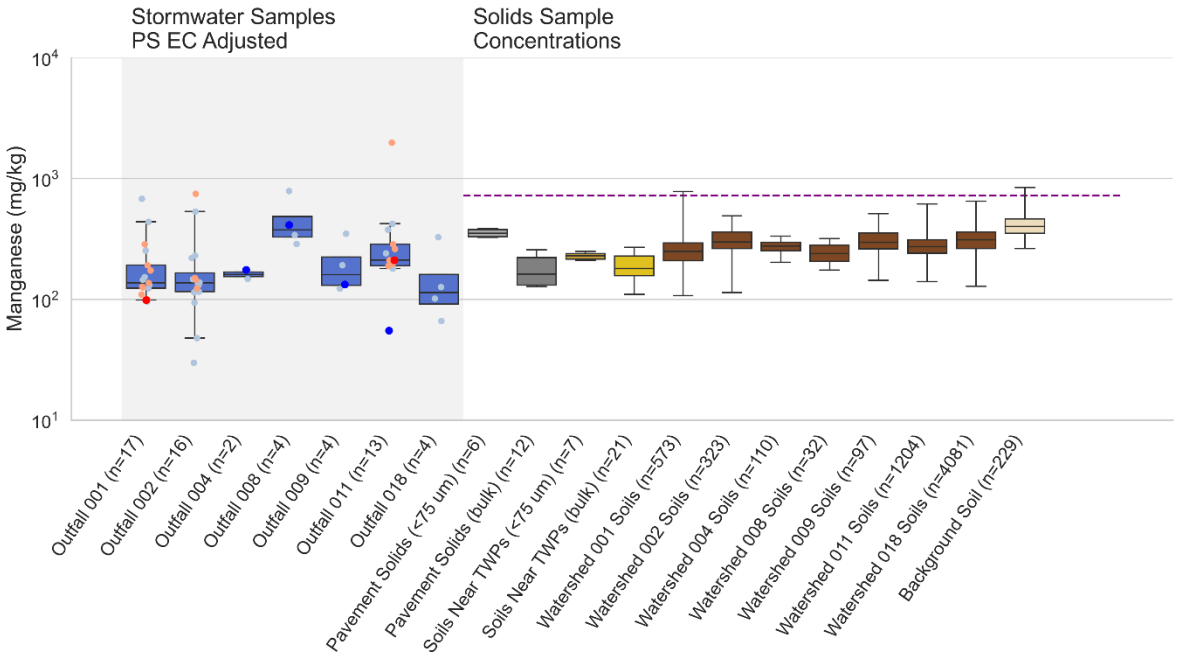
Figures 20 a, b, and c. 2025/26 Manganese (a) Total Concentrations, (b) Dissolved Concentrations, and (c) Particulate Strengths by Outfall

The PS of the outfall stormwater samples compared to the various potential sources is shown in Figures 21a, and the EC-adjusted stormwater PS is shown in Figures 21b. The unadjusted PS of the exceeding sample was just above the BT, but in line with offsite background stormwater concentrations. The EC-adjusted PS of the exceeding sample was below the BT and background soil concentrations. **This evidence suggests that natural background soils are the source of manganese exceedance at Outfall 001 and 011, as the PS of exceeding samples are similar to that of background stormwater.**



Note: Treated Wood Poles shown as 'TWPs' and soils readily mobilized in the top 6 inches are shown for soil solids.
Whiskers represent the 5th and 95th percentiles, and purple line represents the soil BTV (DTSC 2012a, DTSC 2012b).
Red markers indicate PS values of outfall exceeding samples and blue non-exceeding samples in the past year.
Orange markers represent exceedances and light gray markers non-exceedances from the past ten years.

a)

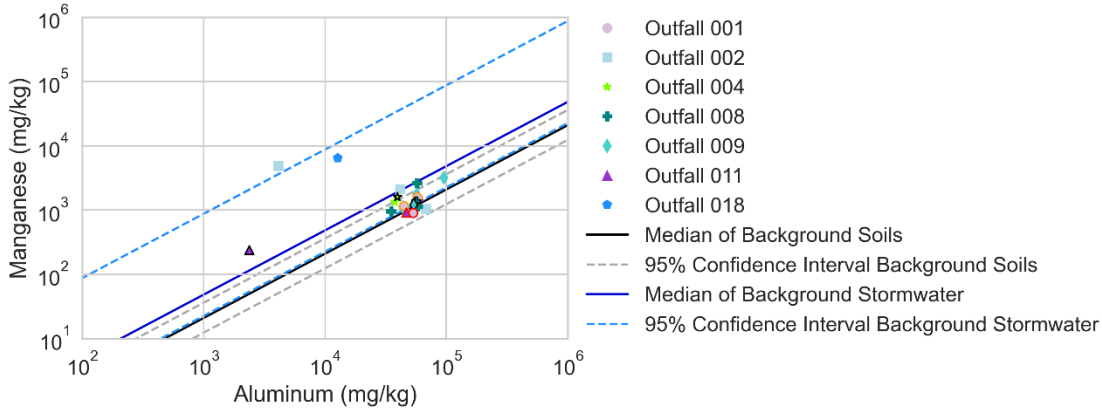


Note: Treated Wood Poles shown as 'TWPs' and soils readily mobilized in the top 6 inches are shown for soil solids. Whiskers represent the 5th and 95th percentiles, and purple line represents the soil BTV (DTSC 2012a, DTSC 2012b). Red markers indicate PS values of outfall exceeding samples and blue non-exceeding samples in the past year. Orange markers represent exceedances and light gray markers non-exceedances from the past ten years.

b)

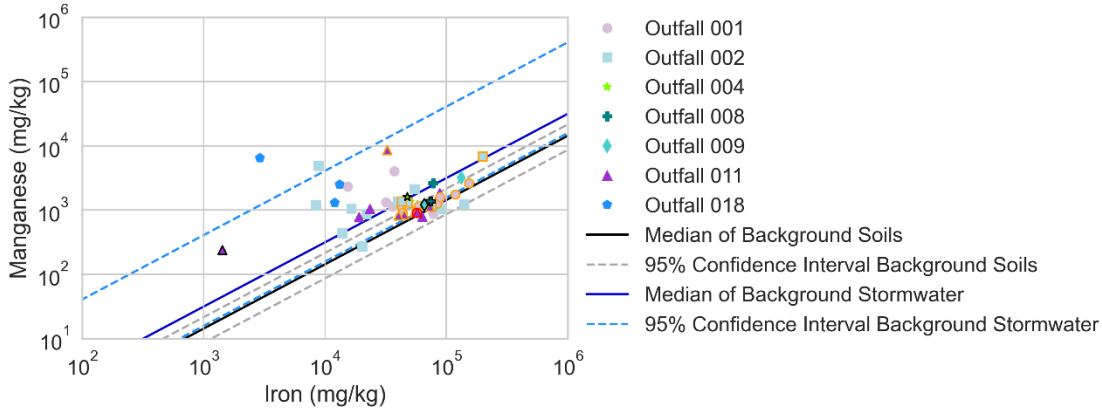
Figures 21 a and b. a) Manganese Particulate Strength in Outfall Stormwater Samples vs. Solid Source Materials and b) Manganese Particulate Strength in Outfall Stormwater Samples Adjusted by the Average Observed Enrichment Coefficient.

As an additional line of evidence, manganese-to-aluminum and aluminum-to-iron ratios – where paired samples were available – in outfall stormwater PS were compared with ratios in offsite background stormwater PS and natural background soil. Figures *22*a and b show the exceeding stormwater samples are similar to, or within the background soil and stormwater 95% confidence interval, which further supports that **natural background soils are likely the source of the exceeding samples for manganese** in the 2025/26 rainy season.



Note: Black borders indicate PS detections in the current water year, while red borders indicate an exceedance. Markers with no border indicate detections and orange borders non-detects in the last 10 years.

a)



Note: Black borders indicate PS detections in the current water year, while red borders indicate an exceedance. Markers with no border indicate detections and orange borders non-detects in the last 10 years.

b)

Figures 22 a and b. a) Manganese vs Aluminum and b) Manganese vs Iron Metal Ratio Plots

3.4. Mercury

Mercury was detected above its daily maximum 2023 Permit Limit of 0.024 µg/L two times, with exceeding concentrations detected at 0.025 µg/L at Outfall 009 and 0.046 µg/L at Outfall 004. A total of thirty samples were analyzed for mercury at SSFL outfalls during the current reporting year. Mercury limits are based on human health for fish consumption over a lifetime; however, neither fish nor fishing is known to occur at or near SSFL outfalls or drainages (see Section 3.5 Human Health Risk Analysis in the main report) and the combined annual average concentration of outfalls draining to Arroyo Simi was below the 0.024 ug/L limit. Site surface soil data indicates that mercury concentrations above the BT (33% of 5,282 samples) are clustered in multiple areas of former site operations (Figure 23). In Outfall 009, 22% of surface soil samples (n=727) were greater than the BT, in Outfall 004, 72% of surface soil samples (n=81) were above the BT.

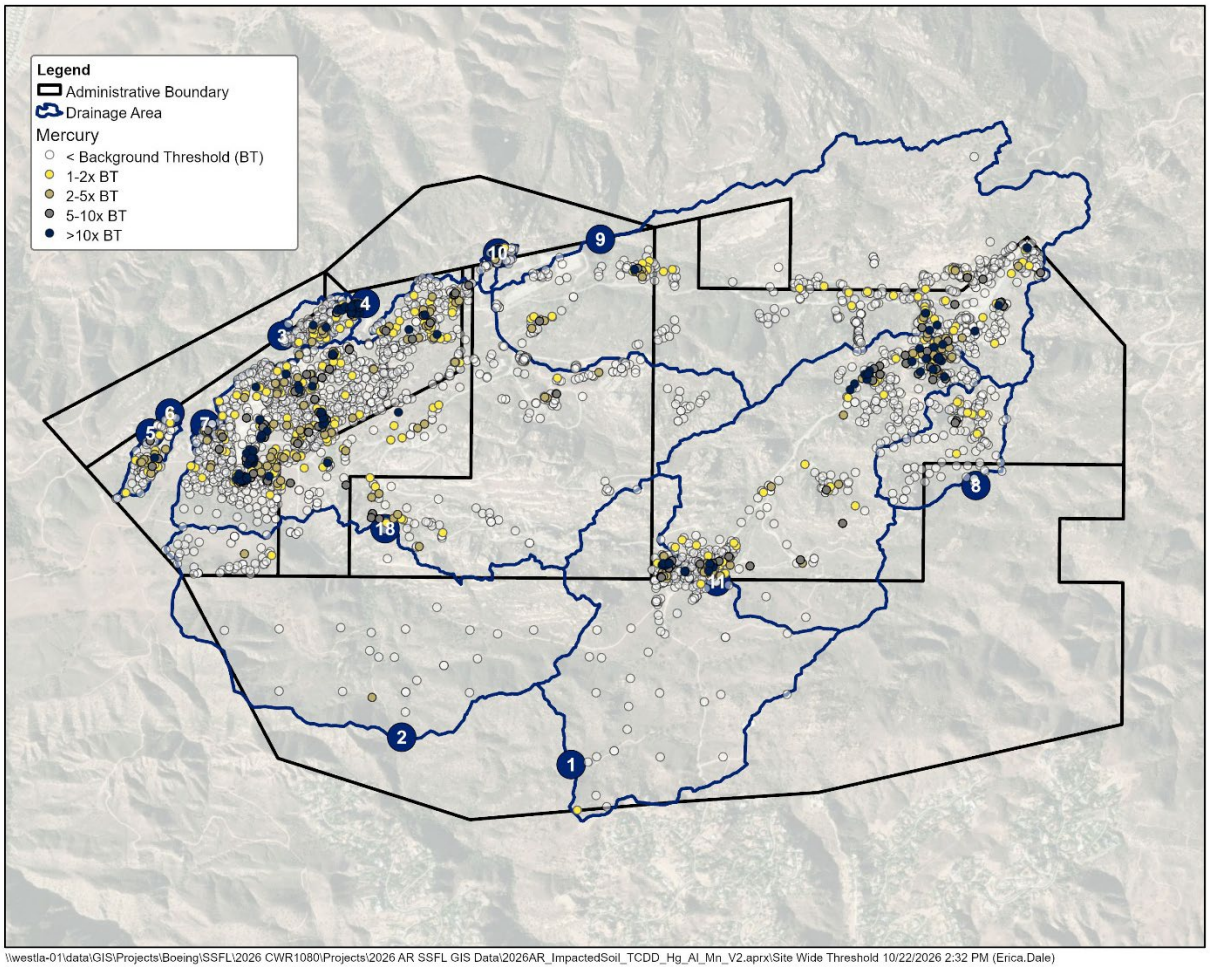
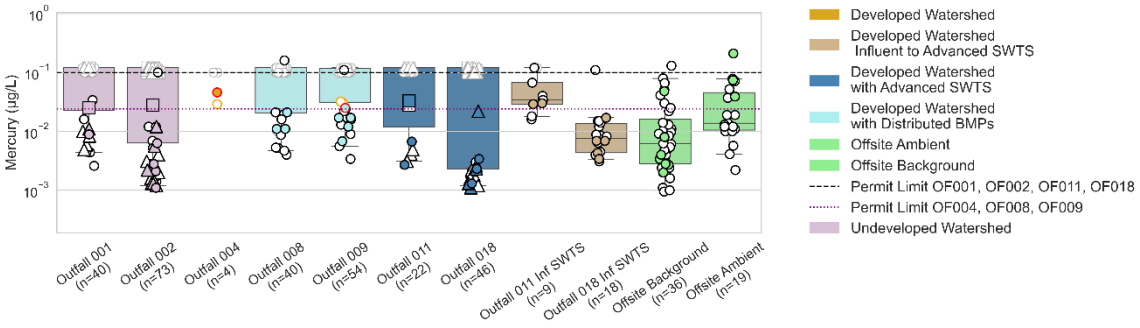


Figure 23. Surface Soil Concentrations of Mercury Relative to USL95Background Thresholds
These maps are for source investigation purposes only and are not to be used for soil clean-up planning.

Figures 24a shows outfall mercury total concentrations, including exceedances observed during the 2025/2026 monitoring period. The exceeding concentrations at Outfall 009 and Outfall 004 were within the range of observed background stormwater samples.

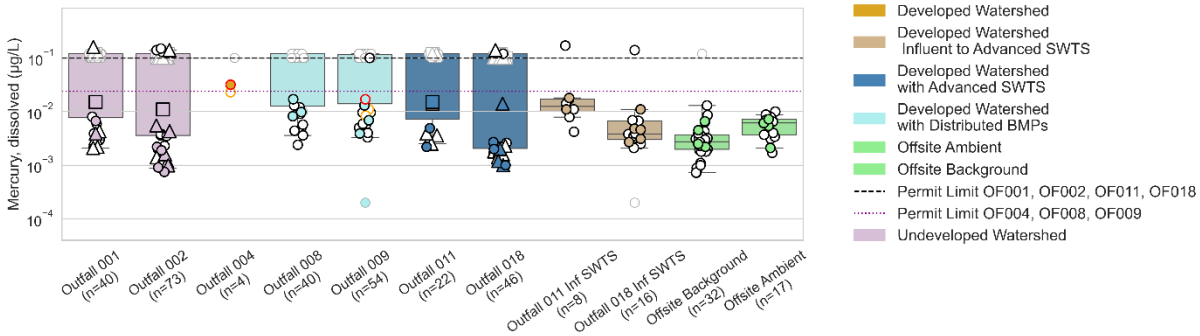
Mercury is a unique exceeding constituent in that it has a high dissolved fraction relative to other exceeding constituents. In 2025/2026, the mean dissolved fraction at SSFL permitted outfalls was 64%, while other exceeding constituent average dissolved fractions were 0%-19%. Therefore, besides looking at total concentration and PS, it is also important to compare SSFL outfall dissolved concentrations with offsite background dissolved concentrations for analytes substantial dissolved fractions. As shown in Figure 24b, Outfall 009 and Outfall 004 exceeding samples had dissolved concentrations of 0.013 ug/L and 0.032 ug/L, respectively. Outfall 004 was above the range observed in offsite stormwater background and ambient mercury samples (0.00072-0.013 ug/L), while Outfall 009 was in line with the maximum. The dissolved analysis supports mercury in surface soils above background as likely contributing to the observed exceedance at Outfall 004 and potentially contributing at Outfall 009 as well.

Figures 24c shows the PS for mercury, with this year's outfall exceedances being slightly elevated compared to background stormwater PS. This is consistent with the presence of mercury in surface soils above background in the Outfall 004 and Outfall 009 drainage areas. These findings suggest the Outfall 004 exceedance was likely driven by soils above the BT, and that the exceedance at Outfall 009 may have contributions from soils above the BT.



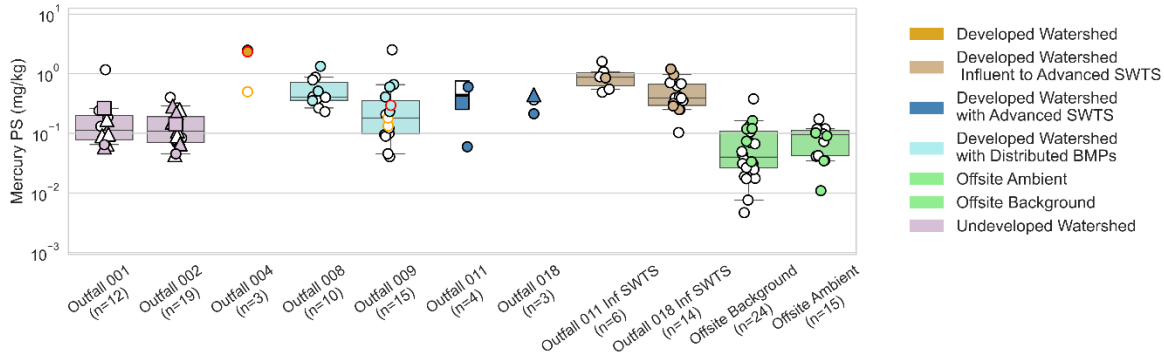
Note: Filled markers indicate samples from the current reporting year and markers without fill represent samples collected in the past 10 years.
Red borders indicate the total concentration exceeded permit limits in the current reporting year and orange borders indicate a previous year's exceedances.
Black marker borders signify detected results and grey signify non-detected results shown as method detection limit.
Triangle markers signify samples collected during fully treated SWTS discharge at Outfalls 011 or 018.
Square markers signify samples collected during untreated bypass and treated SWTS discharge at Outfalls 011 or 018.
Circle markers signify the sample was collected absent from SWTS discharge.

a)



Note: Filled markers indicate samples from the current reporting year and markers without fill represent samples collected in the past 10 years.
Red borders indicate the total concentration exceeded permit limits in the current reporting year and orange borders indicate a previous year's exceedances.
Black marker borders signify detected results and grey signify non-detected results shown as method detection limit.
Triangle markers signify samples collected during fully treated SWTS discharge at Outfalls 011 or 018.
Square markers signify samples collected during untreated bypass and treated SWTS discharge at Outfalls 011 or 018.
Circle markers signify the sample was collected absent from SWTS discharge.

b)

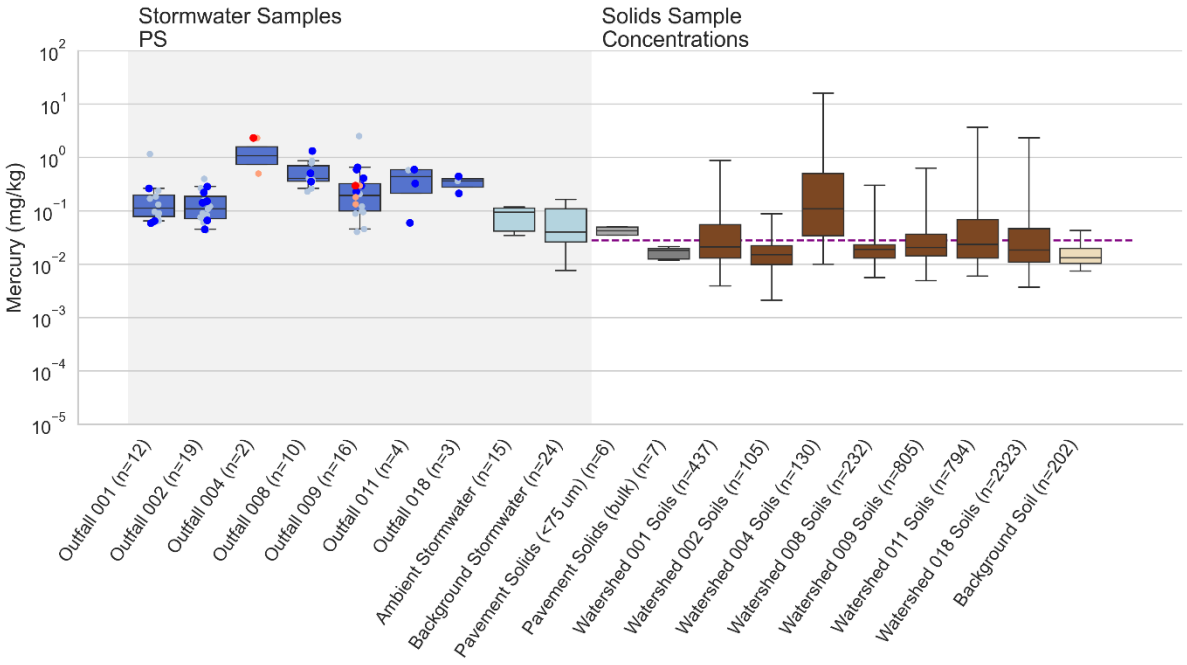


Note: Filled markers indicate samples from the current reporting year and markers without fill represent samples collected in the past 10 years.
Red borders indicate the total concentration exceeded permit limits in the current reporting year and orange borders indicate a previous year's exceedances.
Black marker borders signify detected results and grey signify non-detected results shown as method detection limit.
Triangle markers signify samples collected during fully treated SWTS discharge at Outfalls 011 or 018.
Square markers signify samples collected during untreated bypass and treated SWTS discharge at Outfalls 011 or 018.
Circle markers signify the sample was collected absent from SWTS discharge.

c)

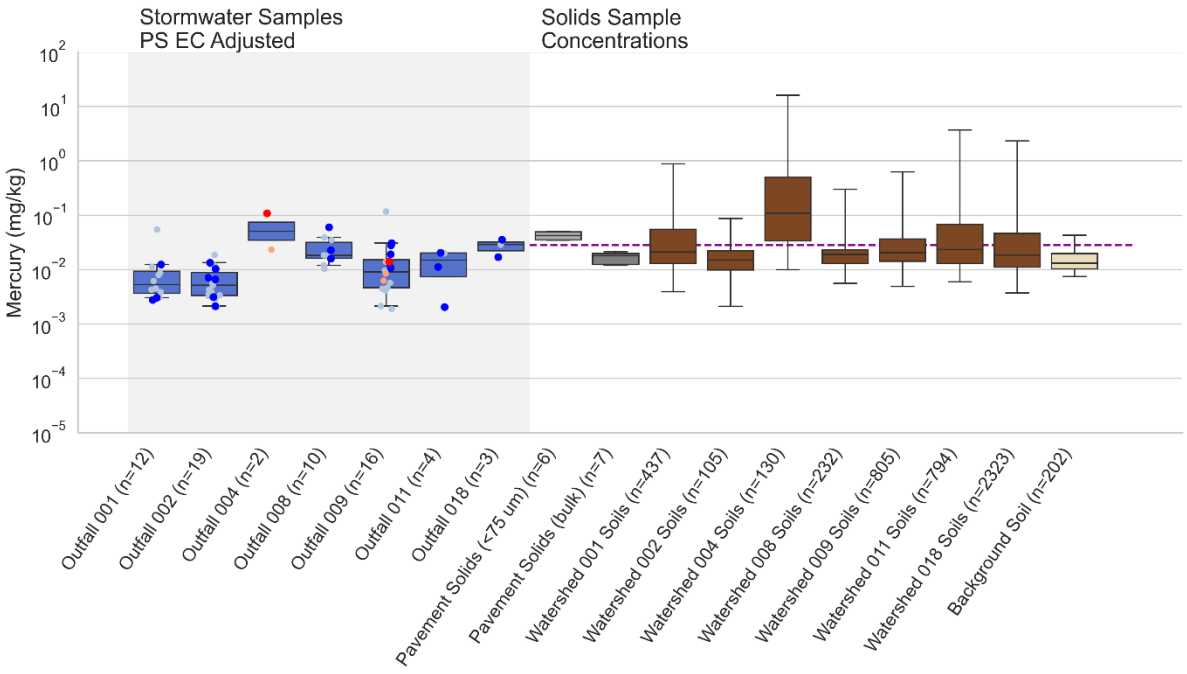
Figures 24 a, b, and C. 2025/26 Mercury a) Total Concentrations, b) Dissolved Concentrations, and (c) Particulate Strengths by Outfall

As shown in Figure 25a and b, the stormwater PS of the exceeding sample at Outfall 009 is slightly above background stormwater PS, while the EC-adjusted PS stormwater concentration of the sample was below the BT and similar to natural background soils and pavement solids. However, since pavement solids and background soils are indistinguishable here, it is likely that the pavement solids are primarily covered by windblown soils rather than a source within the pavement itself. Since background soils have 75th percentile sample concentrations above the exceeding sample PS, they are considered very likely contributors to Outfall 009 exceedances. Additionally, some Watershed 009 surface soils have concentrations above background and these are likely contributing to the exceedance as well. At Outfall 004, the PS of the exceeding stormwater sample and EC-adjusted PS of the exceeding stormwater sample was above the BT and most potential sources, but was similar to the elevated Outfall 004 surface soil concentrations. These results indicate surface soils above background are very likely the source of the mercury exceedance at Outfall 004.



Note: Treated Wood Poles shown as 'TWPs' and soils readily mobilized in the top 6 inches are shown for soil solids.
Whiskers represent the 5th and 95th percentiles, and purple line represents the soil BTV (DTSC 2012a, DTSC 2012b).
Red markers indicate PS values of outfall exceeding samples and blue non-exceeding samples in the past year.
Orange markers represent exceedances and light gray markers non-exceedances from the past ten years.

a)

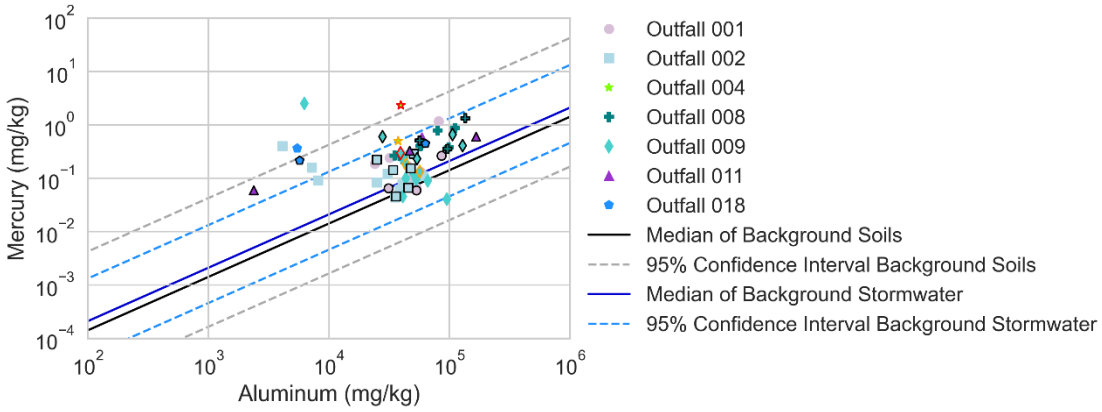


Note: Treated Wood Poles shown as 'TWPs' and soils readily mobilized in the top 6 inches are shown for soil solids. Whiskers represent the 5th and 95th percentiles, and purple line represents the soil BTV (DTSC 2012a, DTSC 2012b). Red markers indicate PS values of outfall exceeding samples and blue non-exceeding samples in the past year. Orange markers represent exceedances and light gray markers non-exceedances from the past ten years.

b)

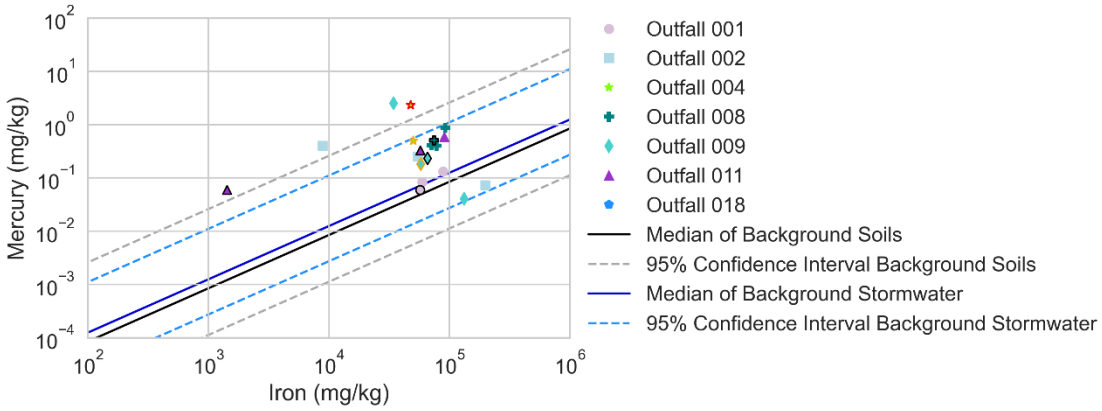
Figure 25 a and b. a) Mercury Particulate Strength in Outfall Stormwater Samples vs. Solid Source Materials and b) Mercury Particulate Strength in Outfall Stormwater Samples Adjusted by the Average Observed Enrichment Coefficient.

The next line of evidence reviewed was the metal ratios of mercury-to-aluminum, mercury-to-iron, and mercury-to-manganese ratios – where paired samples were available – in outfall stormwater PS were compared with ratios in offsite background stormwater PS and natural background soil. The Outfall 004 exceeding samples' metal ratios, shown in Figures 26 a-c, were observed to have a metal ratio above background stormwater and natural background soils, demonstrating surface soils above background to be a likely contributor to exceedances. The Outfall 009 exceeding sample metal ratio was observed to be within the background soil and stormwater 95% confidence interval when a pair was available for aluminum. This indicates impacted soils above background were likely contributing to Outfall 004 exceedance, however, natural background soils were largely responsible for the Outfall 009 exceedance.



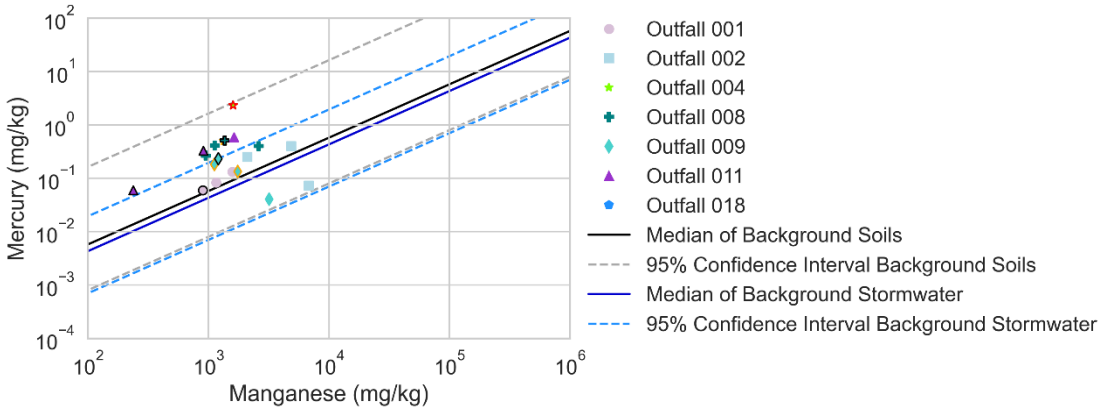
Note: Black borders indicate PS detections in the current water year, while red borders indicate an exceedance. Markers with no border indicate detections and orange borders non-detects in the last 10 years.

a)



Note: Black borders indicate PS detections in the current water year, while red borders indicate an exceedance. Markers with no border indicate detections and orange borders non-detects in the last 10 years.

b)



Note: Black borders indicate PS detections in the current water year, while red borders indicate an exceedance. Markers with no border indicate detections and orange borders non-detects in the last 10 years.

c)

Figures 26 a-c. a) Mercury vs Aluminum, b) Mercury vs Iron, and c) Mercury vs Manganese Metal Ratio Plots

Together, LOEs support that the mercury concentrations in the exceeding sample at Outfalls 004 was very likely caused by surface soils above background at Outfall 004. At Outfall 009, the exceeding sample was likely attributable to onsite soil concentrations above background, however, the sorbed concentration showed similarity to metal ratios in background stormwater PS and natural background soils.

3.5. TCDD TEQ (no DNQ)

TCDD TEQ (no DNQ) was detected above its daily maximum 2023 Permit Limit of 2.8E10^{-8} µg/L two times at Outfall 002, with exceeding concentrations detected at 3.4E10^{-8} µg/L for an event with no bypass flow from Outfall 018, and 7.2E10^{-8} µg/L for an event with bypass flow from Outfall 018. TCDD TEQ (no DNQ) limits are based on protection of human health for fish consumption for a lifetime; however, neither fish nor fishing is known to occur at or near SSFL outfalls or drainages (see Section 3.5 Human Health Risk Analysis in the main report) and the annual average concentration at all outfalls was below the 2.8E10^{-8} µg/L limit.

The soil concentration maps indicate elevated concentrations are present on the site in 10% of 4,435 samples. Outfall 002 was the only location with exceedances this year and there are soils with TCDD TEQ concentrations above BTs in the upper reaches of the watershed and more in the upstream Outfall 018 watershed, as shown in Figure 27. Of Outfall 002 surface soil samples (n=143), 2% were above the BT.

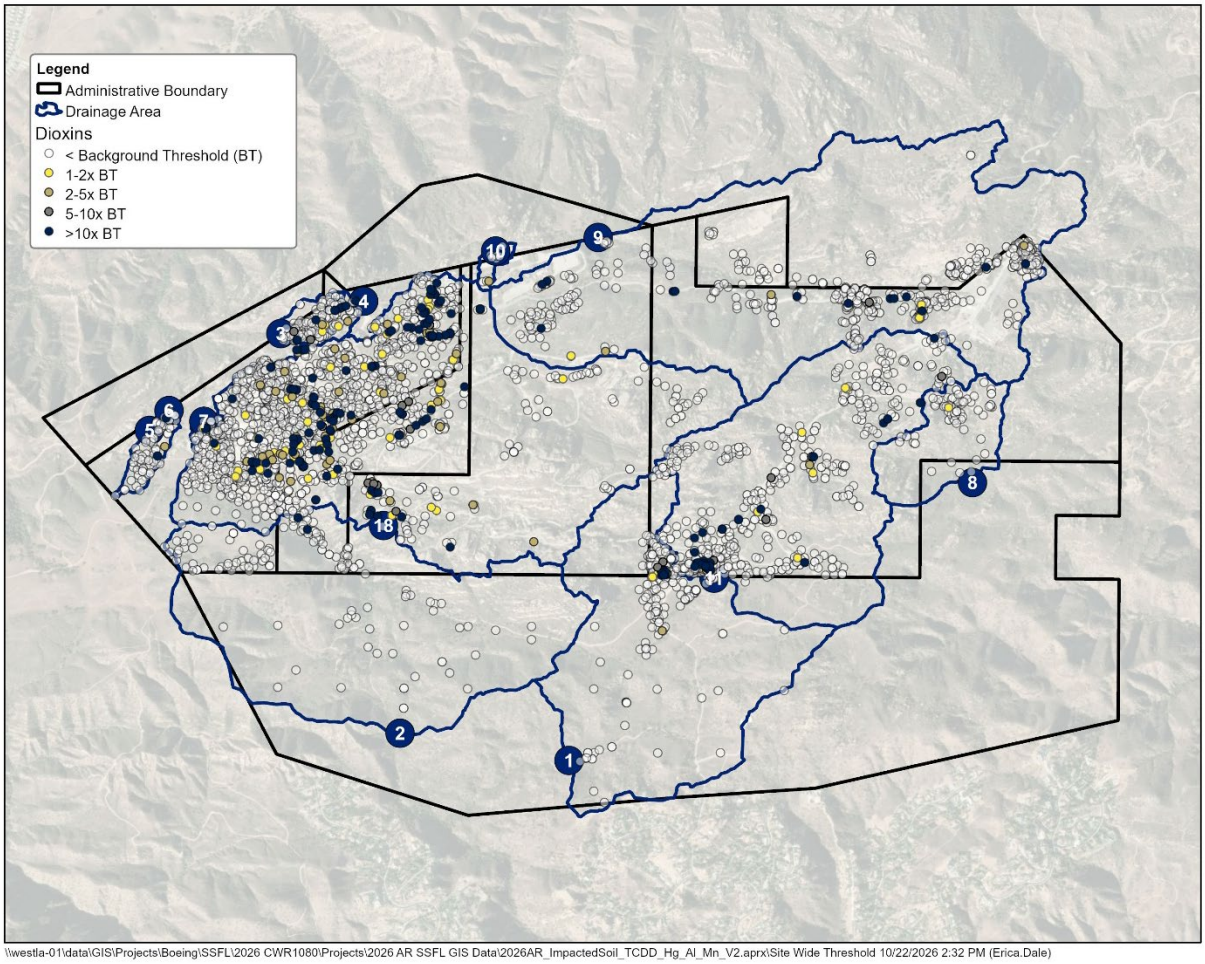
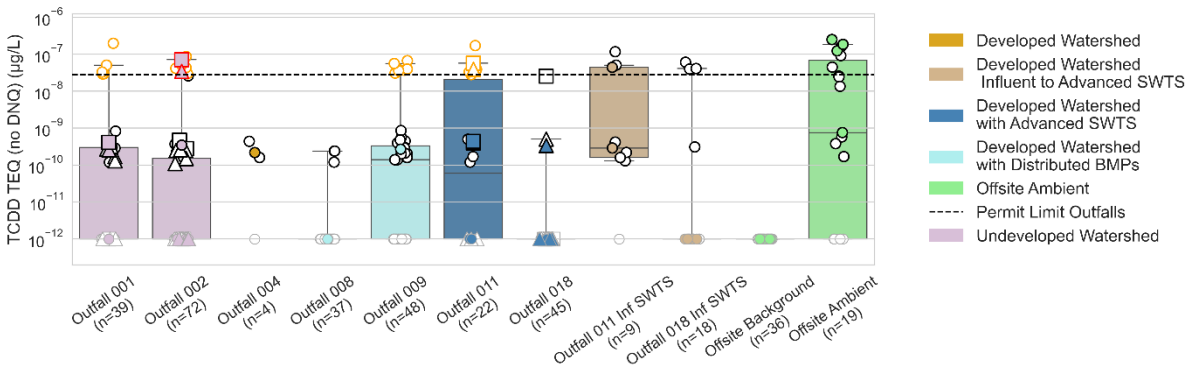


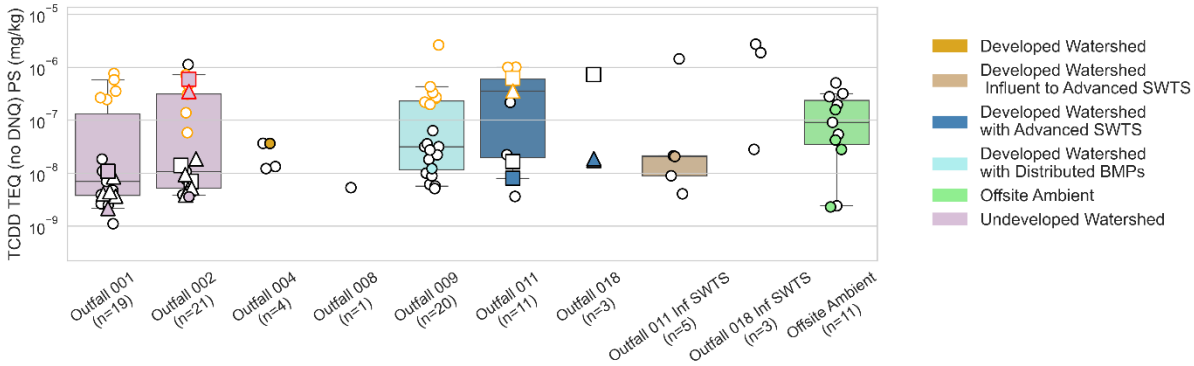
Figure 27. Surface Soil Concentrations of TCDD TEQ (no DNQ)Relative to USL95 Background Thresholds.
These maps are for source investigation purposes only and are not to be used for soil clean-up planning.

Figures 28a shows the 2025/26 outfall concentrations of TCDD TEQ (no DNQ), including the exceeding samples at Outfall 002. Figures 28b shows the outfall PS values of TCDD TEQ (no DNQ), with the PS values shown as similar to the maximum of offsite ambient concentrations (which includes treated wood poles and paved roads in its watershed).



Note: Filled markers indicate samples from the current reporting year and markers without fill represent samples collected in the past 10 years.
Red borders indicate the total concentration exceeded permit limits in the current reporting year and orange borders indicate a previous year's exceedances.
Black marker borders signify detected results and grey signify non-detected results shown as method detection limit.
Triangle markers signify samples collected during fully treated SWTS discharge at Outfalls 011 or 018.
Square markers signify samples collected during untreated bypass and treated SWTS discharge at Outfalls 011 or 018.
Circle markers signify the sample was collected absent from SWTS discharge.

a)

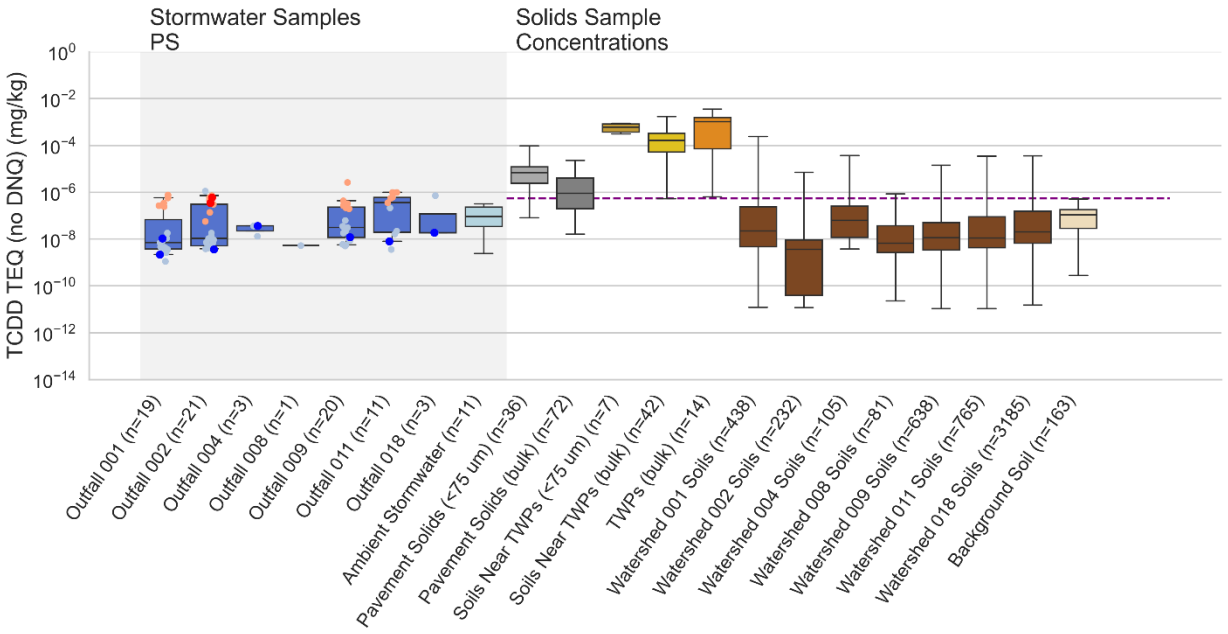


Note: Filled markers indicate samples from the current reporting year and markers without fill represent samples collected in the past 10 years.
Red borders indicate the total concentration exceeded permit limits in the current reporting year and orange borders indicate a previous year's exceedances.
Black marker borders signify detected results and grey signify non-detected results shown as method detection limit.
Triangle markers signify samples collected during fully treated SWTS discharge at Outfalls 011 or 018.
Square markers signify samples collected during untreated bypass and treated SWTS discharge at Outfalls 011 or 018.
Circle markers signify the sample was collected absent from SWTS discharge.

b)

Figures 28 a and b. a) 2025/26 Dioxins Concentrations and b) Particulate Strengths by Outfall

The exceeding samples at Outfall 002, shown in Figure 29, had unadjusted PS values close to the BT and the upper range of background soils and orders of magnitude below soils near treated wood poles. The Outfall 002 watershed also has some soils above background soil concentrations, which could have contributed to the exceedances. The PS of the exceeding stormwater samples was slightly above the ambient stormwater PS. However, the data were collected for different storm events, and PS can be highly variable by event. No EC adjusted PS values were explored provided the highly variable constitution of dioxin congeners in stormwater which makes the EC highly uncertain. Together this indicates that the exceeding TCDD TEQ (no DNQ) at Outfall 002 very likely had contributions from soils near treated wood poles and likely had contributions from soils above background in Watershed 002.



Note: Red markers indicate PS values of outfall exceeding samples and blue non-exceeding samples in the past year.
Orange markers represent exceedances and light gray markers non-exceedances from the past ten years.
The purple line represents the soil background threshold (DTSC 2012a, DTSC 2012b).
Whiskers represent the 1st and 99th percentiles.
Treated Wood Poles shown as 'TWPs' and soils readily mobilized in the top 6 inches are shown for soil solids.

Figure 29. Dioxins/Furans Particulate Strength in Outfall Stormwater Samples vs. Solid Source Materials.

In 2021, soil samples collected at various distances from treated wood poles were further investigated to determine the extent to which they influence the surrounding soils. Figure 30 summarizes the results of this sampling along with previous soils sampled near treated wood poles that were analyzed for different size fractions. The highest concentrations were found in the fine fraction and at a distance of 1 foot from the treated wood pole. Examining the bulk soil samples, concentrations decreased with increasing distance from the poles, and the lowest concentrations were observed 20 feet away from the poles, although they were still slightly above background conditions. These results indicate a strong correlation between dioxin concentrations and distance from treated wood poles, which supports the hypothesis that treated wood poles are a source of dioxins in the surrounding soils.

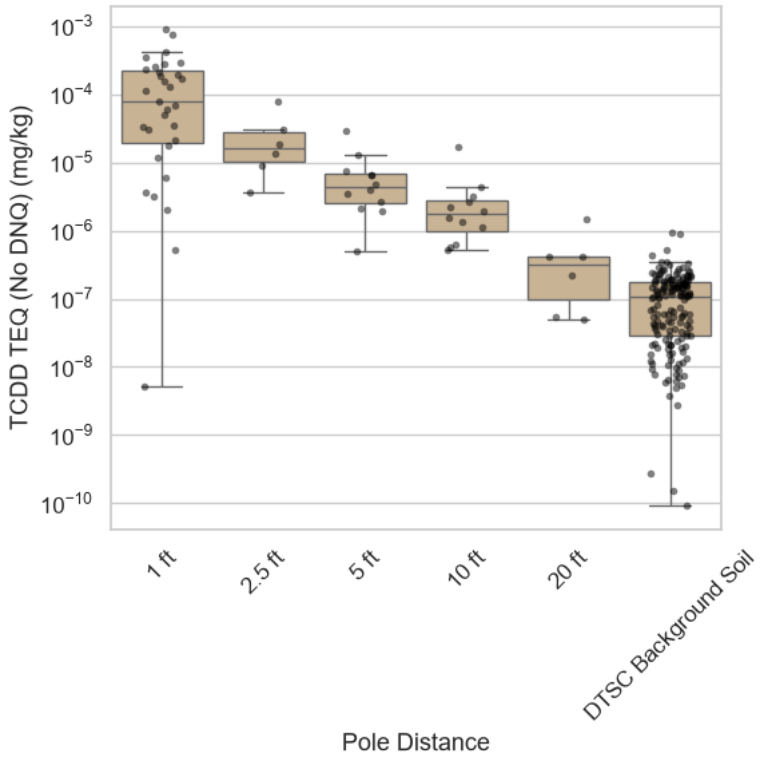
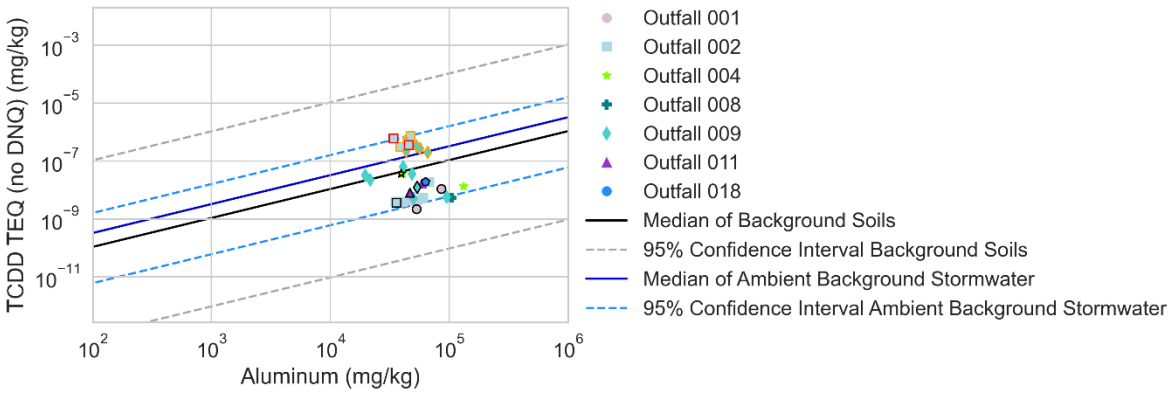


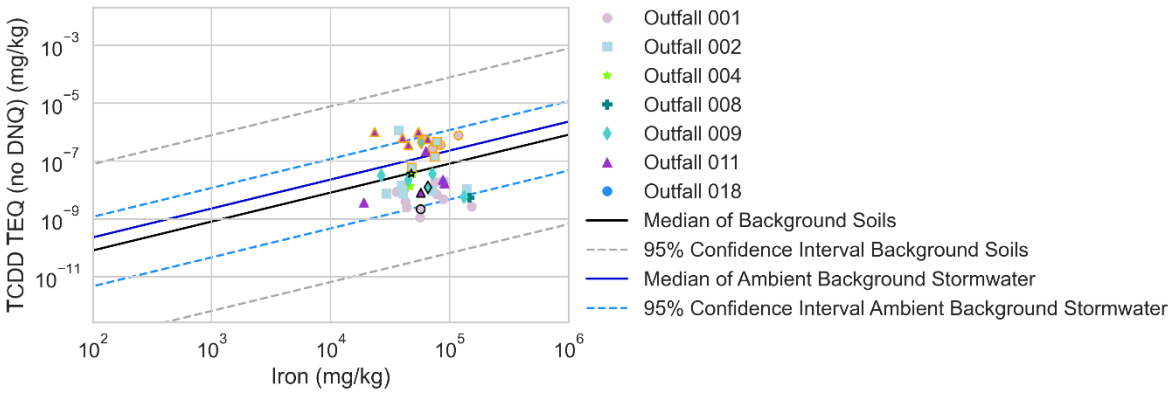
Figure 30. TCDD TEQ (no DNQ) Concentrations in Soils at Varying Distances from Treated Wood Utility Poles Compared to Natural Background Soil Concentrations

Next, metal ratios of TCDD TEQ (no DNQ)-to-aluminum TCDD TEQ (no DNQ)-to-iron, and TCDD TEQ (no DNQ)-to-manganese ratios in outfall stormwater PS were compared with ratios in offsite background stormwater PS and natural background soil. The metal ratios of the exceeding samples (available for TCDD TEQ (no DNQ)-to-aluminum) were consistent and fell within the 5th to 95th percentiles of background soils and ambient stormwater, shown in Figures 31a, supporting background and ambient source contributions of TCDD TEQ (no DNQ) in the exceeding samples. Ambient stormwater was considered rather than background stormwater, since the ambient stormwater samples are collected in an area containing paved roads and treated wood utility poles, both non-industrial and non-site-specific sources of TCDD TEQ (no DNQ).



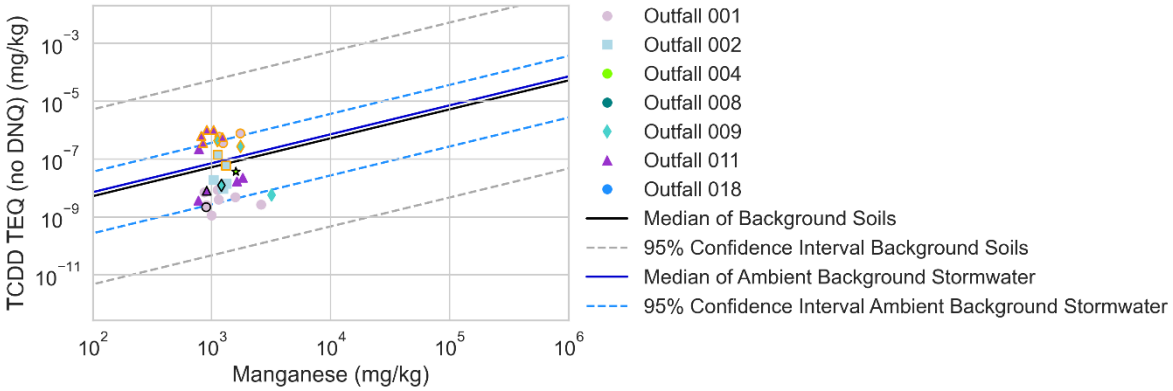
Note: Black borders indicate PS detections in the current water year, while red borders indicate an exceedance. Markers with no border indicate detections and orange borders non-detects in the last 10 years.

a)



Note: Black borders indicate PS detections in the current water year, while red borders indicate an exceedance. Markers with no border indicate detections and orange borders non-detects in the last 10 years.

b)



Note: Black borders indicate PS detections in the current water year, while red borders indicate an exceedance. Markers with no border indicate detections and orange borders non-detects in the last 10 years.

c)

Figures 31a-c. TCDD TEQ (no DNQ) vs Aluminum, b) TCDD TEQ (no DNQ) vs Iron, and c) TCDD TEQ (no DNQ) vs Manganese Metal Ratio Plots

Together, LOEs support that the TCDD TEQ (no DNQ) solid concentrations have likely contributions from background and ambient sources, in addition to impacted onsite soil concentrations above background during reviews of contaminant maps and solid source concentrations. Additionally, the TCDD TEQ (no DNQ) particulate strength in the exceeding sample is very likely to be impacted by soils near treated wood poles (there are 43 poles in the 002 watershed), which are highly concentrated for TCDD TEQ (no DNQ). All of these sources are likely contributors of TCDD TEQ (no DNQ) in the exceeding stormwater samples.

Conclusions

The evaluations of various LOEs provide a collective weight of evidence to identify which sources most likely contributed to each permit limit exceedance in the 2025/26 reporting year. In some cases, one or more sources were identified as potential causes of stormwater exceedances. A summary of these analyses and sources identified by LOEs is presented in Table 6 below.

The combined LOEs revealed that the exceedances for aluminum and manganese at SSFL outfalls were very likely attributable to the natural background levels of these constituents in soils. This conclusion is strongly supported by the fact that 0% and 0.2% of sitewide surface soil samples at SSFL are above USL95 background thresholds for aluminum and manganese, respectively.

In contrast, for the mercury exceedances at Outfalls 009 and 004, both the 009 and 004 watersheds have mercury concentrations above background in surface soils in former operational areas, so legacy impacted surface soils could have contributed to stormwater concentrations at both outfalls. The forensic LOEs evaluated herein conclude that mercury concentrations in the exceeding sample at Outfall 004 was indeed very likely caused by surface soils above background at in the 004 watershed. However, at Outfall 009, the mercury particulate strength of the exceeding sample was most similar to offsite background stormwater and natural background soil samples. That said, the *dissolved* mercury concentration in the 009 exceeding sample was equal to the maximum of offsite background and ambient stormwater samples, indicating onsite surface soils above background as potential contributors.

For the TCDD TEQ (no DNQ) exceedance at Outfall 002, the 002 watershed has limited TCDD TEQ (no DNQ) concentrations above background in surface soils in the upper watershed (this is limited to just three soil samples, though they are located in drainages downstream from former operational areas and treated wood poles), so legacy impacted surface soils could have contributed to stormwater concentrations at this outfall. The forensic LOEs evaluated herein conclude that TCDD TEQ concentrations in the exceeding sample at Outfall 002 was likely contributed by onsite surface soils above background and very likely from soils near treated wood poles (which have some of the highest TCDD TEQ concentrations seen in onsite surface soils).

This year's annual report captures the SWEP's recommended measures to address these identified sources of the 2025/26 outfall exceedances for TCDD TEQ and mercury. These include recommendations for interim soil removal, if feasible, new erosion controls at upland areas with impacted surface soils, new check structure sediment controls in drainages with impacted sediment samples, and modifications to existing treatment controls once data are available to evaluate the effectiveness of a new filtration media that is being pilot tested.

Table 6. Summary of Source Investigation Lines of Evidence by Outfall and Constituent

Outfall	Parameter	Number of Exceed-ances	Are surface soils below background thresholds in the watershed?	Are PS and Dissolved Concen-trations Similar to Offsite?	Particulate Strength Comparison		Fingerprinting		Source(s) by Weight of Evidence
					Similar to Background or Ambient Stormwater?	Likely Solid Source Based on PS	Soil Ratio within 95th percentile of BS	Stormwater Ratio within 95th percentile of BS	
001	Aluminum	3	yes	yes	yes, BS	BS	yes	yes	BS
	Manganese	1	yes	yes	yes, BS & AS	BS	yes	yes	BS
002	Aluminum	3	yes	yes	yes, BS & AS	BS	yes	yes	BS
	TCDD TEQ (no DNQ)	2	**no**	yes	yes, AS	AB, TWPs	yes	yes	AB, TWPs
004	Mercury*	1	**no**	**no**	**no**	AB	**no**	**no**	AB
009	Aluminum	3	yes	yes	yes, BS	BS	yes	yes	BS
	Mercury*	1	**no**	yes	yes, BS	AB, BS	yes	yes	AB, BS
011	Aluminum	1	yes	yes	yes, BS	BS	yes	yes	BS
	Manganese	1	yes	yes	yes, BS & AS	BS	yes	yes	BS
018	Aluminum	1	yes	yes	yes, BS	BS	yes	yes	BS

Shaded cells indicate likely contributions from onsite surface soils above background
BS = Background Soils/Stormwater
AB: Onsite Surface Soils Above Background Thresholds
AS = Ambient Stormwater
TWPs = Treated Wood Poles
PV = Pavement Solids
— = Not applicable / No data
*Dissolved mercury concentration were also compared to offsite background and ambient stormwater concentrations. This line of evidence was specific to mercury due to its higher dissolved fraction.

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DTSC (2012a). *Chemical Soil Background Study Report: Santa Susana Field Laboratory, Ventura County, California. Final.*

DTSC (2012b). *Combined-Data Background Threshold Values and Methodology Narrative Chemical Soil Background Study.*

DTSC (2013). *Chemical Look-Up Table Technical Memorandum: Santa Susana Field Laboratory, Ventura County, California*. Final

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MWH. (2005). *Standardized Risk Assessment Methodology (SRAM) Work Plan, Revision 2. SSFL, Ventura County.* September.

MWH. (2007). *Offsite Data Evaluation Report: Santa Susana Field Laboratory, Ventura County, CA.* December 2007.

Appendix E: 2025/26 Mercury Subarea Prioritization Analysis

Geosyntec consultants

MEMORANDUM

Date:	October 31, 2026
To:	SSFL Surface Water Expert Panel
From:	Geosyntec Consultants
Subject:	2026 SSFL Subarea Prioritization Analysis Results

Introduction

The purpose of this analysis is to prioritize and rank subareas in the Santa Susana Field Laboratory (SSFL) **Outfall 009** watershed for potential implementation of new or enhanced stormwater controls[1], to address the 2025/26[2] National Pollutant Discharge Elimination System (NPDES) Permit limit exceedance for **mercury** at Outfall 009. In prior years, the subarea monitoring and prioritization analysis had been performed in this watershed to address other constituents exceeding Permit limits at Outfall 009, including dioxins and lead, and resulted in implementation of numerous distributed stormwater controls such as the culvert modifications, biofilter, bioswales, and other media filters.

Mercury is a newly exceeding constituent at Outfall 009 due to its reduced Permit limit (from 0.13 to 0.024 µg/L) in the 2023 NPDES Permit[3] that became effective on January 1, 2024. The Permit requirement to use sufficiently sensitive analytical methods has not changed; however, the lower mercury Permit limit necessitated use of a more sensitive analytical method (i.e., from any of the options in 40 CFR Part 136 – i.e., EPA 245.1/245.1 or EPA1631 – to EPA 1631E[4]) for evaluating mercury at concentrations relevant to the current Permit limit.

[1] For the purpose of this report, the overarching term "stormwater controls" will be used to describe the standard suite of passive control practices, including erosion controls, sediment controls, and treatment controls. For detailed definitions or examples of erosion and sediment controls, see the CASQA Construction BMP Handbook at http://www.cabmphandbooks.com; for a detailed definition or examples of treatment controls, see the Ventura County Technical Guidance Manual for Stormwater Quality Control Measures at https://vcstormwater.org/wp-content/uploads/2025/05/VC_TGM_2025_Reissuance_Final_Complete_Document_rdx.pdf. The more general term, "Best Management Practice" (or BMP), is used in this report as a synonym for "stormwater control" but is used only for referencing the "potential BMP subarea monitoring locations," or monitoring locations where new stormwater controls are being contemplated based on a review of available monitoring results.

[2] The 2025/26 reporting year is defined as July 1, 2025 – June 30, 2026.

[3] NPDES Permit No. CA0001309 for the Boeing Company, SSFL, Canoga Park, CA, Order No. R4-2023-0359 (LARWQCB, 2023).

[4] EPA 245.1 and 245.2 methods use cold vapor atomic absorption, and have a minimum level of quantification of 0.2 ug/L. EPA 1631E uses oxidation, purge and trap, and cold vapor atomic fluorescence spectrometry, and has a minimum level of quantification of 0.0005 ug/L.

This new analytical method yields more detected results, enabling more quantitative information for use in the statistical analyses to prioritize subareas and develop stormwater control recommendations to reduce mercury loads to the outfall.

Accordingly, the evaluation was conducted in two primary steps. First, the subarea prioritization analysis used the entire historical mercury dataset beginning in 2014 to present, subject to the data-screening criteria described below, to identify the highest-ranked subareas. Second, the highest-ranked subareas were evaluated using more recent stormwater results (2022/23 reporting year to present) collected using EPA Method 1631E to determine whether current conditions warrant further evaluation or action. Because the more recent EPA Method 1631E dataset has spatial and sample-count limitations, surface soil mercury data were also evaluated independently to identify potential mercury source areas that may not be adequately characterized by the recent stormwater dataset. Together, these evaluations were used to develop the Surface Water Expert Panel's (SWEP) recommendations presented herein.

Approach

Subarea Prioritization and Ranking Approach

The SWEP's subarea prioritization methodology was originally described in the December 16, 2010 sampling recommendations memo from the SWEP and Geosyntec (Geosyntec Consultants, 2010). This statistical methodology has been revised to improve suitability for investigating potential mercury source areas. The revisions account for characteristics of mercury and the available stormwater dataset. Because dissolved fractions of mercury are greater than for the constituents for which the original methodology was developed, dissolved concentrations were considered alongside particulate strengths and total concentrations in the prioritization analysis.

The revised statistical methodology was applied to qualifying mercury monitoring data collected within the Outfall 009 watershed after completion and stabilization of the 008/009 Interim Source Removal Action (ISRA) soil removals in 2013. This post-ISRA period was selected to represent stormwater conditions following removal of onsite surface soils impacted by constituents historically exceeding Permit limits, including mercury, and to avoid incorporating monitoring results representative of pre-removal source conditions into the subarea prioritization.

The ranking process consists of the following steps, with modifications for the current mercury-specific application noted in italics:

1. **Compare subarea[5] monitoring results with subarea-specific stormwater background[6] data and NPDES Permit limits**[7];
    a. *Subarea monitoring results for mercury used in this analysis were limited to detected sample results or non-detected sample results with detection limits less than or equal to the 2023 Permit limit for mercury. Non-detected samples with detection limits greater than the 2023 Permit limit were excluded because they could not be meaningfully evaluated relative to the Permit limit and provided limited information for identifying potential sources of mercury.*
    b. *Particulate strength (PS) results were also only considered when total and dissolved mercury and total suspended solids (TSS) were detected for a given sampling event.*
    c. *Dissolved mercury concentrations were included in the analysis starting in the 2025/26 reporting year.*
2. **Determine pollutant-specific "weighting factors**" for each subarea monitoring location based on the comparison in step #1 (using a statistical methodology[8] that accounts for sample size and number of results that are above the Outfall 009 NPDES Permit limits or the 95th percentile of background PS), with the highest weighting factors assigned to subareas that most frequently exceed both of these thresholds;
3. **Determine ranking "scores" for each subarea based on the pollutant-specific weighting factors**; and
4. **Rank the monitoring subareas based on the mercury scores**.
    a. *Subareas that were determined to be inactive[9] were excluded from this analysis, since they were deemed inactionable.*

This general approach is summarized in the flow chart included as Attachment 1. Background stormwater concentrations used for comparison with onsite subareas are established based on off-site subarea monitoring locations with undeveloped or minimally developed watersheds.

Outfall 009 subarea monitoring locations used for this evaluation are shown in Attachment 2. Details on the subarea monitoring locations are provided in Attachment 3.

The data summarized and their periods of record in this report are as follows:

- Stormwater control performance monitoring data: 2/2014 – 2/2026
- NPDES outfall monitoring data: 12/2014 – 4/2026

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[5] "Subareas" are defined here as drainage areas in the 009 watershed with an outlet location for stormwater sampling, and including land uses that include ISRA, RCRA Facility Investigation (RFI), and/or developed areas (i.e., buildings, asphalt parking lots, roads, etc.) so that impacted stormwater quality might be expected and/or stormwater controls might be effective for reducing pollutant loads to the downstream NPDES outfall, pending an evaluation of the monitoring results.

[6] "Off-site stormwater background monitoring locations" are defined here as locations in these watersheds that generally represent stormwater from unimpacted areas, or areas that do not include ISRA, RFI, or significant development, thereby representing subarea-specific background (or reference) stormwater quality.

[7] The NPDES Permit limits are only applicable to the outfalls and not to the subareas within the outfall drainage areas; however, the Permit limits were used as comparison values for the stormwater controls subarea prioritization analyses discussed herein.

[8] Outlined in the 2013 paper A New Statistical Methodology: Using subcatchment monitoring data to prioritize placement of stormwater treatment controls (Otto, 2013).

[9] "Inactive" refers to subarea sampling results that were collected prior to substantial change within the subarea drainage area. When a substantial change occurs, the associated subarea sampling location is updated to reflect the new conditions, thus causing the previous subarea sampling location to become inactive.

- Other subarea monitoring data: 2/2014 – 2/2026
- Non-Industrial sources special study stormwater monitoring data: 12/2022 – 2/2024

Each subarea is listed with its category (or data type), watershed, co-location (i.e., an alternate subarea identifier for the same location), a location description, approximate upstream drainage area, and, if a monitoring location was historically discontinued, the reason for the discontinuation. Potential stormwater control subareas include the letters "BMP" in the subarea identifier, while Special Studies locations include "EPNDSW" in the subarea identifier and ISRA performance monitoring locations include the letters "SW" in the subarea identifier.

For all parameters, lab results that are estimated (or "J-flagged," or results that are above the detection limit but below the reporting limit) are included in the analysis. It is the SWEP's view that the minor decrease in the statistical confidence in these individual results still enhances the overall confidence in the sample summary statistics by providing additional data observations, especially considering the limited number of data available for many locations (and it is these summary statistics that serve as the basis for the SWEP's stormwater control recommendations).

Development of Recommendations

Following identification of the top 20 ranked subareas using the post-ISRA period of record described above, more **recent stormwater monitoring data collected using EPA Method 1631E were used as a second-stage evaluation to determine recommendations** for the highest-ranking subareas. These more recent data better represent current conditions, such as mercury source areas, vegetation coverage, erosion controls, and treatment controls, compared to stormwater sample results analyzed using the previous analytical methods of EPA 245.1 or EPA 245.2.

Because EPA Method 1631E was not implemented until the 2022/23 reporting year, the recent dataset is limited in both spatial coverage and sample count, and some historically prioritized subareas cannot yet be adequately characterized using recent stormwater data alone. Therefore, surface soil mercury data were also evaluated to identify potential mercury source areas where recent stormwater data are limited or unavailable. Surface soil conditions, existing stormwater controls, available control-performance data, and implementation feasibility were also considered.

The recommendation methodology described below was used to evaluate the highest-ranking subareas, determined through the prioritization analysis. Recent stormwater sample results are the main consideration of the recommendation methodology as these data better represent the current conditions.

- Subareas with two or more recent stormwater sample (2022/23 to present) results detected above the Permit limit (PL):
    - If an existing stormwater treatment control is present: evaluate media replacement or design modification in 2027 if at least three performance samples are available.
    - If no existing stormwater treatment control is present: evaluate for new erosion or treatment control intervention(s).
- Subareas with two or more stormwater sample results detected above the PL before 2022/23:
    - Implement targeted stormwater monitoring to evaluate current stormwater runoff mercury concentrations.
- Subareas with sufficient recent stormwater data and less than two samples above the PL:
    - No recommended action at this time.

To address spatial gaps in the recent stormwater dataset, the following methodology was also applied to areas with mercury-impacted surface soils, including areas outside the highest-ranked subareas:

- Subareas with onsite surface soils above mercury cleanup thresholds, with limited or no stormwater data:
    - Implement targeted stormwater monitoring, where feasible, to evaluate whether mercury from these areas is contributing to stormwater runoff.
    - Evaluate the need for erosion control intervention(s) based on current vegetation coverage and site conditions.

This evaluation resulted in one of four recommendations for any evaluated area: no action at this time, targeted stormwater monitoring, erosion control intervention, or treatment control intervention. This framework is intended to support the iterative improvement of mercury characterization and distributed controls across the Outfall 009 watershed.

Results

Subarea Prioritization and Ranking Results

The top 20 ranked subarea monitoring locations, from the prioritization analysis, are presented in Table 1 and Figure 1. Mercury scores range from 0 to 1.0, with scores closer to 1.0 indicating subareas with poorer historical mercury-related water quality. The top 20 ranked subarea monitoring locations are the subareas with mercury scores closest to 1.0, ranging from 0.84 to 0.21. The mercury score is used to determine the mercury rank, with the highest mercury score assigned a rank of 1. Subareas with tied mercury scores are assigned the same mercury rank, indicated with a ".5"; the mercury rank is then continued following the next unique mercury score.

Within the top 20, eight locations ranked distinctly higher (ranked 1 to 3.5) than the remaining 12 locations (11 tied with a rank of 9.5, one with a rank of 20). Of the 11 locations ranked at 9.5, one was located entirely on Sage Ranch property and is representative of conditions with no prior industrial activity. This result suggests that the locations ranked from 9.5 to 20 have mercury concentrations similar to levels found in unimpacted areas with no prior industrial activity.

Onsite surface soils above the cleanup threshold, determined herein when two or more surface soil samples exceed the Outfall 009 soil clean-up threshold, were not observed in nine of the 11 subareas ranked at 9.5. Additionally, for certain subareas, stormwater control performance has already been demonstrated, mercury concentrations are comparable to background conditions, or field evaluations identified limited opportunities for practical or beneficial additional controls. Onsite surface soils above the cleanup threshold have also not been observed within these subareas.

Of the eight highest-ranking locations, three are associated with the B-1 Media Filter which was reconstructed with sulfur impregnated granular activated carbon (GAC) in January 2026 to improve mercury removal capabilities. Since reconstruction, one paired influent and effluent sample has been collected at the B-1 Media Filter. Based on this single sample pair, the B-1 Media Filter showed a potentially small reduction in mercury concentrations, but more paired samples are needed to confirm.

A complete summary of the weights computed by potential subarea monitoring location (including number of total and dissolved concentration samples, number greater than the 2023 Permit limit, number of particulate strength results, weight, and rank) is included as Attachment 4.

Based on these results, the eight highest-ranking subareas were carried forward for evaluation using more recent stormwater data and the recommendation methodology described above.

The subarea prioritization represents one pathway for identifying areas warranting further evaluation. Separately, the watershed-wide surface soil evaluation was used to identify potential mercury source areas that may not be adequately represented by the subarea monitoring network or by the more recent stormwater dataset. Accordingly, the areas evaluated for recommendations include both the highest-ranking subareas identified through the prioritization analysis and additional potential source areas identified through the surface soil evaluation.

Surface Soil Evaluation Results

Post-ISRA surface soil mercury data were evaluated throughout the Outfall 009 watershed as an additional line of evidence for identifying potential mercury source areas.

Within the top 20 ranked subareas, Table 1 identifies the presence of surface soil mercury concentrations above the applicable cleanup threshold (CT). Onsite surface soils above the cleanup threshold for mercury were identified within six of the eight highest-ranking subareas and three of the remaining 12 top-20 subareas. Surface soil data were not used to calculate the mercury scores or rankings, but were considered as an independent line of evidence for evaluating potential locations for further SWEP recommendations.

Figure 2 and Figure 3 present the spatial distribution of the prioritized subareas and associated mercury rankings together with the post-ISRA surface soil data. Soil concentrations are presented as the ratio of the measured mercury concentration to the applicable CT, with ratios greater than 1 indicating concentrations above the CT.

Recommendations

Recommendations Evaluation

Based on the prioritization results and the recommendation methodology, six of the eight highest-ranking subareas were identified for targeted stormwater monitoring because available recent stormwater data were insufficient to adequately characterize current mercury conditions (Highlighted in grey in Table 1).

- **B1 Media Filter Inlet south (before treatment)**: B1BMP0005 (B1BMP0004-5, B1SW0011, B1SW0013)
- **Northern Detention Bioswale Effluent**: ILBMP0007 (ILBMP0005-7)
- **Lower Parking Lot 24" stormdrain bypass**: ILBMP0001
- **B1 Media Filter Effluent (post-media filter reconstruction, post-curb cuts):** B1SW0014-C (B1BMP0006)
- **Well 13 Road Runoff (east of OF009 autosamplers)**: A2BMP0009
- **NASA Sewage Treatment Plan (STP) & Ash Pile (adjacent to ELV Treatment Control)**: APBMP0001-A

Additionally, two more areas were identified through the surface soil evaluation for targeted stormwater monitoring. Both areas are associated with former industrial operations.

- **Area I Landfill:** A1BMP0002, ILBMP0002, and A1BMP0003
- **Area II Landfill:** A2BMP0001 and A2BMP0008

Targeted stormwater monitoring at these locations will provide additional data needed to further characterize potential mercury source areas, evaluate existing stormwater controls, and determine whether future erosion control intervention or treatment control interventions may be warranted. Figure 2 and Figure 3 also show the spatial distribution of the prioritized subareas within the Outfall 009 watershed and their associated mercury rankings, providing context for their locations relative to potential mercury source areas and existing stormwater controls.

No erosion control interventions or treatment control interventions are recommended at this time because none of the eight highest-ranking subarea sampling locations, determined through the prioritization analysis, have 2 or more recent mercury samples above permit limits. This will be reevaluated in 2027 based on new sample results and if outfall exceedances for mercury persist.

Final SWEP Recommendations

The subareas and potential mercury source areas identified through the evaluations above are incorporated into the final SWEP recommendations below. Based on consideration of the available stormwater monitoring and surface soil data, existing stormwater controls, site conditions, implementation feasibility, and observations from the annual site visit, additional associated monitoring locations are also included, where appropriate, to collect further data and evaluate potential mercury source areas.

To facilitate implementation, the recommended monitoring locations are grouped into focus areas based on common drainage patterns, source-area characteristics, and stormwater management objectives. Actual locations to be monitored are included in parentheses for each focus area. Further details on all SWEP recommendations can be referenced in the 2025/26 SSFL Annual Report main document.

- **Throughout the 009 watershed**, remove surface soils above current cleanup thresholds for mercury, if feasible, similar to what was done for the prior 008/009 Interim Source Removal Action (ISRA), except locations where potential short term water quality impacts of excavation could be worse than the benefits of it (e.g., on the steep slope of the A2LF within the Northern Drainage lower canyon).
- **Area I Landfill (A1BMP0002, ILBMP0002, and A1BMP0003):** Continue stormwater monitoring to provide updated mercury data for stormwater.
- **Area II Landfill (A2BMP0001 and A2BMP0008):** Conduct targeted stormwater monitoring to evaluate whether mercury concentrations remain elevated in stormwater from hillside areas associated with upgradient mercury-impacted soils in the vicinity of the Area II Landfill. To evaluate these subareas, it is recommended to conduct targeted stormwater monitoring upstream and downstream of the Area II Landfill in the Northern Drainage to determine the influence the Area II Landfill may have on Outfall 009 stormwater quality for mercury. The Northern Drainage is accessible upstream and downstream of the Area II Landfill by two access roads which will improve sampling safety and reliability, compared to collecting stormwater samples from other areas in the vicinity of the Area II Landfill. The annual SWEP site visit of SSFL included an inspection of the Area II Landfill to evaluate potential recommendations to improve mercury stormwater quality in stormwater from this area, as mercury-impacted surface soils are present within these subareas. The inspection concluded that no erosion control improvements were recommended since the slopes within this subarea were highly stable with vegetation and plant growth, no new stormwater treatment control would be feasible due to site constraints,

and no ISRA would be recommended in this area as the surface soil disturbance would negatively impact mercury stormwater quality compared to observed current conditions.

- **Well 13 Road (A2BMP0009):** Conduct targeted stormwater monitoring to provide updated mercury data for stormwater. Since historic stormwater sampling indicated elevated mercury concentrations in runoff from this subarea, it is recommended to conduct targeted stormwater monitoring to evaluate the current concentrations of mercury in stormwater runoff.
- **Northern Detention Bioswale (ILBMP0006, ILBMP0007)**: Conduct targeted stormwater monitoring for the influent and effluent of this stormwater control to provide updated mercury data for stormwater from upgradient surface soils that are elevated for mercury. Additionally, compare monitoring results from the northern detention bioswale to those collected at the lower lot biofilter, as the effluent from the northern detention bioswale is routed to the lower lot biofilter for further treatment.
- **B1 Media Filter (B1BMP0005, B1BMP0004-5, B1SW0011, B1SW0013, B1SW0014-C, B1BMP0006, B1BMP0003, B1BMP0002, B1BMP0004, B1BMP0004-5, B1SW0015):** Continue monitoring influent and effluent of this stormwater control to evaluate mercury removal effectiveness of the enhanced treatment media.
- **Lower Parking Lot Biofilter (ILBMP0001):** Continue stormwater monitoring to provide updated mercury data for stormwater that bypasses the lower lot biofilter.
- **NASA Sewage Treatment Plan (STP) & Ash Pile (adjacent to ELV Treatment Control)**: **(APBMP0001-A):** Conduct targeted stormwater monitoring to provide updated mercury data for stormwater from this subarea. To focus on potential impacts from elevated soil concentrations it is recommended to relocate the monitoring location to just upstream of the ELV effluent location.

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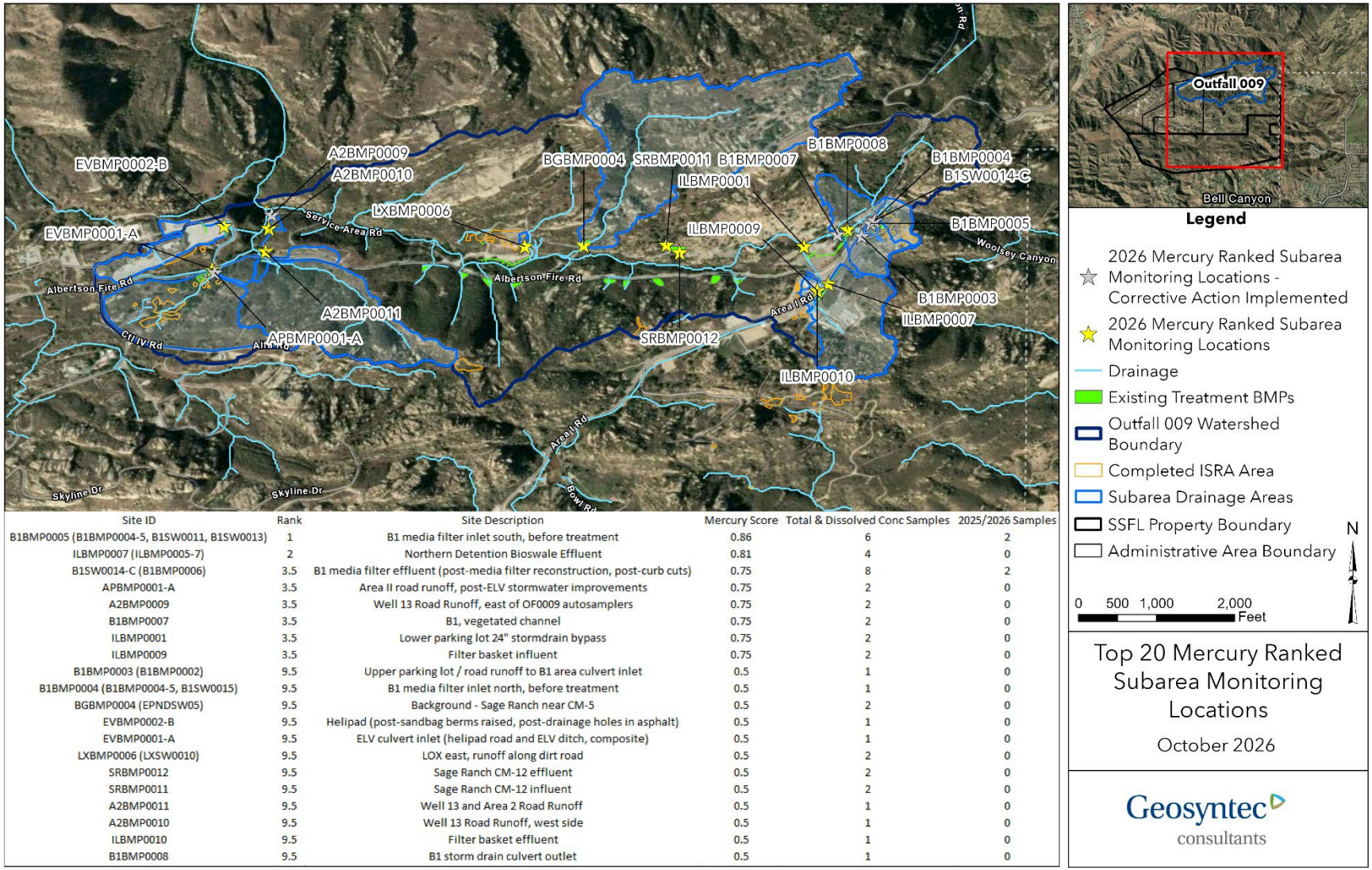
Table 1: Top 20 Subareas Ranked by Mercury Score

Mercury Rank	Mercury Score	Subarea (Co-locations)	Description	Approximate Upgradient Drainage Area (ac)	Number of Sample Results (Number of Sample Results > PL or 95th PS)[1]		Elevated concentrations of mercury in subarea soils?[3]	Recommendation:
					Previous Analytical Methods[2] (2013-2022)	Current Analytical Method[2] (2022-2026)		
1	**0.86**	**B1BMP0005 (B1BMP0004-5, B1SW0011, B1SW0013)**	**B1 media filter inlet south, before treatment**	**2.0**	**5 (5)**	**3 (1)**	**YES**	**Targeted Stormwater Monitoring: Continue sampling reconstructed B1 Media Filter (influent and effluent) to evaluate stormwater control mercury removal performance**
2	**0.81**	**ILBMP0007 (ILBMP0005-7)**	**Northern Detention Bioswale Effluent**	**2.6**	**5 (4)**	**0**	**YES**	**Targeted Stormwater Monitoring: Sample N Detention Bioswale (influent and effluent) to provide recent data on mercury from this subarea**
3.5	0.75	B1BMP0007	B1, vegetated channel (Northern Drainage near shooting range, downstream of B1 media filter effluent)	50.6	2 (2)	0	YES	None; location being address by continued monitoring at the B1 Media Filter
3.5	**0.75**	**ILBMP0001**	**Lower parking lot 24" stormdrain bypass**	**30.2**	**2 (2)**	**0**	**YES**	**Targeted Stormwater Monitoring: Continue sampling to provide recent data on mercury from this subarea**
3.5	**0.75**	**B1SW0014-C (B1BMP0006)**	**B1 media filter effluent (post-media filter reconstruction, post-curb cuts)**	**8.6**	**6 (6)**	**3 (0)**	**YES**	**Targeted Stormwater Monitoring: Continue sampling (covered by B1BMP0005 above)**
3.5	0.75	ILBMP0009	Filter basket influent	0.86	2 (2)	0	No	None; location flows into biofilter for further treatment
3.5	**0.75**	**A2BMP0009**	**Well 13 Road Runoff, east of OF009 autosamplers**	**0.48**	**2 (2)**	**0**	**No**	**Targeted Stormwater Monitoring: Continue sampling to provide recent data on mercury from this subarea. Additionally, sample in the Northern Drainage upstream and downstream of the Area II Landfill to determine the influence the Area II Landfill may have on stormwater quality for mercury**
3.5	**0.75**	**APBMP0001-A**	**NASA Sewage Treatment Plant & Ash Pile (near ELV)**	**0.26**	**2 (2)**	**0**	**YES**	**Targeted Stormwater Monitoring: Sample to provide recent data on mercury from this subarea.**
9.5	*0.5*	*BGBMP0004 (EPNDSW05)*	*Background - Sage Ranch near CM-5*	*81.1*	*0*	*3 (1)*	*No*	*None (background location)*
9.5	0.5	B1BMP0008	B1 storm drain culvert outlet	43.2	1 (1)	0	YES	None; location being address by continued monitoring at the B1 Media Filter
9.5	0.5	SRBMP0012	Sage Ranch CM-12 effluent	19.6	0	3 (1)	No	None
9.5	0.5	SRBMP0011	Sage Ranch CM-12 influent	19.6	0	3 (1)	No	None
9.5	0.5	EVBMP0002-B	Helipad (post-sandbag berms raised, post-drainage holes in asphalt)	9.1	1 (1)	0	No	None
9.5	0.5	EVBMP0001-A	ELV culvert inlet (helipad road and ELV ditch, composite)	7.4	1 (1)	0	No	None
9.5	0.5	B1BMP0004 (B1BMP0004-5, B1SW0015)	B1 media filter inlet north, before treatment	6.7	1 (1)	0	YES	None; location being address by continued monitoring at the B1 Media Filter
9.5	0.5	A2BMP0010	Well 13 Road Runoff, west side	1.9	1 (1)	0	No	None
9.5	0.5	ILBMP0010	Filter basket effluent	0.86	1 (1)	0	No	None
9.5	0.5	LXBMP0006 (LXSW0010)	LOX east, runoff along dirt road	0.28	3 (2)	0	No	None
9.5	0.5	A2BMP0011	Well 13 and Area 2 Road Runoff	0.1	1 (1)	0	No	None
20	0.21	LPBMP0003	Lower parking lot sediment basin outlet, before treatment	29.9	5 (5)	9 (0)	YES	None

Note: *Italic* text indicates subarea monitoring locations representative of background conditions in the Outfall 009 watershed with no industrial impacts.
Note: Bold text and shaded row indicates recommended actions for subarea monitoring locations.
[1] The number of sample results includes total concentration, dissolved concentration, and particulate strength sample results included in the prioritization analysis.
[2] The analytical methods used in previous sampling efforts were EPA 245.1 and 245.2 methods, which use cold vapor atomic absorption and have a minimum level of quantification of 0.2 ug/L. The analytical method used in current sampling efforts is EPA 1631E, which uses oxidation, purge and trap, and cold vapor atomic fluorescence spectrometry and has a minimum level of quantification of 0.0005 ug/L. EPA 1631E was introduced started in the 2022/2023 water year.
[3] Onsite surface soils above the cleanup threshold are indicated as present if two or more surface soil concentrations within the subarea are greater than the applicable Outfall 009 soil clean-up threshold for mercury.



Site ID	Rank	Site Description	Mercury Score	Total & Dissolved Conc Samples	2025/2026 Samples
B1BMP0005 (B1BMP0004-5, B1SW0011, B1SW0013)	1	B1 media filter inlet south, before treatment	0.86	6	2
ILBMP0007 (ILBMP0005-7)	2	Northern Detention Bioswale Effluent	0.81	4	0
B1SW0014-C (B1BMP0006)	3.5	B1 media filter effluent (post-media filter reconstruction, post-curb cuts)	0.75	8	2
APBMP0001-A	3.5	Area II road runoff, post-ELV stormwater improvements	0.75	2	0
A2BMP0009	3.5	Well 13 Road Runoff, east of OF0009 autosamplers	0.75	2	0
B1BMP0007	3.5	B1, vegetated channel	0.75	2	0
ILBMP0001	3.5	Lower parking lot 24" stormdrain bypass	0.75	2	0
ILBMP0009	3.5	Filter basket influent	0.75	2	0
B1BMP0003 (B1BMP0002)	9.5	Upper parking lot / road runoff to B1 area culvert inlet	0.5	1	0
B1BMP0004 (B1BMP0004-5, B1SW0015)	9.5	B1 media filter inlet north, before treatment	0.5	1	0
BGBMP0004 (EPNDSW05)	9.5	Background - Sage Ranch near CM-5	0.5	2	0
EVBMP0002-B	9.5	Helipad (post-sandbag berms raised, post-drainage holes in asphalt)	0.5	1	0
EVBMP0001-A	9.5	ELV culvert inlet (helipad road and ELV ditch, composite)	0.5	1	0
LXBMP0006 (LXSW0010)	9.5	LOX east, runoff along dirt road	0.5	2	0
SRBMP0012	9.5	Sage Ranch CM-12 effluent	0.5	2	0
SRBMP0011	9.5	Sage Ranch CM-12 influent	0.5	2	0
A2BMP0011	9.5	Well 13 and Area 2 Road Runoff	0.5	1	0
A2BMP0010	9.5	Well 13 Road Runoff, west side	0.5	1	0
ILBMP0010	9.5	Filter basket effluent	0.5	1	0
B1BMP0008	9.5	B1 storm drain culvert outlet	0.5	1	0

Figure 1: Top 20 Ranked Subareas

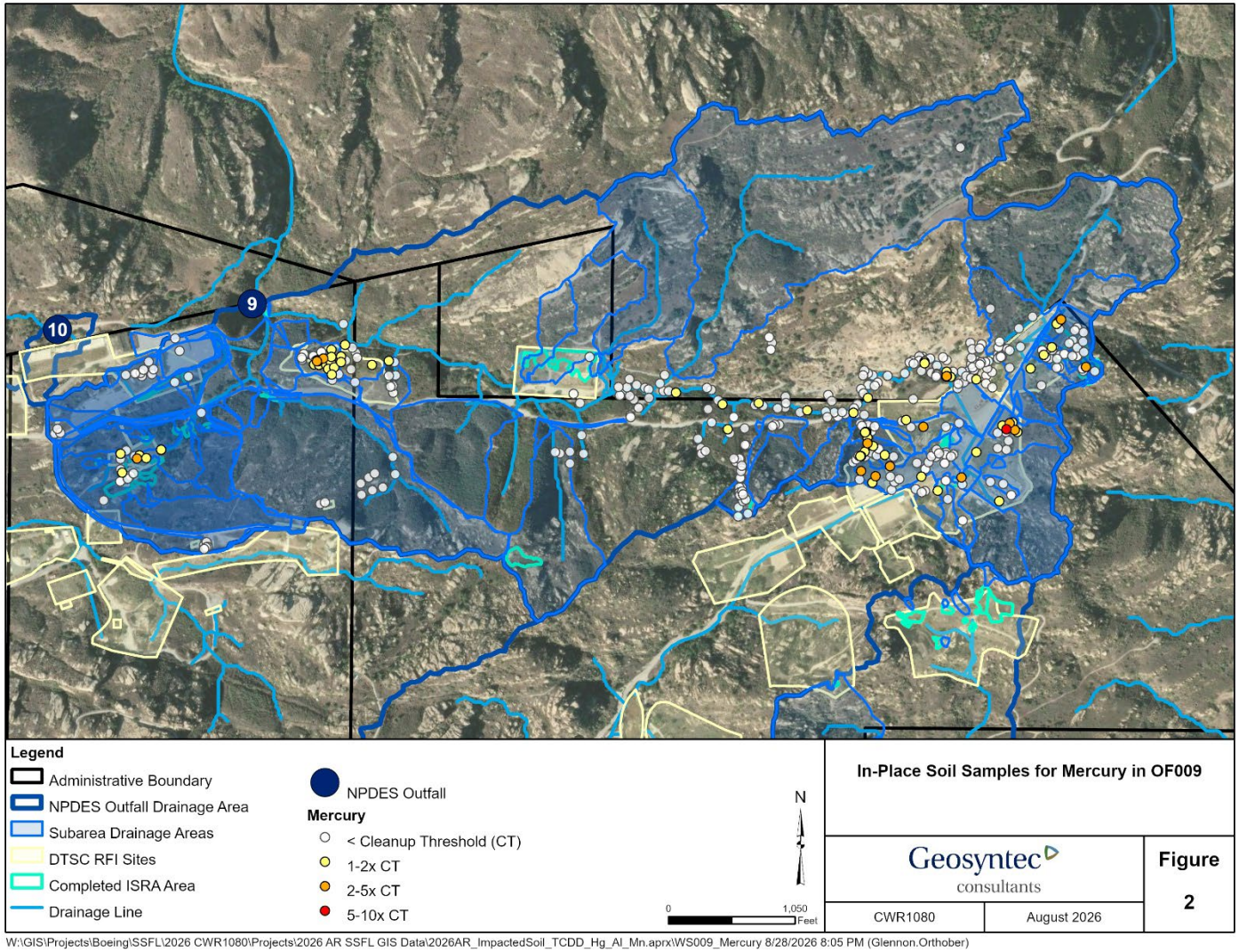


Figure 2: In-Place Mercury Surface Soil Samples in Outfall 009

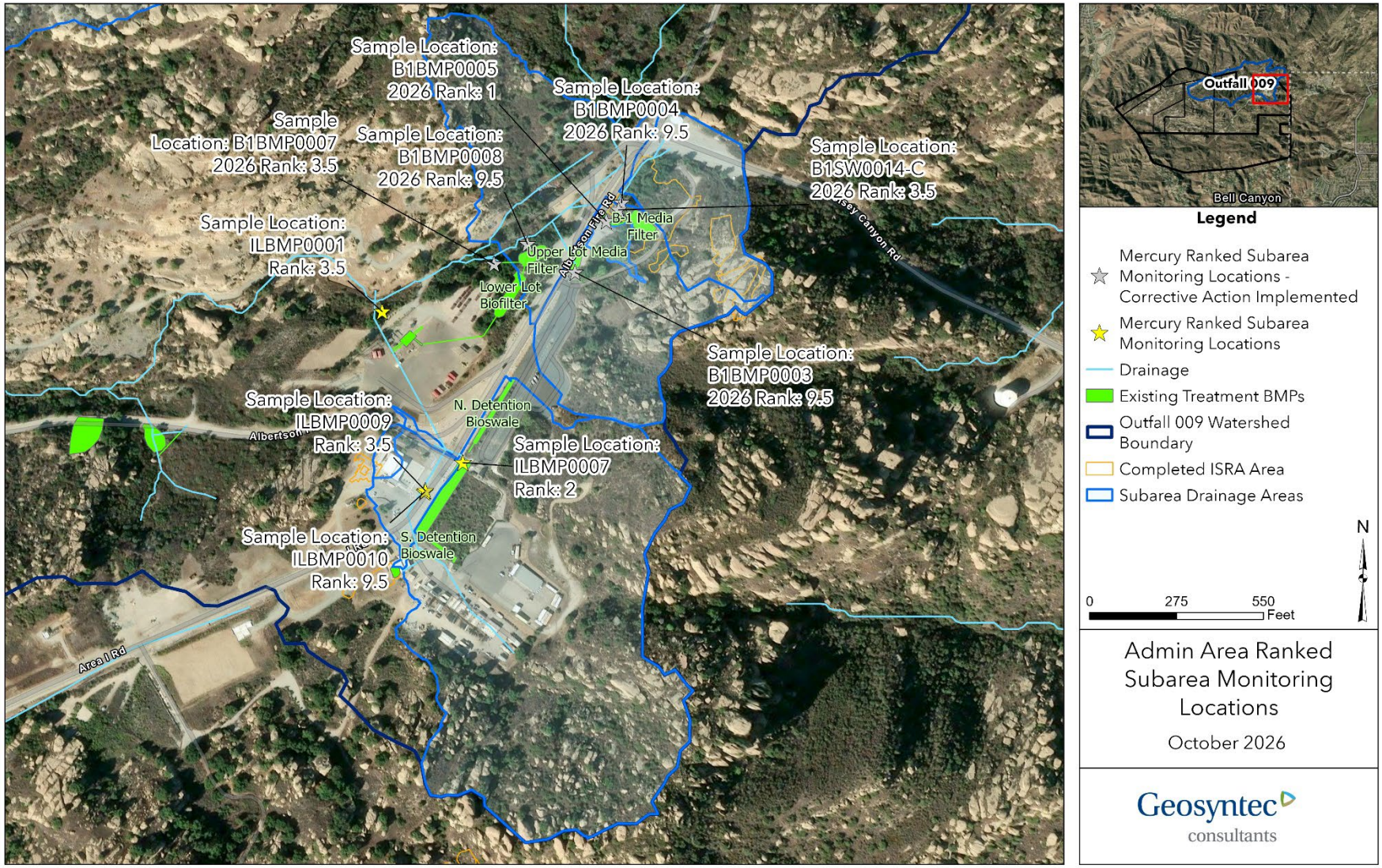


Figure 3: Admin Area Ranked Subareas

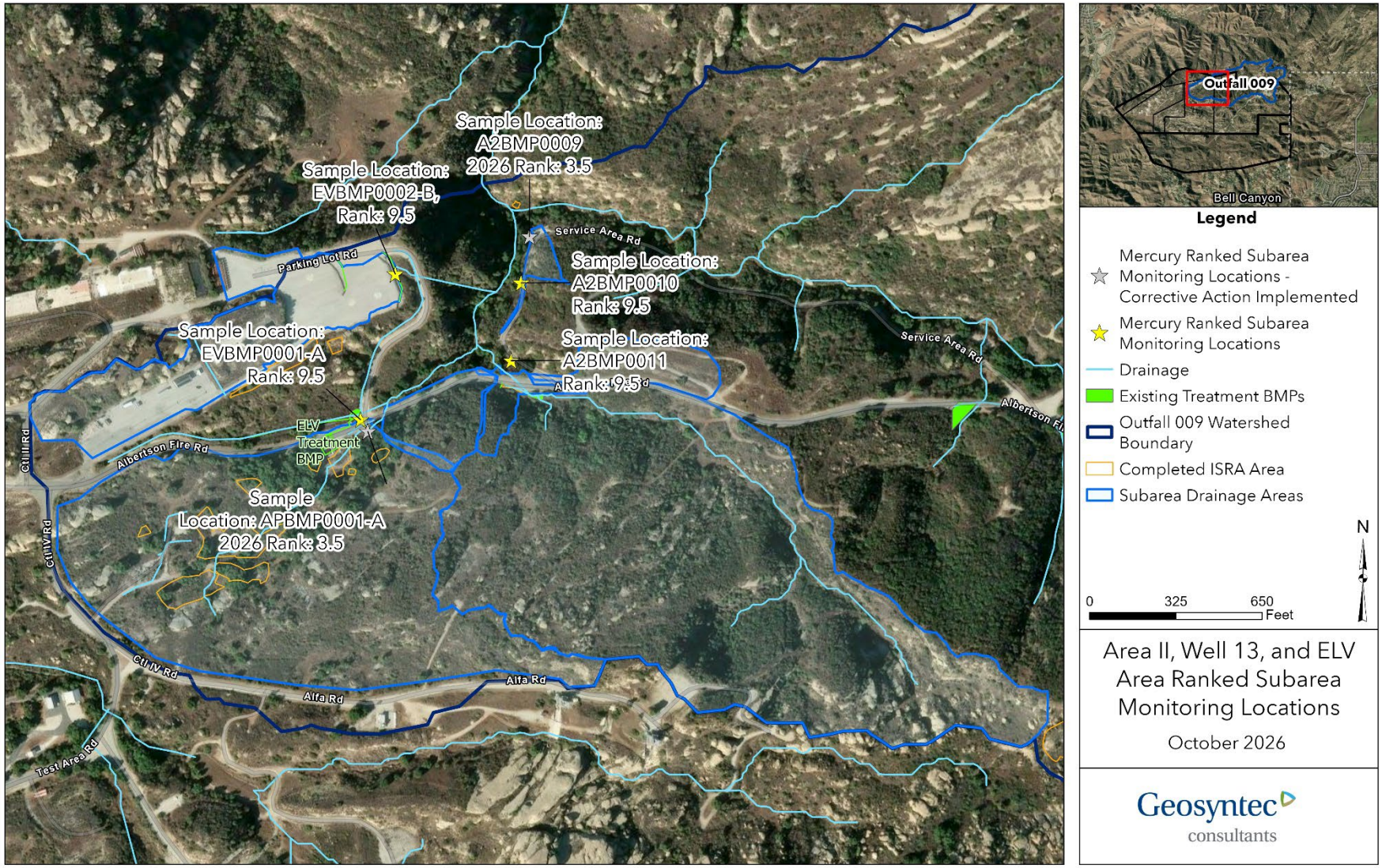


Figure 4: Area II, Well 13, and ELV Area Ranked Subareas

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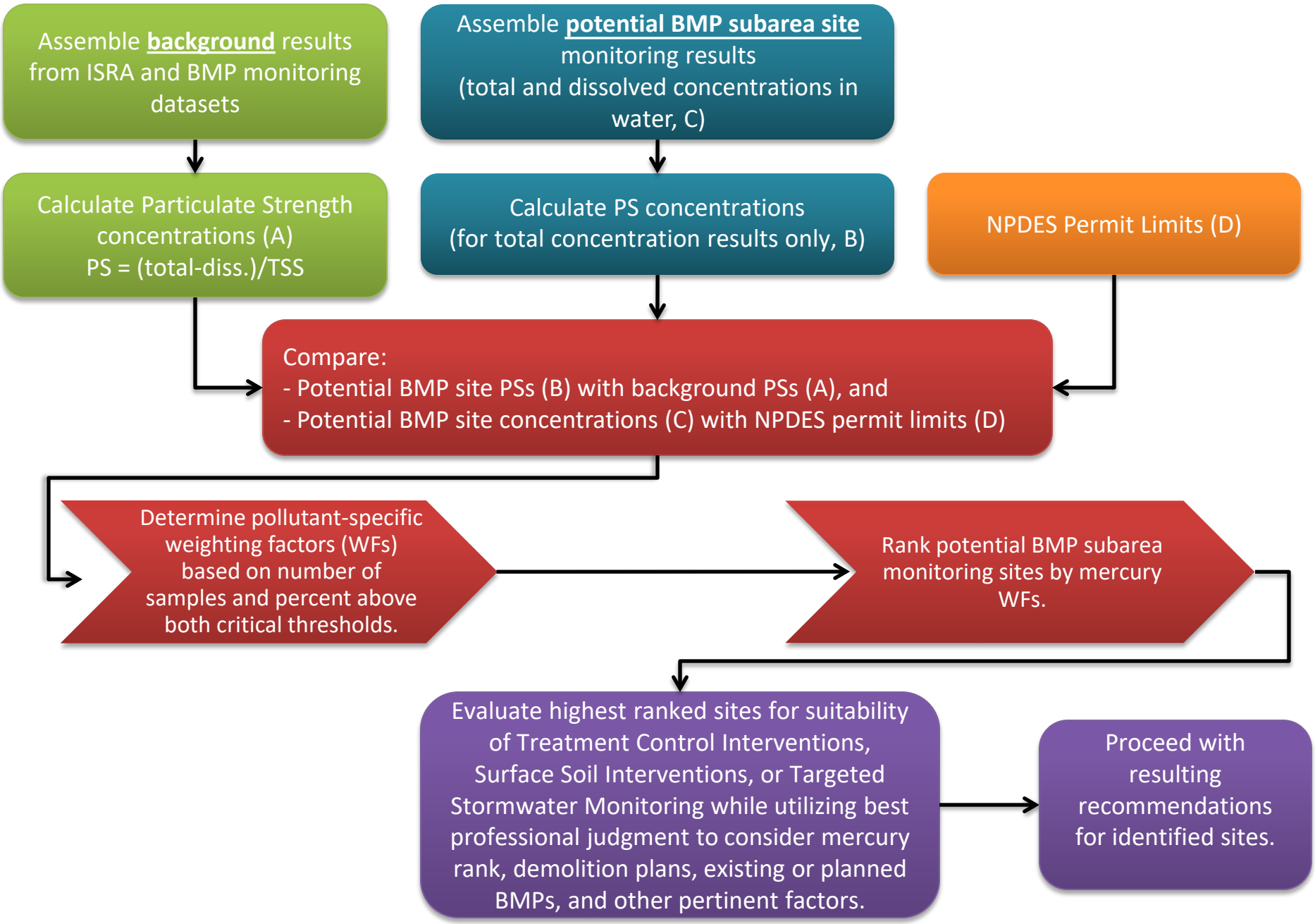
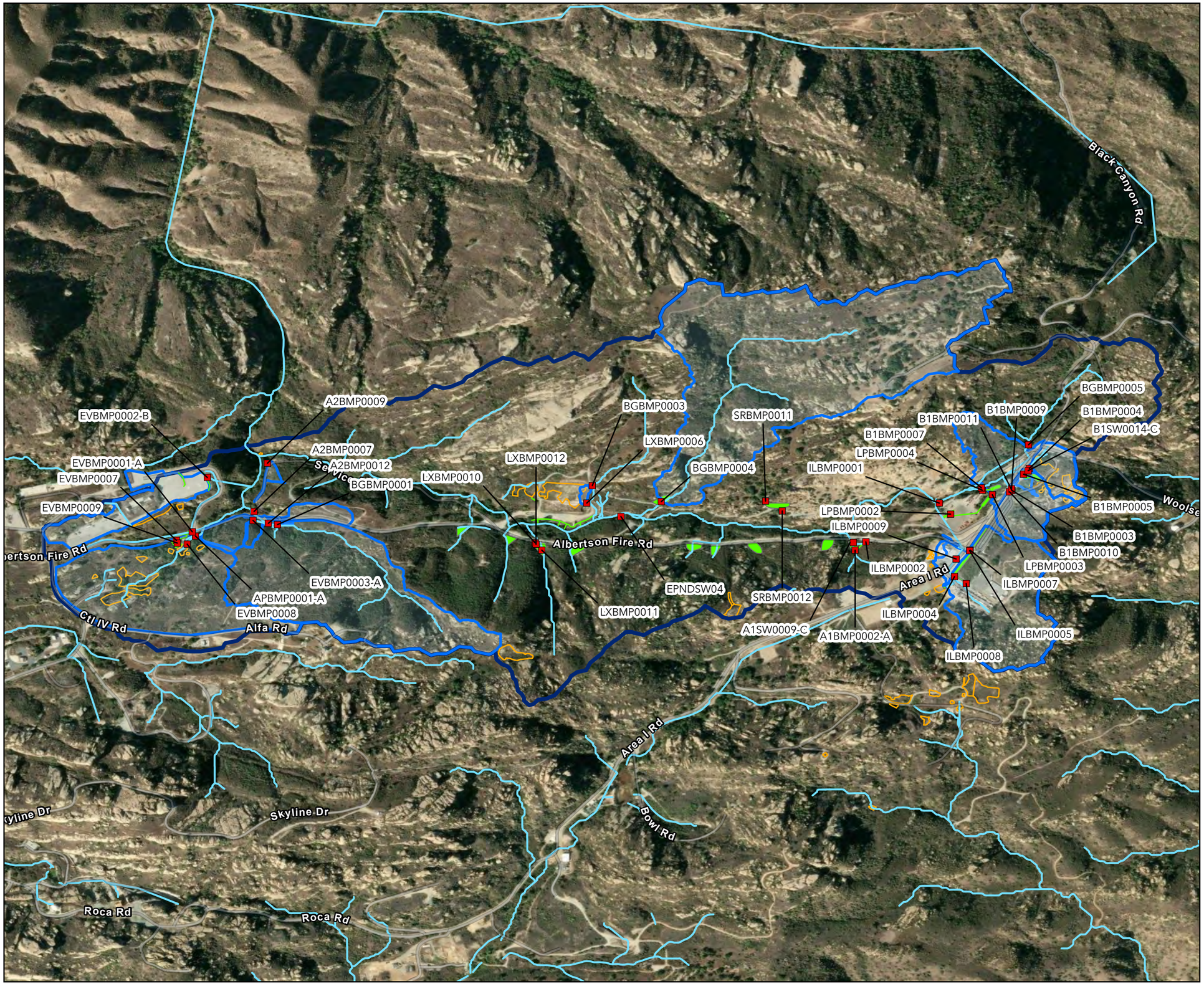
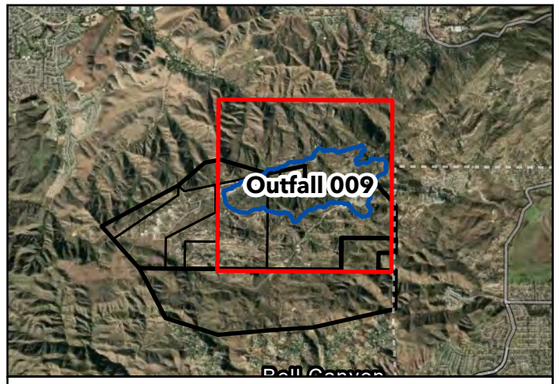
ATTACHMENTS

Attachment 1. Summary Flowchart for BMP Subarea Prioritization Analysis Approach







Legend

- 2026 BMP Subarea Locations
- Subarea Drainage Areas
- Drainage
- Existing Treatment BMPs
- Outfall 009 Watershed Boundary
- Completed ISRA Area
- SSFL Property Boundary
- Administrative Area Boundary

N

0 500 1,000 2,000 Feet

BMP Subarea Monitoring Locations Included in Prioritization

October 2026

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Attachment 3. Outfall 009 Watershed Subarea Monitoring Locations

Site Identifier (Co-location)	Subcategory	Prioritization Category	Watershed	Description	Approximate Upstream Drainage Area (ac)	If Discontinued, Reason for Discontinuation
A1BMP0002-A (A1SW0004-A)	Existing BMP Performance	BMP Subarea	Outfall 009	CM-9 upstream toward A1LF (post-A1LF asphalt removal), before treatment	6.6	2012-2013 reporting year: Discontinued A1SW0004-A as it had been monitored for three reporting years under the ISRA performance monitoring program. Continued monitoring at co-located BMP monitoring location A1BMP0002-A.
A1SW0009-C (A1BMP0003)	ISRA Performance	BMP Subarea	Outfall 009	CM-9 downstream-underdrain outlet (post-perforated pipe and upper basin installed)	10.2	2013-2014 reporting year: Discontinued ISRA performance monitoring at A1SW0009 and was replaced by BMP monitoring location A1BMP0003.
A2BMP0009	Subarea for BMP Siting Analysis	BMP Subarea	Outfall 009	Well 13 Road Runoff, east of OF0009 autosamplers	0.48	n/a
A2BMP0012	Existing BMP Performance	BMP Subarea	Outfall 009	CM-1 influent road runoff	1.2	n/a
APBMP0001-A	Subarea for BMP Siting Analysis	BMP Subarea	Outfall 009	Area II road runoff, post-ELV stormwater improvements	0.26	n/a
B1BMP0003 (B1BMP0002)	Subarea for BMP Siting Analysis	BMP Subarea	Outfall 009	Upper parking lot / road runoff to B1 area culvert inlet	8.6	2011-2012 reporting year: B1BMP0002 was replaced with monitoring location B1BMP0003, following the installation of the B1 Retention Basin. 2016-2017 reporting year: Discontinued monitoring at B1BMP0003 as it has been replaced by the addition of two influent locations to monitor sheet flow from the upper lot and main road culvert (B1BMP0010 and B1BMP0009, respectively) and one effluent monitoring location at the underdrains (B1BMP0011).

Site Identifier (Co-location)	Subcategory	Prioritization Category	Watershed	Description	Approximate Upstream Drainage Area (ac)	If Discontinued, Reason for Discontinuation
B1BMP0004 (B1BMP0004-5, B1SW0015)	Existing BMP Performance	BMP Subarea	Outfall 009	B1 media filter inlet north, before treatment	6.7	2012-2013 reporting year: Discontinued ISRA performance monitoring at B1SW0015 as it had been monitored for two years and sufficient data had been collected to show a general decrease in downstream results. 2016-2017 reporting year: Discontinued B1 media filter monitoring at B1BMP0004 and B1BMP0004-5 because positive performance has been demonstrated with respect to improving water quality over a representative distribution of storm depths and intensities.
B1BMP0005 (B1BMP0004-5, B1SW0011, B1SW0013)	Existing BMP Performance	BMP Subarea	Outfall 009	B1 media filter inlet south, before treatment	0.37	2011-2012 reporting year: B1SW0011 was replaced with B1SW0013, following the reconfiguration of the B1 Retention Basin discharge pipe. 2012-2013 reporting year: Discontinued ISRA performance monitoring at B1SW0013 as that location had been monitored for two years and sufficient data had been collected to show a general decrease in downstream results. 2016-2017 reporting year: Discontinued B1 media filter monitoring at B1BMP0005 and B1BMP0004-5 because positive performance has been demonstrated

Site Identifier (Co-location)	Subcategory	Prioritization Category	Watershed	Description	Approximate Upstream Drainage Area (ac)	If Discontinued, Reason for Discontinuation
						with respect to improving water quality over a representative distribution of storm depths and intensities.
B1BMP0007	Subarea for BMP Siting Analysis	BMP Subarea	Outfall 009	B1, vegetated channel	50.6	2016-2017 reporting year: Discontinued vegetated channel monitoring at B1BMP0007, downstream of the B1 storm drain, since sufficient data has been collected and no notable water quality improvements have been demonstrated.
B1BMP0009	Existing BMP Performance	BMP Subarea	Outfall 009	Upper Lot Media Filter – Road Culvert Influent	2.5	n/a
B1BMP0010	Existing BMP Performance	BMP Subarea	Outfall 009	Upper Lot Media Filter – Parking Lot Influent	2.4	n/a
B1BMP0011	Existing BMP Performance	BMP Subarea	Outfall 009	Upper Lot Media Filter - Effluent	5.1	n/a
B1SW0014-C (B1BMP0006)	ISRA Performance	BMP Subarea	Outfall 009	B1 media filter effluent (post-media filter reconstruction, post-curb cuts)	8.6	2012-2013 reporting year: B1SW0014 was replaced by monitoring location B1BMP0006. 2016-2017 reporting year: Discontinued B1 media filter monitoring at B1BMP0006 and B1BMP0004-5 because positive performance has been demonstrated with respect to improving water quality over a representative distribution of storm depths and intensities.
BGBMP0001 (A2BMP0006, A2SW0007)	Existing BMP Performance	Background	Outfall 009	Background - CM-1 upstream east tributary, before treatment	39.3	2011-2012 reporting year: Discontinued BGBMP0001 based on a review of results from the previous reporting year for background

Site Identifier (Co-location)	Subcategory	Prioritization Category	Watershed	Description	Approximate Upstream Drainage Area (ac)	If Discontinued, Reason for Discontinuation
						monitoring locations on Sage Ranch and finding these to be sufficient data for the program. 2012-2013 reporting year: Discontinued A2SW0007 as it had been monitored for two years and sufficient data had been collected. Monitoring continued at co-located BMP monitoring location A2BMP0006.
A2SW0002-A (A2BMP0007)	ISRA Performance	BMP Subarea	Outfall 009	CM-1 effluent (post-filter fabric over weir boards)	43	2012-2013 reporting year: Discontinued ISRA performance monitoring at A2SW0002 as it had been monitored for three years. Monitoring continued at co-located BMP monitoring location A2BMP0007.
BGBMP0003	Subarea for BMP Siting Analysis	Background	Outfall 009	Background - Sage Ranch near LOX	16.8	2012-2013 reporting year: Monitoring at all remaining background locations was discontinued as sufficient data had been collected but has been reinstated since the 2014/15 monitoring period.
BGBMP0004 (EPNDSW05)	Subarea for BMP Siting Analysis	Background	Outfall 009	Background - Sage Ranch near CM-5	81.1	2012-2013 reporting year: Monitoring at all remaining background locations was discontinued as sufficient data had been collected but has been reinstated since the 2014/15 monitoring period.
BGBMP0005 (EPNDSW07)	Subarea for BMP Siting Analysis	BMP Subarea	Outfall 009	Sage Ranch near entrance	29.8	n/a
EPNDSW04	Special Studies	BMP Subarea	Outfall 009	Northern Drainage downstream of box culvert	270.4	n/a
EVBMP0001-A	Subarea for BMP Siting Analysis	BMP Subarea	Outfall 009	ELV culvert inlet (helipad road and ELV ditch, composite)	7.4	n/a

Site Identifier (Co-location)	Subcategory	Prioritization Category	Watershed	Description	Approximate Upstream Drainage Area (ac)	If Discontinued, Reason for Discontinuation
EVBMP0002-B	Subarea for BMP Siting Analysis	BMP Subarea	Outfall 009	Helipad (post-sandbag berms raised, post-drainage holes in asphalt)	9.1	n/a
EVBMP0003-A	Existing BMP Performance	BMP Subarea	Outfall 009	CM-1 upstream west, post-ELV improvements, before treatment	1.4	n/a
EVBMP0007	Existing BMP Performance	BMP Subarea	Outfall 009	Influent to ELV sedimentation, before treatment	6.6	n/a
EVBMP0008	Existing BMP Performance	BMP Subarea	Outfall 009	Effluent from ELV treatment BMP	6.6	n/a
EVBMP0009	Existing BMP Performance	BMP Subarea	Outfall 009	Influent to ELV media filter, before treatment	6.6	n/a
ILBMP0001	Subarea for BMP Siting Analysis	BMP Subarea	Outfall 009	Lower parking lot 24" storm drain bypass	30.2	n/a
ILBMP0002	Existing BMP Performance	BMP Subarea	Outfall 009	Road runoff to CM-9, before treatment	2.2	n/a
ILBMP0004	Existing BMP Performance	BMP Subarea	Outfall 009	Western Concrete Swale (B1436 Southern Detention Bioswale Influent)	0.92	n/a
ILBMP0005 (ILBMP0005-7)	Existing BMP Performance	BMP Subarea	Outfall 009	Downstream (B1436 Southern Detention Bioswale)	15.6	2017-2018 reporting year: Discontinued monitoring at ILBMP0005-7 due to the discontinuation of monitoring at ILBMP0007.
ILBMP0007 (ILBMP0005-7)	Existing BMP Performance	BMP Subarea	Outfall 009	Northern Detention Bioswale Effluent	2.6	2017-2018 reporting year: Discontinued monitoring at ILBMP0007 due to sufficient data having been collected at this site.
ILBMP0008	Existing BMP Performance	BMP Subarea	Outfall 009	Eastern Concrete Swale (B1436 Southern Detention Bioswale influent)	13.3	n/a

Site Identifier (Co-location)	Subcategory	Prioritization Category	Watershed	Description	Approximate Upstream Drainage Area (ac)	If Discontinued, Reason for Discontinuation
ILBMP0009	Existing BMP Performance	BMP Subarea	Outfall 009	Filter basket influent	0.86	n/a
LPBMP0002	Existing BMP Performance	BMP Subarea	Outfall 009	Lower parking lot influent to cistern, before treatment	29.9	n/a
LPBMP0003	Existing BMP Performance	BMP Subarea	Outfall 009	Lower parking lot sediment basin outlet, before treatment	29.9	n/a
LPBMP0004	Existing BMP Performance	BMP Subarea	Outfall 009	Lower parking lot biofilter outlet	29.9	n/a
LXBMP0006 (LXSW0010)	Subarea for BMP Siting Analysis	BMP Subarea	Outfall 009	LOX east, runoff along dirt road	0.28	2016-2017 reporting year: LXBMP0006 has been temporarily discontinued until remediation begins, since sufficient data has otherwise been collected.
LXBMP0010	Existing BMP Performance	BMP Subarea	Outfall 009	Service Area Road BMP – Road Runoff Influent to CM-3	0.25	n/a
LXBMP0011 (BGBMP0002, LXSW0003)	Existing BMP Performance	Background	Outfall 009	CM-3 Undeveloped Hillside Runoff	16.3	2011-2012 reporting year: Discontinued LXSW0003 due to the low concentrations observed in results from the previous reporting year. Monitoring continued at BGBMP0002 as a background location. 2012-2013 reporting year: Discontinued BGBMP0002 as sufficient data had been collected at all remaining background locations but has been reinstated since the 2014/15 monitoring period.
LXBMP0012	Existing BMP Performance	BMP Subarea	Outfall 009	CM-3 Effluent	17	n/a
Outfall 009**	NPDES	NPDES	Outfall 009	NPDES Outfall 009	536	n/a

Site Identifier (Co-location)	Subcategory	Prioritization Category	Watershed	Description	Approximate Upstream Drainage Area (ac)	If Discontinued, Reason for Discontinuation
SRBMP0011	Existing BMP Performance	BMP Subarea	Outfall 009	CM-12 Influent	n/a	n/a
SRBMP0012	Existing BMP Performance	BMP Subarea	Outfall 009	CM-12 Effluent	n/a	n/a

Notes

- Gray text indicates historic subarea monitoring locations that have been discontinued.
- (**) NPDES outfall monitoring data are included in this analysis for comparison and method testing purposes only. New stormwater controls are not being contemplated at these locations.

Rank	Potential BMP Subarea (Co-Location)	Description	Approximate Upgradient Drainage Area (ac)	Mercury Weight	Number of Total Conc Sample Results[1]	Total Conc N > PL	Number of Dissolved Conc Sample Results[1]	Dissolved Conc N > PL	Number of PS Results	N > 95th	PS and Conc Exceed?
1	B1BMP0005 (B1BMP0004-5, B1SW0011,	B-1 media filter inlet south, before treatment	0.37	0.86	3	3	3	2	2	1	TRUE
2	ILBMP0007 (ILBMP0005-7)	Northern Detention Bioswale Effluent	2.6	0.81	2	2	2	2	1	0	FALSE
3.5	B1BMP0007	B-1, vegetated channel	50.6	0.75	1	1	1	1	0	0	FALSE
3.5	ILBMP0001	Lower parking lot 24" stormdrain bypass	30.2	0.75	1	1	1	1	0	0	FALSE
3.5	B1SW0014-C (B1BMP0006)	B-1 media filter effluent (post-media filter reconstruction, post-curb cuts)	8.6	0.75	6	5	2	1	1	0	FALSE
3.5	ILBMP0009	Filter basket influent	0.86	0.75	1	1	1	1	0	0	FALSE
3.5	A2BMP0009	Well 13 Road Runoff, east of OF0009 autosamplers	0.48	0.75	2	2	0	0	0	0	FALSE
3.5	APBMP0001-A	Area II road runoff, post-ELV stormwater improvements	0.26	0.75	2	2	0	0	0	0	FALSE
9.5	BGBMP0004 (EPNDSW05)	Background - Sage Ranch near CM-5	81.1	0.50	1	1	1	0	1	0	FALSE
9.5	B1BMP0008	B1 storm drain culvert outlet	43.2	0.50	0	0	1	1	0	0	FALSE
9.5	SRBMP0011	Sage Ranch CM-12 influent	19.6	0.50	2	1	1	0	0	0	FALSE
9.5	SRBMP0012	Sage Ranch CM-12 effluent	19.6	0.50	2	1	1	0	0	0	FALSE
9.5	EVBMP0002-B	Helipad (post-sandbag berms raised, post-drainage holes in asphalt)	9.1	0.50	1	1	0	0	0	0	FALSE
9.5	B1BMP0003 (B1BMP0002)	Upper parking lot / road runoff to B-1 area culvert inlet	8.6	0.50	1	1	0	0	0	0	FALSE
9.5	EVBMP0001-A	ELV culvert inlet (helipad road and ELV ditch, composite)	7.4	0.50	1	1	0	0	0	0	FALSE
9.5	B1BMP0004 (B1BMP0004-5, B1SW0015)	B-1 media filter inlet north, before treatment	6.7	0.50	1	1	0	0	0	0	FALSE
9.5	A2BMP0010	Well 13 Road Runoff, west side	1.9	0.50	0	0	1	1	0	0	FALSE
9.5	ILBMP0010	Filter basket effluent	0.86	0.50	0	0	1	1	0	0	FALSE
9.5	LXBMP0006 (LXSW0010)	LOX east, runoff along dirt road	0.28	0.50	1	1	1	1	1	0	FALSE
9.5	A2BMP0011	Well and Area 2 Road Runoff	0.10	0.50	0	0	1	1	0	0	FALSE
21	LPBMP0003	Lower parking lot sediment basin outlet, before treatment	29.9	0.21	6	3	5	2	3	0	FALSE
22	EVBMP0003-A	CM-1 upstream west, post-ELV improvements, before treatment	1.4	0.19	3	1	2	0	0	0	FALSE
23	A1BMP0002-A (A1SW0004-A)	CM-9 upstream toward A1LF (post-A1LF asphalt removal), before treatment	6.6	0.15	5	4	5	1	5	0	FALSE
24	LPBMP0004	Lower parking lot biofilter outlet	29.9	0.11	3	0	6	3	2	0	FALSE
25	A2SW0002-A (A2BMP0007)	CM-1 effluent (post-filter fabric over weir boards)	43	0.090	6	2	6	2	2	0	FALSE
26.5	LXBMP0011	CM-3 Undeveloped Hillside Runoff	16.3	0.060	3	1	2	0	2	0	FALSE
26.5	LXBMP0010	Service Area Road BMP – Road Runoff Influent to CM-3	0.25	0.060	2	0	3	1	2	0	FALSE
28	ILBMP0004	Western Concrete Swale (B1436 Southern Detention Bioswale)	0.92	0.054	8	5	10	3	7	0	FALSE
29.5	BGBMP0001 (A2BMP0006, A2SW0007)	Background - CM-1 upstream east tributary, before treatment	39.3	0.020	4	1	3	0	2	0	FALSE
29.5	A2BMP0012	CM-1 influent road runoff	1.2	0.020	5	1	5	1	2	0	FALSE
31	EVBMP0008	Effluent from ELV treatment BMP	6.6	0.010	5	1	5	1	3	0	FALSE
32	ILBMP0005 (ILBMP0005-7)	Downstream (B1436 Southern Detention Bioswale)	15.6	0.0033	8	2	9	3	7	0	FALSE
33	EPNDSW04	Northern Drainage downstream of box culvert	270	0.0022	8	3	8	1	6	0	FALSE
34	ILBMP0002	Road runoff to CM-9, before treatment	2.2	0.0022	7	2	8	2	7	0	FALSE
35	LPBMP0002	Lower parking lot influent to cistern, before treatment	29.9	7.4E-04	8	1	8	2	5	0	FALSE
36	B1BMP0009	Upper Lot Media Filter – Road Culvert Influent	2.5	2.0E-04	6	0	8	2	6	0	FALSE
37	A1SW0009-C (A1BMP0003)	CM-9 downstream-underdrain outlet (post-perforated pipe and upper basin installed)	10.2	1.4E-04	6	1	6	0	5	0	FALSE
38	B1BMP0011	Upper Lot Media Filter - Effluent	5.1	7.2E-05	6	0	7	1	5	0	FALSE
39	B1BMP0010	Upper Lot Media Filter – Parking Lot Influent	2.4	3.8E-05	6	0	7	1	6	0	FALSE
40	ILBMP0008	Eastern Concrete Swale (B1436 Southern Detention Bioswale influent)	13.3	3.3E-05	8	1	8	1	7	0	FALSE
41	BGBMP0003	Background - Sage Ranch near LOX	16.8	2.9E-06	9	1	7	0	7	0	FALSE

[1] Mercury sample results were limited to detected sample results or sample results with detection limits lower than or equal to the 2023 Permit Limit for mercury.

N = Number of mercury sample results

PL = 2023 mercury Permit Limit

PS = Particulate Strength

95th = 95th percentile stormwater background particulate strength results threshold

Conc = Mercury concentration sample result

Appendix F: Updated Background Stormwater Thresholds

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Technical Memorandum

Date: October 30, 2026

To: Los Angles Regional Water Quality Control Board (RWQCB)

Copies to: Bronwyn Kelly (RWQCB), Jenny Newman (RWQCB), Jeffery Wokurka (Boeing Company)

From: Geosyntec Consultants and Surface Water Expert Panel

Subject: Background and Ambient Stormwater Thresholds 2026 Update

INTRODUCTION

Background thresholds for stormwater discharges were calculated for priority constituents of potential concern (COPCs) at the Santa Susana Field Laboratory (SSFL), as described by Exhibit D of the 2022 Memorandum of Understanding (MOU) between The Boeing Company (Boeing) and the Los Angeles Regional Water Quality Control Board (RWQCB) staff.[1] This memorandum is an update to that original memorandum, *"Santa Susana Field Laboratory Background Stormwater Thresholds"*, prepared on May 22, 2022[1]. This 2026 update was prepared by Geosyntec Consultants (Geosyntec) in close consultation with the SSFL Surface Water Expert Panel (SWEP) and incorporates their review, guidance, and recommendations. The SWEP consists of Dr. Robert Pitt (University of Alabama), Dr. Robert Gearheart (Humboldt State University), Dr. Michael Stenstrom (University of California, Los Angeles), Jonathan Jones (Wright Water Engineers), and Dr. Gregory Pasternack (University of California, Davis).

Stormwater background thresholds were calculated following a National Pollutant Discharge Elimination System (NPDES) permit limit derivation approach contained in the EPA Technical Support Document (TSD) for Water Quality-based Toxics Control[2]. Threshold values were

[1] Memorandum of Understanding Establishing the Processes, Methodologies, and Standards for Assessing Stormwater Discharges and Applicable Requirements Following The Boeing Company Soil Cleanup at the Santa Susana Field Laboratory Site Exhibit D Santa Susana Field Laboratory Background Stormwater Thresholds. California Regional Water Quality Control Board – Los Angeles Region and The Boeing Company, August 12, 2022. Available at: https://www.waterboards.ca.gov/losangeles/santa_susana/SSFL_Mediation-EOBoeingSigned_FINAL_RWQCB-BoeingSSFL_MOU_08122022_EXHIBITS.pdf

[2] Daily maximum permit limits were calculated following the statistical derivation of water quality-based limits in Appendix E Lognormal Distribution and Permit Limit Derivations of the EPA TSD. United States Environmental Protection Agency (1991). Technical Support Document for Water Quality-based Toxics Control. Appendix E. EPA/505/2-90-001.

calculated following TSD methods for computing maximum daily limits – as opposed to average monthly or yearly limits – to be consistent with the stormwater discharge limits contained in the *NPDES Permit No. CA0001309 for the Boeing Company, SSFL, Canoga Park, CA, Order No. R4-2023-0359.*

This analysis used a combination of published stormwater concentration data from minimally developed California reference watersheds (<5% developed land), collected by other investigators, and offsite background stormwater samples from similarly undeveloped reference watersheds near SSFL, collected by Boeing consultants. The offsite background and "ambient" sites that Boeing's consultants sampled are located in watersheds that are near SSFL but receive no runoff from the site or adjacent drainages. The two background sites near SSFL have less than 1% development, while the "ambient" sample location has no current or historical industrial activity and is 25% residential and 75% undeveloped.

Boeing's offsite background stormwater sample collection effort is ongoing, so these datasets will continue to grow to support the development of more robust stormwater background threshold values. Therefore, **the threshold values presented here remain preliminary and subject to change**. **The values presented here are updated to incorporate samples collected between July 2025 and June 2026.**

Updates to the Original Threshold Calculation Methodology

The original Santa Susana Field Laboratory Background Stormwater Thresholds memorandum prepared in 2022 (2022 Memo) presented preliminary threshold values derived through multiple approaches and datasets. These consisted of a "stormwater-based" approach, using data from onsite and offsite background stormwater samples, and an alternative "soil-based" approach, which converted background soil threshold values (BTVs) into corresponding stormwater concentrations using SSFL background stormwater total suspended solids (TSS). However, based on further discussions with the SWEP, and feedback from RWQCB staff, it was decided that moving forward only the **offsite stormwater-based approach** should be used, which is implemented in this memorandum.

A further refinement to the original calculation approach was to incorporate a goodness-of-fit test to evaluate whether the lognormal distribution assumed in the TSD calculation is appropriate. In the 2022 Memo, background thresholds were calculated even when the data did not approximate the assumed lognormal (or, for pH, normal) distribution. This approach was adopted due to the small dataset (monitoring at offsite background locations began in 2021), which would grow over time and was assumed to likely approach log-normal with continued monitoring. However, even with the additional years of monitoring data, the distribution for some analytes continues to deviate from lognormality, particularly in the upper tail that is critical

for background threshold estimation. Accordingly, the background threshold calculation method was updated to include a goodness-of-fit test, as recommended in Appendix E of the EPA TSD, to help evaluate the quality of the reported thresholds.

In the updated approach, when data fail the Anderson–Darling goodness-of-fit test with a 5% tolerance, the background threshold value is derived using a nonparametric calculation of the 99th percentile, following the TSD guidance. This approach reduces uncertainty associated with poor distributional fits while maintaining consistency with the TSD. The statistical basis for each reported background threshold is documented in the results.

Priority COPC Selection and Data Sources

SSFL "priority" COPCs – i.e., those COPCs being sampled at offsite background monitoring locations and for which background thresholds are calculated – were initially selected based on the following criteria centered on the *National Pollutant Discharge Elimination System (NPDES) Permit No. CA0001309 for the Boeing Company, SSFL, Canoga Park, CA, Order No. R4-2015-0033 (2015 Permit)*:

1. the constituent *exceeded* the 2015 Permit effluent limit in at least three outfall samples; and
2. the constituent was *detected* in at least three background stormwater samples *and exceeded* the 2015 Permit effluent limit in at least one background stormwater sample.

Following the adoption of the *NPDES Permit No. CA0001309 for the Boeing Company, SSFL, Canoga Park, CA, Order No. R4-2023-0359* (2023 Permit), which updated some effluent limits and added additional monitoring constituents, the criteria for selecting priority COPCs were revised to be the following:

1. constituents with either a 2015 or 2023 Permit effluent limit,
2. constituents in the Standardized Risk Assessment Methodology (SRAM), Revision 2 Addendum, Santa Susana Field Laboratory, Ventura County, California (2022) that were detected at least once in stormwater,
3. Polychlorinated biphenyl (PCB) congeners, or
4. regulated Per- and Polyfluoroalkyl Substances (PFAS) -- PFOA, PFOS, PFNA, PFHxS, HFPO-DA, PFBS, and mixtures of two or more of the PFAS substances.[3]

[3] US EPA, O. (2021, November 16). Per- and Polyfluoroalkyl Substances (PFAS) [Reports and Assessments]. https://www.epa.gov/sdwa/and-polyfluoroalkyl-substances-pfas

Data Sources

Offsite stormwater background data collected near SSFL and published data reported by others are considered in this memorandum and were also used in the original 2022 memorandum. A summary of these sampling datasets is also provided in this section.

Two types of offsite background watersheds were sampled to derive separate thresholds. Background stormwater sampling data represent watersheds with no development impacts (e.g., roads, residential development, utility poles), while ambient stormwater sampling data represent watersheds with some anthropogenic influence (residential development, roads, and utility poles) but without any industrial sources.

On-site stormwater results from undeveloped areas that were included in the original 2022 memorandum are no longer used to calculate any thresholds.

Offsite Background Stormwater

To assess background stormwater thresholds of NPDES-permitted constituents at SSFL, offsite stormwater monitoring was conducted at two sites near SSFL, Las Llajas Canyon (EPOSBKGRLC) and Montgomery Canyon (EPOSBKGRMC), shown in **Figure 1**. The offsite stormwater runoff was collected from catchments in natural, largely undeveloped areas with no known historical industrial activities. These sites receive no runoff from SSFL nor areas that border SSFL, and are more than 99% undeveloped.

To further support the analysis of background concentrations, additional representative offsite background stormwater quality data were obtained from the Southern California Coastal Water Research Project (SCCWRP) Assessment of Water Quality Concentrations and Loads from Natural Landscapes[4] and Lawrence Livermore National Laboratory (LLNL)[5]. Only wet weather samples collected from watersheds with less than 5% residential development and no industrial activities were used for the analysis. **Additionally, to most closely reflect geologic conditions at the SSFL, only the data collected in watersheds with sedimentary geology were used for this analysis.**

During analyses and threshold calculation, all offsite background data sites were combined into a single, offsite background stormwater dataset. Statistical evaluations supporting combining data from these various locations are described below.

[4] Yoon, K. V., & Stein, E. D. (2007). *Assessment of Water Quality Concentrations and Loads from Natural Landscapes*. Technical Report 500. Southern California Coastal Water Research Project, Costa Mesa, California. (Available from: http://www.sawpa.org/documents/SCCWRP500_natural_loading.pdf).

[5] Gross alpha results were pulled from the LLNL Livermore Site Annual Storm Water Monitoring Reports and Site Annual Environmental Reports (Available from https://saer.llnl.gov/).

Offsite Ambient Stormwater

Offsite ambient (non-industrial) stormwater is intended to represent slightly more developed conditions, including paved roads, utility poles, and buildings, while excluding any industrial or heavy commercial activities. These non-industrial, non-background areas are of particular interest for dioxins since treated wood utility poles are known to be a dioxin source.

Stormwater samples from a lightly developed, non-industrial area were evaluated for TCDD TEQ and TCDD TEQ (no DNQ) to characterize representative ambient conditions in offsite non-industrial areas. The offsite ambient stormwater sampling location, Box Canyon (EPOSBKGRBC), shown in **Figure 1**, is 75% undeveloped and 25% residential.

METHODS

This section describes the evaluation of data suitability and the statistical methods used to develop background and ambient stormwater thresholds. Consistent with EPA TSD guidance, the methodology was designed to provide statistically defensible and conservative threshold values while avoiding unsupported distributional assumptions or extrapolation beyond the available data.

Data Acceptability Evaluation

The TSD discusses using sufficient data in these calculations, but does not provide a concrete minimum number of samples. In an analysis performed by SWEP member Dr. Robert Pitt, probability distributions and confidence intervals were evaluated for stormwater data to determine the effect of data availability on the reliability of the statistical distribution and the width of the associated confidence intervals. Different sample sizes were evaluated by halving the dataset and removing every other observation. This process was repeated to obtain increasingly smaller sample sizes. For all COPCs assessed, the analysis revealed that 12 samples generally produced confidence interval ranges largely consistent with those obtained with the full sample size. Below this number, the confidence intervals were notably wider. The complete analysis is included in *Appendix A: Effects of Sample Numbers on Probability Distributions.*

Based on these findings, a minimum sample size of 12 observations was established for statistical threshold development. This criterion was adopted to provide a consistent basis for evaluating statistical reliability because the TSD does not specify a minimum sample size.

Dr. Pitt also evaluated published offsite background datasets generated by others, which were included in the threshold calculations, to identify potential high outliers or non-background samples to omit. This was achieved by preparing probability plots for monitoring data, as described in *Appendix B: 99th Percentile Confidence Intervals for Offsite and SSFL On-site*

Concentrations of Constituents of Concern. Based on this analysis and desktop evaluation of the sampled watersheds, the SWEP determined that the following data should be omitted:

- All samples from offsite SCCWRP location NL07: the drainage area of this offsite location includes part of the former Capistrano Test Site, a large research and development complex operated by Northrop Grumman Aerospace Systems. The elevated concentrations observed, however, suggest influence by non-background sources.
- All samples from offsite SCCWRP location NL22: the drainage area of this offsite location includes small, undeveloped portions of the SSFL Northern Buffer Zone and Area IV. The elevated concentrations associated with this sampling location suggest that the samples may be influenced by non-background sources.
- Arsenic result from offsite SCCWRP location NL11 on February 11, 2005: this sample result was suspected to be incorrectly transcribed, and the true sample result could not be determined.

Final stormwater sampling locations and counts are shown in **Table 1** and **Figure 1** below.

Table 1. Summary of offsite background and offsite ambient stormwater samples

Sample Type	Source	Location	Monitoring Start	Monitoring End	Sample Count
Offsite Background Stormwater	LLNL[1]	ALPO	2010-02-09	2015-11-09	14
Offsite Background Stormwater	LLNL[1]	ASS2	2010-02-09	2015-11-09	14
Offsite Background Stormwater	LLNL[1]	CARW2	2010-02-08	2014-12-11	9
Offsite Background Stormwater	SCCWRP[1]	NL05	2005-01-07	2005-01-07	10
Offsite Background Stormwater	SCCWRP[1]	NL09	2005-02-11	2005-02-12	4
Offsite Background Stormwater	SCCWRP[1]	NL10	2005-01-07	2005-01-07	10
Offsite Background Stormwater	SCCWRP[1]	NL11	2005-02-11	2005-02-12	4
Offsite Background Stormwater	SCCWRP[1]	NL20	2004-12-07	2004-12-07	1
Offsite Background Stormwater	SCCWRP[1]	NL21	2004-12-07	2004-12-07	1
Offsite Background Stormwater	SSFL SWEP Background Study	EPOSBKGRLC	2021-12-30	2026-02-16	20
Offsite Background Stormwater	SSFL SWEP Background Study	EPOSBKGRMC	2023-01-09	2026-01-03	14
Offsite Ambient Stormwater	SSFL SWEP Background Study	EPOSBKGRBC	2021-12-31	2026-02-16	19

Note 1. Lawrence Livermore National Laboratory (LLNL) data and Southern California Coastal Water Research Program (SCCWRP) monitoring results were reported by others and are not associated with SSFL.



Figure 1. California Offsite Background Stormwater Sampling Location

Threshold Calculation

Stormwater-based background and ambient thresholds were calculated for each priority COPC with sufficient sample size and at least one detected result. The thresholds were calculated using the approach for calculating water quality-based maximum daily limits, as detailed in Appendix E of the EPA TSD, which are based on the 99th percentile of historic water quality monitoring data at a location.

Where all samples were detected above the method detection limit, the 99th percentile thresholds were calculated using the lognormal distribution equations provided in Table E-1 of Appendix E of EPA TSD. For constituent sample populations with a mixture of detected and non-detected results, the 99th percentile thresholds were calculated using the delta-lognormal equations in Table E-1 of Appendix E of EPA TSD. The delta-lognormal distribution is a generalization of the lognormal distribution that accounts for the proportion of non-detects while using detected results (assumed lognormal) to calculate summary statistics. A histogram of an example delta-lognormal dataset is shown in **Figure 2**.

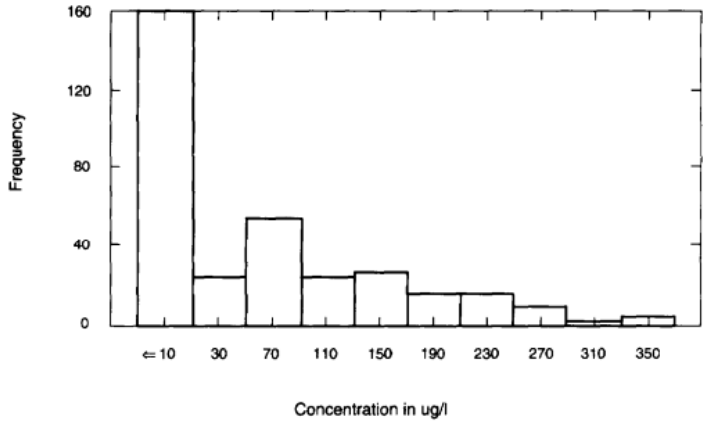


Figure 2. Histogram of a delta-lognormally distributed dataset with non-detect data shown at the detection limit[6]

Constituent data populations were evaluated for lognormality using the Anderson-Darling test applied to log-transformed values[7]. For pH values, which represent already lognormally transformed concentrations of hydrogen ions, a normal distribution fit was used to calculate thresholds and Anderson-Darling goodness of fit for normal data evaluated.

[6] Figure obtained from Appendix E of the EPA TSD.
[7] Singh, A., Singh, A., & Engelhardt, M. (1997). The Lognormal Distribution in Environmental Applications (Technology Support Center Issue No. EPA/600/R-97/006). USEPA.

Where the Anderson-Darling goodness-of-fit test indicated an acceptable fit to the assumed lognormal (or normal) distribution (i.e., the test statistic was less than or equal to the critical value at the 5% significance level), the background threshold was based on the calculated 99th percentile assuming a lognormal distribution. When the Anderson-Darling test statistic exceeded the critical value at the 5% significance level, the null hypothesis was rejected, indicating a statistically significant departure from the assumed lognormal distribution. In those cases, the data were considered not to fit the assumed parametric distribution, and the background threshold was instead calculated using a nonparametric 99th percentile using the p*(n-1) interpolation where p is the percentile and n is the number of samples. When the number of results was insufficient to calculate the 99th percentile (less than 12 samples), the maximum observed concentration was used as the background threshold.

RESULTS

Of the more than 500 constituents analyzed in stormwater at SSFL, 91 priority COPCs were identified based on meeting one or more of the following criteria: having an effluent limit in the 2015 or 2023 NPDES permit, inclusion in the SRAM evaluation with at least one stormwater detection, or inclusion in PCB or PFAS analyte lists.

Summary statistics and thresholds for the 57 COPCs with applicable 2015 or 2023 permit limits are presented in **Attachment D Table 1.** Of these, background stormwater thresholds were calculated for 41 COPCs and ambient stormwater thresholds were calculated for 41 COPCs. To view distributions of COPC stormwater concentrations relative to the lognormal cumulative distribution function and calculated thresholds and permit limits for each of these cases described, see *Attachment C – Example Analyte Distributions*.

Of these, 28 COPCs have a background and/or ambient thresholds greater than the corresponding 2015 or 2023 Permit limits: aluminum, arsenic, barium, biochemical oxygen demand, bis(2-ethylhexyl) phthalate, boron, cadmium, chloride, chromium, combined radium-226 and radium-228, copper, gross alpha, gross beta, iron, lead, manganese, mercury, nickel, nitrite as nitrogen, oil & grease, pentachlorophenol, perchlorate, pH, selenium, sulfate, total dissolved solids, uranium, and zinc.

Summary statistics and threshold evaluations for the remaining 39 COPCs without permit limits (i.e., SRAM analytes, PFAS, and PCBs) are provided in **Attachment D Table 2**. Since these COPCs do not have SSFL specific permit limits, California (CA) primary maximum contaminant levels (MCLs), or drinking water standards, and CA Toxics Rule thresholds are provided for reference.

Because of continued regulatory, SWEP, and public interest in PFAS and PCBs, the results for these COPCs are discussed here. Sample data from offsite background and ambient locations are limited because these constituents were only recently added to the monitoring program with the adoption of the 2023 NPDES permit. Given the small dataset, thresholds cannot yet be calculated; therefore, in these cases only the maximum observed concentrations are reported and compared against the applicable water quality objectives.

Observed PFOA and PFOS concentrations at some background and ambient sites indicate that stormwater from those locations may occasionally exceed the 2024 USEPA drinking water Maximum Contaminant Levels (MCLs).

Total Polychlorinated Biphenyls (PCBs) were evaluated two ways: first the summation of Aroclors (“aroclor method”) and then the summation for all 209 congeners analyzed by method 1668c (”congener method”). Detections for Total PCBs were only observed for the more sensitive congener method which cannot be used for compliance purposes, with maximum concentrations of 0.000313 µg/L and 0.0375 µg/L for background and ambient samples, respectively. Both background and ambient maximum results are above the California Toxics Rule (CTR) criterion for human health (fish consumption only) of 0.00017 µg/L.

The higher of ambient and background thresholds is recommended for comparison with SSFL stormwater samples due to its watersheds consisting of largely undeveloped areas with non-industrial infrastructure (e.g. paved roads and treated wood poles). These recommended thresholds are shown in Table 2 below.

Background and Ambient Stormwater Thresholds 2026 Update
October 31, 2026

Table 2. Summary of Preliminary Background Stormwater Thresholds

Constituent	Units	2023 NPDES Permit Limit[1]	Background Stormwater Threshold[2,3]	Threshold Basis[2,3]
1,1-Dichloroethene	µg/L	6	ND	no detects in either background or ambient locations
1,2-Dichloroethane	µg/L	0.500	ND	no detects in either background or ambient locations
2,4,6-Trichlorophenol	µg/L	13	ND	no detects in either background or ambient locations
2,4-Dinitrotoluene	µg/L	18	ND	no detects in either background or ambient locations
3,3'-Dichlorobenzidine	µg/L	0.0770	ND	no detects in either background or ambient locations
4,4'-DDE	µg/L	0.00059	ND	no detects in either background or ambient locations
alpha-BHC	µg/L	0.0300	ND	no detects in either background or ambient locations
Aluminum	**µg/L**	**1,000**	**229,657**	Ambient Lognormal 99th percentile
Ammonia as Nitrogen (N)	mg/L	10.1	2.04	Background Nonparametric 99th percentile
Antimony	µg/L	6	3.03	Background Lognormal 99th percentile
Arsenic	**µg/L**	**10**	**19.0**	Ambient Lognormal 99th percentile
Barium	**mg/L**	**1**	**1.08**	Ambient Nonparametric 99th percentile
Benzidine	µg/L	0.00054	ND	no detects in either background or ambient locations
Beryllium	µg/L	4	3.69	Ambient Lognormal 99th percentile
Biochemical Oxygen Demand (BOD)	**mg/L**	**30**	**598**	Ambient Lognormal 99th percentile
bis (2-ethylhexyl) Phthalate	**µg/L**	**4**	**5.24**	Background Nonparametric 99th percentile
Boron	**mg/L**	**1**	**7.01**	Background Lognormal 99th percentile
Cadmium	**µg/L**	**3.10**	**8.24**	Background Lognormal 99th percentile
Chloride	**mg/L**	**150**	**553**	Background Lognormal 99th percentile
Chromium	**µg/L**	**16**	**272**	Ambient Lognormal 99th percentile
Chromium VI	µg/L	16	1.10	Background Nonparametric 99th percentile
Combined Radium-226 and Radium-228	**pCi/L**	**5**	**17.3**	Ambient Lognormal 99th percentile
Copper	**µg/L**	**31**	**142**	Ambient Lognormal 99th percentile
Cesium-137	pCi/L	200	ND	no detects in either background or ambient locations
Cyanide	µg/L	8.50	5	Background Nonparametric 99th percentile
Fluoride	mg/L	1.60	1.33	Background Lognormal 99th percentile
Gross Alpha	**pCi/L**	**15**	**142**	Ambient Lognormal 99th percentile
Gross Beta	**pCi/L**	**50**	**118**	Ambient Lognormal 99th percentile
Heptachlor	µg/L	0.00042	ND	no detects in either background or ambient locations
Indeno(1,2,3-cd)pyrene	µg/L	0.100	ND	no detects in either background or ambient locations
Iron	**mg/L**	**no limit**	**295**	Ambient Lognormal 99th percentile
Lead	**µg/L**	**5.20**	**280**	Ambient Lognormal 99th percentile
Manganese	**µg/L**	**50**	**5,021**	Background Lognormal 99th percentile
Mercury	**µg/L**	**0.0240**	**0.280**	Ambient Lognormal 99th percentile
Nickel	**µg/L**	**86**	**151**	Ambient Lognormal 99th percentile
Nitrate + Nitrite as N	mg/L	8	6.85	Ambient Lognormal 99th percentile
Nitrate as N	mg/L	8	6.73	Ambient Lognormal 99th percentile
Nitrite as N	mg/L	1	1.39	Background Nonparametric 99th percentile
n-Nitrosodimethylamine	µg/L	16	ND	no detects in either background or ambient locations
Oil & Grease	**mg/L**	**15**	**15.1**	Ambient Lognormal 99th percentile
Pentachlorophenol	µg/L	1	5.74	Ambient Nonparametric 99th percentile
Perchlorate	**µg/L**	**6**	**47.1**	Background Nonparametric 99th percentile
pH (field)	**SU**	**6.5 - 8.5**	**5.60 - 9.78**	Background Normal 1st - 99th percentile
Selenium	**µg/L**	**5**	**41.2**	Background Nonparametric 99th percentile
Silver	µg/L	4.10	2.26	Ambient Lognormal 99th percentile
Strontium-90	pCi/L	8	1.37	Background Nonparametric 99th percentile
Sulfate	**mg/L**	**250**	**1,968**	Background Nonparametric 99th percentile
Surfactants (MBAS)	mg/L	0.500	0.169	Ambient Lognormal 99th percentile
TCDD TEQ (no DNQ)	**µg/L**	**2.80e-08**	**4.26e-06**	Ambient Lognormal 99th percentile
Temperature	°F	80	66.7	no detects in either background or ambient locations
Thallium	µg/L	2	1.97	Ambient Lognormal 99th percentile
Total Dissolved Solids	**mg/L**	**850**	**3,976**	Background Nonparametric 99th percentile
Total PCBs Arochlor Method	µg/L	0.00017	ND	no detects in either background or ambient locations
Trichloroethene	µg/L	5	ND	no detects in either background or ambient locations
Tritium	pCi/L	20,000	241	Background Nonparametric 99th percentile
Uranium, Total	**pCi/L**	**20**	**37.3**	Background Lognormal 99th percentile
Zinc	**µg/L**	**120**	**1,209**	Ambient Lognormal 99th percentile
Total PCBs Congener Method	**µg/L**	0.5	**0.0375**	Ambient max result
Mixture of PFAS Congeners	**Hazard Index**	1	**1.24**	Background max result
HFPO-DA	ng/L	10	ND	no detects in either background or ambient locations
PFBS	ng/L	--	17	Background max result
PFHxS	ng/L	10	2.50	Background max result
PFNA	ng/L	10	9.80	Background max result
PFOA	**ng/L**	4	**52**	Background max result
PFOS	**ng/L**	4	**19**	Background max result
1,2,3,4,6,7,8-HpCDD	µg/L	--	0.00120	Ambient Lognormal 99th percentile
1,2,4-Trichlorobenzene	µg/L	5	0.130	Background Nonparametric 99th percentile
1,3-Dichlorobenzene	µg/L	--	0.150	Background Nonparametric 99th percentile
1,4-Dichlorobenzene	µg/L	5	0.140	Background Nonparametric 99th percentile
2,4-Dichlorophenol	µg/L	93	1.53	Background Nonparametric 99th percentile
2,4-Dimethylphenol	µg/L	540	5.63	Background Nonparametric 99th percentile
2,6-Dinitrotoluene	**µg/L**	**0.11**	**5.47**	Background Nonparametric 99th percentile
2-Chloronaphthalene	µg/L	1700	1.01	Background Nonparametric 99th percentile
4-Nitrophenol	µg/L	--	6.28	Background Nonparametric 99th percentile
Acenaphthene	µg/L	1200	0.867	Background Nonparametric 99th percentile
Anthracene	µg/L	9600	0.708	Background Nonparametric 99th percentile
Benzo(a)pyrene	**µg/L**	**0.2**	**0.853**	Background Nonparametric 99th percentile
Benzyl alcohol	µg/L	--	2.10	Ambient max result
Chrysene	**µg/L**	**0.0044**	**0.605**	Background Nonparametric 99th percentile
Cobalt	µg/L	--	110	Ambient Lognormal 99th percentile
Endosulfan I	µg/L	0.22	0.0911	Ambient Nonparametric 99th percentile
Fluoranthene	µg/L	300	0.730	Background Nonparametric 99th percentile
Fluorene	µg/L	1300	0.828	Background Nonparametric 99th percentile
Formaldehyde	µg/L	--	11	Background max result
Hexachloroethane	µg/L	1.9	1.28	Background Nonparametric 99th percentile
Isophorone	µg/L	8.4	1.62	Background Nonparametric 99th percentile
Lithium	mg/L	--	0.220	Background max result
Molybdenum	µg/L	--	46	Background max result
Nitrobenzene	µg/L	17	1.50	Background Nonparametric 99th percentile
Phenanthrene	µg/L	--	0.625	Background Nonparametric 99th percentile
Phenol	µg/L	21,000	1.03	Ambient Nonparametric 99th percentile
Pyrene	µg/L	960	0.618	Background Nonparametric 99th percentile
Strontium	mg/L	--	5.70	Background max result
Styrene	µg/L	100	0.280	Ambient max result
Titanium	µg/L	--	540	Ambient max result
Vanadium	µg/L	--	19	Ambient max result

Notes:

1. Where there are multiple permit limits for different outfalls, the lowest one is shown here. Where there is no Permit Limit CA Primary MCLs or CTR criteria are shown.
2. 99th percentile calculated following Appendix E of the US EPA Technical Support Document (TSD) for Water Quality-based Toxics Control. EPA/505/2-90-001.
   The calculation assumes a lognormal distribution for results that are detected 100% of the time or a deltalognormal distribution if there are any nondetects.
   If the data fail the Anderson-Darling test for lognormality, then the nonparametric 99th percentile is calculated.
3. The threshold is based on the 99th percentile if sufficient data is available, otherwise the max result is used.

ND = no detected results, cannot calculate a threshold

The threshold values presented here remain preliminary and subject to change as additional samples are collected.

Bolded COPCs indicate where the background stormwater threshold is higher than the permit limit (or CA Primary MCL or CTR criteria for total PCBs, PFAS, PAHs, and other constituents without permit limits).

CONCLUSIONS AND RECOMMENDATIONS

Background and ambient stormwater thresholds were calculated for COPCs with at least 12 samples and at least one detected result using offsite background and ambient stormwater monitoring results and are intended to be used for comparison with modeling results and stormwater monitoring results during periods without wildfire impacts. Preliminary background and ambient thresholds in the original memorandum, 'Santa Susana Field Laboratory Background Stormwater Thresholds' (2022) were updated to include local offsite background and ambient stormwater data collected in recent years and to include a check of the assumed lognormal distributional fit. The updated methodology emphasizes the use of the most statistically reliable threshold estimate supported by the available data and avoids relying on distributional assumptions that are not supported by the monitored dataset.

The COPCs with background and ambient stormwater thresholds calculated above existing permit limits are those for which background or ambient thresholds are necessary, because, based on these data, they're occasionally measured above SSFL existing permit limits in stormwater without industrial impacts. The higher of ambient and background thresholds should be applied to SSFL due to its watersheds comprising of a combination of undeveloped area and non-industrial infrastructure (e.g. paved roads and treated wood poles). These thresholds are summarized in Table 2 of this memorandum.

The values reported in this memorandum are preliminary and subject to change as the stormwater background monitoring datasets continue to grow. The SWEP recommends continuing monitoring at the offsite locations to fill remaining data gaps and improve threshold value certainty. For the 2026/27 rainy season, analyses may cease for any COPC with 12 or more samples in both datasets (ambient and background) AND both thresholds <90% of Permit Limits. Furthermore, 2026/27 is expected to be the final season of offsite sampling for many COPCs since final threshold values will be needed in 2027 for comparison with the MOU post-cleanup model scenario runs.

ATTACHMENT A – EFFECTS OF SAMPLE NUMBERS ON PROBABILITY DISTRIBUTIONS

R. Pitt
September 2, 2021

Effects of Sample Numbers on Probability Distributions

Overview of Probability Distributions

To show the effects of different sample sizes, probability distributions were prepared of selected on-site background stormwater measurements using Minitab version 20.3. All distributions were with log-normal scales for the concentrations, except for pH which is already log transformed. Figure 1 is an example probability distribution for iron on-site concentrations. These show the percent of data lower than any concentration. Also shown is the 95th percent confidence interval (CI). The width of the CI is narrowest at the median (greatest reliability at that value as there are equal amounts of data above and below the value to determine the median). The CI width widens for the extreme ends of the distributions as there are less data to define the extreme values of the distribution.

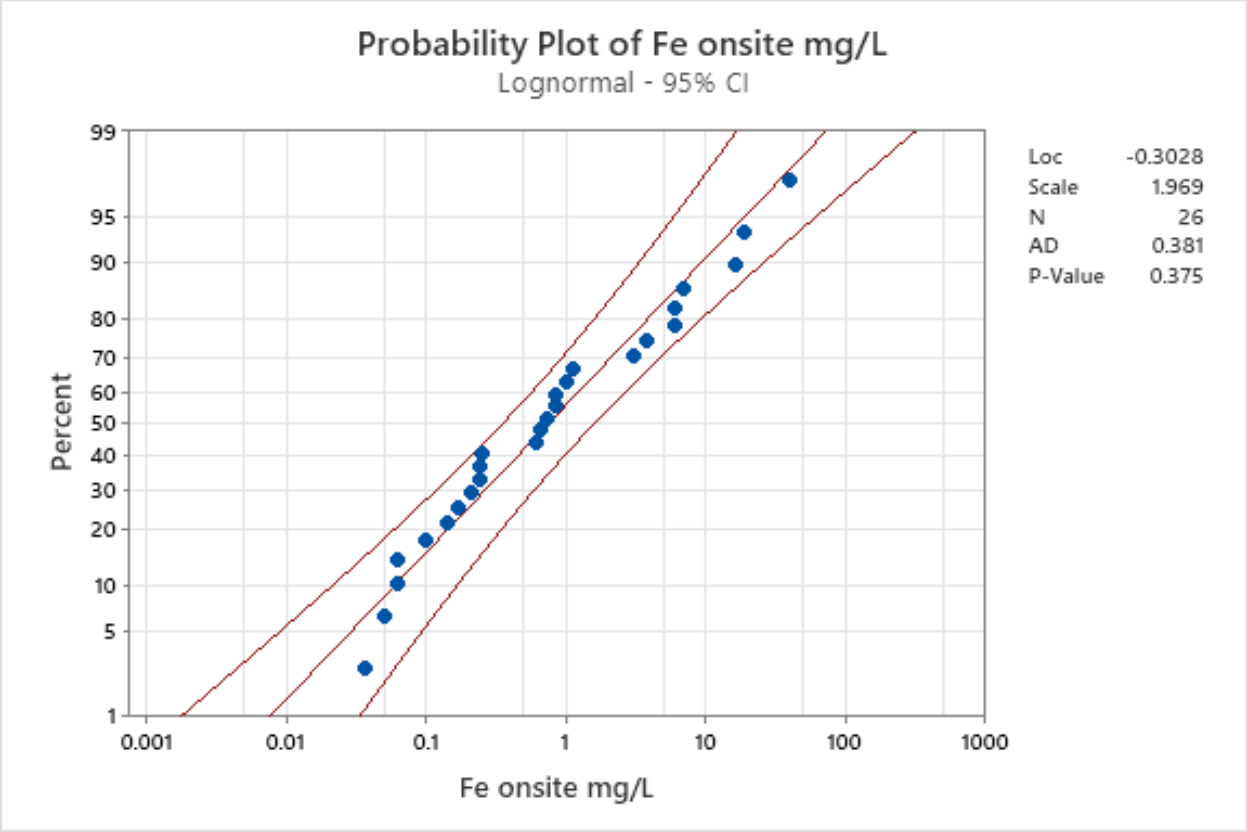


Figure 1. Example probability distribution for on-site iron concentrations.

The Minitab version of the probability distribution also includes several statistical parameters for the plot. The location (Loc) term indicates the relative placement of the distribution, most useful for comparing to other distributions when plotting more than one distribution on one plot. The scale value

relates to the slope of the distribution. Steeper distributions have smaller scale values. If the data are not log-transformed (as for the pH plots), the median and standard deviation are shown instead of the location and scale values. N refers to the number of data points used on the plot. AD refers to the Anderson-Darling statistic that indicates how well the data fits the distribution. The p-value shown refer to the AD test statistic. Traditionally, if the p value is <0.05, the data are assumed to be significantly different from the fitted distribution. Therefor, a large p value is desired to show good fits with the log-normal distribution. For low p values, other distributions can be tested, or the data more closely examined to identify if any data errors are evident, or if subsets of data do not belong in the same distribution and should be separated. Visual observations of the probability distribution also assist with these evaluations. However, it is possible that the data and sources are all acceptable and that they simply do not fit a mathematically described distribution.

Effects of Sample Numbers on Statistical Distributions

The amount of data available can affect the reliability of the statistical distribution and especially the width of the associated confidence intervals. Basically, fewer data will be needed if the data follows the distribution well, with little variation. However, sufficient data are needed to represent the range of conditions expected (such as seasons and rain depth, for example). If the data set are comprised of different sampling locations known to represent the same sample category (such as a specific land use), some locations may represent extreme conditions but should be included as they are needed to help represent the range of concentrations for the category being examined. However, careful quality control is necessary to verify the accuracy of the transcribed data, especially for the extended values. “Outliers” should not be routinely rejected or trimmed simply due to their extreme values, as they are needed to help represent the range of conditions being examined, but need to be verified. Also, when determining extreme probability values (such as the 99th percentile values), it would be best to have sufficient data to bracket those values (requiring 100+ samples for the 99th percentile). The confidence intervals are much wider at the extreme percentile values indicating greater variability with few samples.

To illustrate the effects of varying amounts of data, on-site background data for nitrate+nitrite, manganese, copper, zinc, and pH were used in the following analyses. The analyses started with the full set of observations available, and each subsequent set was halved by removing every other observation (the initial list was sorted by site and date, so this was similar to just obtaining every other sample at the locations). The following tables and figures show the resulting probability distributions, along with a summary table showing the CI ranges (manually estimated from the plots) and the test statistics. Plots were also prepared showing how the CI narrowed and shifts occurred in the 99th percentile values with increasing numbers of samples.

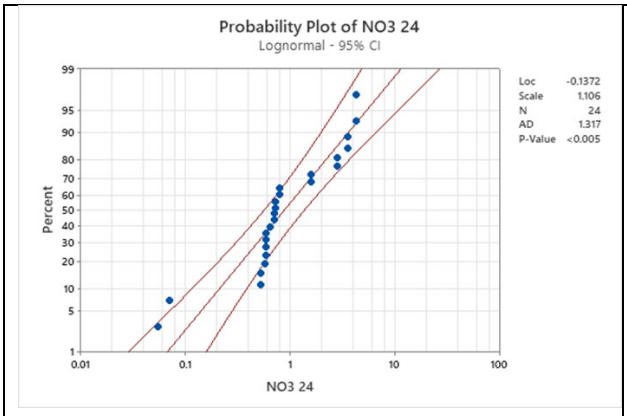
As noted above, the distribution responses to changes in sample numbers varied for the different constituents, but it can be seen visually that about 12 samples were close to the narrowest CI ranges that were associated with the largest numbers of samples available. In many cases, there were odd behaviors in the CI ranges when fewer samples were evaluated. If a location had a few samples available but was combined with samples from other sites in the same grouping, the overall distribution would benefit as the total number of samples for the category being investigated would increase and could add to a better representative of the whole category population. However, if the complete category only

had very few samples, it may still be useful, but it must be recognized that the confidence of the resulting values would decrease (as the CI widens).

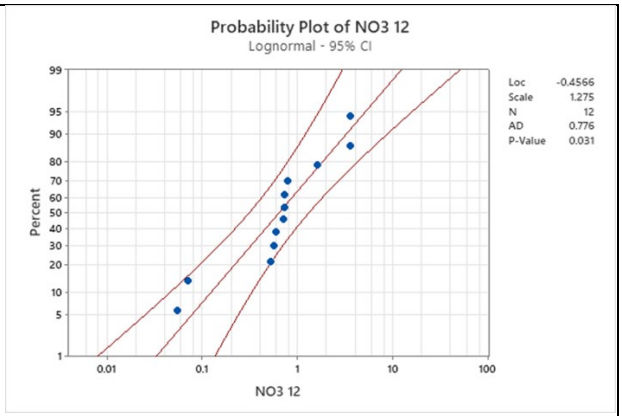
These plots indicate the number of selected data points, and the full data set plot also indicates the number of samples that had non-detected concentrations. For these analyses, no substitution was used for the non-detectable values. These can usually be seen on the probability plots as many points on a vertical line at the detection limit. However, the detection limits varied during the extended time of the sampling period, so this would not be as obvious in some cases. Variable detection limits assist the probability plots by showing data below other detection limits. This likely results in a better representation for the probability plots, but also contributes to poor fits to the log-normal distributions.

The most appropriate data for statistical analyses, including probability plots, would be to use the actual laboratory measured concentrations that are not truncated to the detection limit. Reporting these low values as the detection limits are appropriate for regulatory purposes when they are below the numeric reporting limit, usually calculated based on a high confidence criterion. For statistical analyses, the actual values, even if below the reporting limits, would be best, as any arbitrary traditional substitution (such as the detection limit or half of the detection limit) could introduce errors in the probability plots and dramatically restrict the use of many statistical tests. It is possible to substitute the missing values by extrapolating the probability distribution using several techniques, but any of these processes affect the variability of the concentrations. As noted above, the data available for these analyses only show the detection limits with no substitutions.

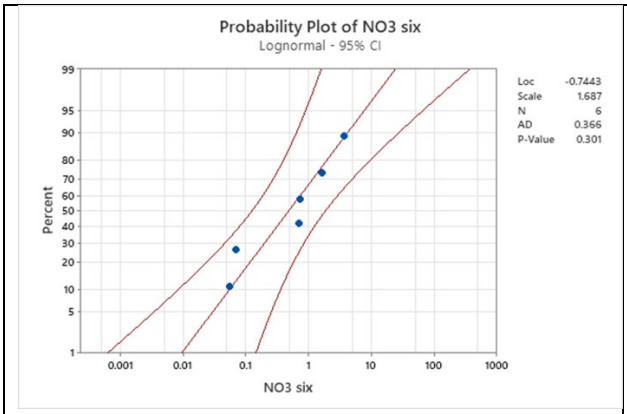
Nitrate+nitrite on-site background concentrations (mg/L)



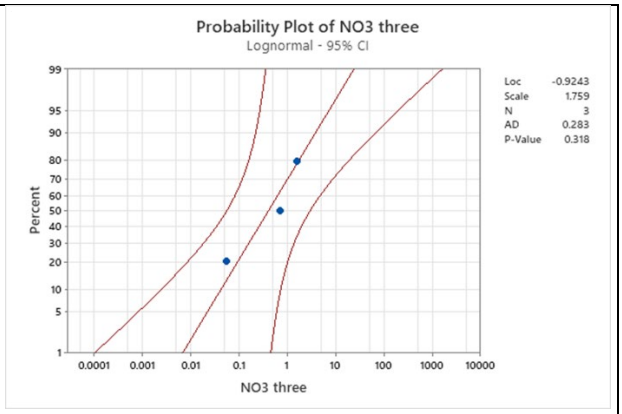
24 samples (2 non-detects, <0.07 and <0.055)



12 samples



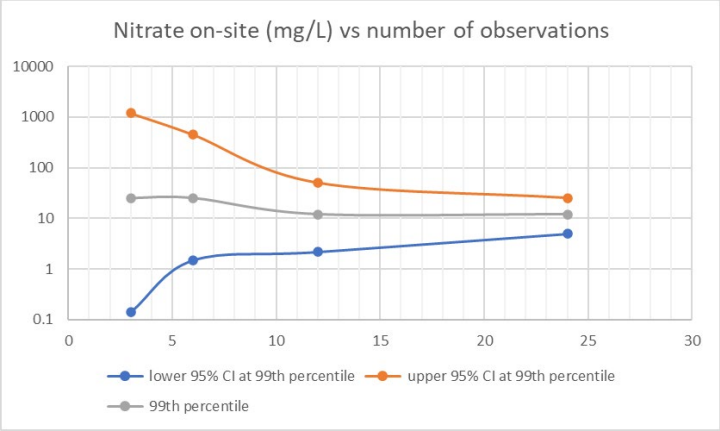
6 samples



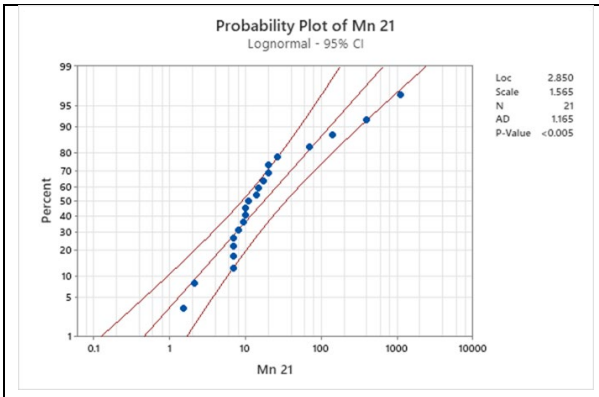
3 samples

The plots are labelled as NO_3, but represent NO_3+NO_2 measurements.

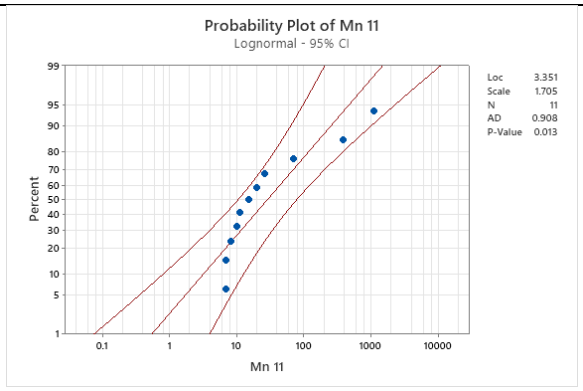
# of samples	lower 95% CI at 99th percentile	upper 95% CI at 99th percentile	99th percentile	AD p	Loc	Scale
24	5	25	12	<0.005	-0.137	1.11
12	2.2	50	12	0.031	-0.457	1.28
6	1.5	450	25	0.301	-0.744	1.68
3	0.14	1200	25	0.318	-0.924	1.76



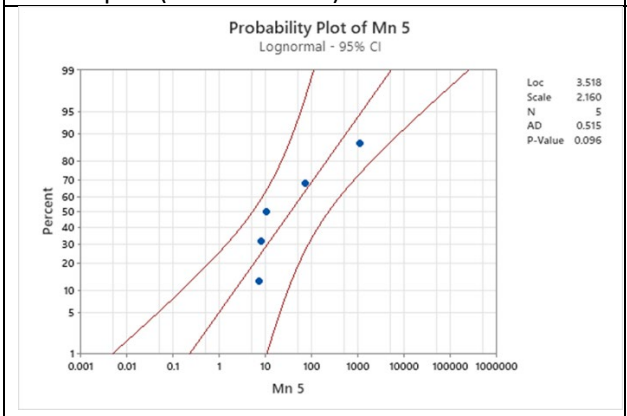
Manganese on-site background concentrations (ug/L)



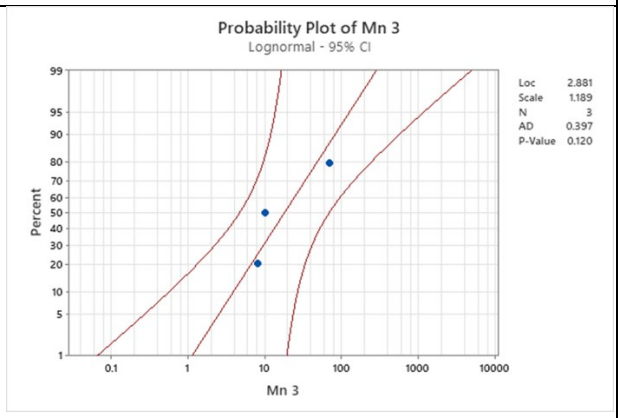
21 samples (6 non-detects)



11 samples

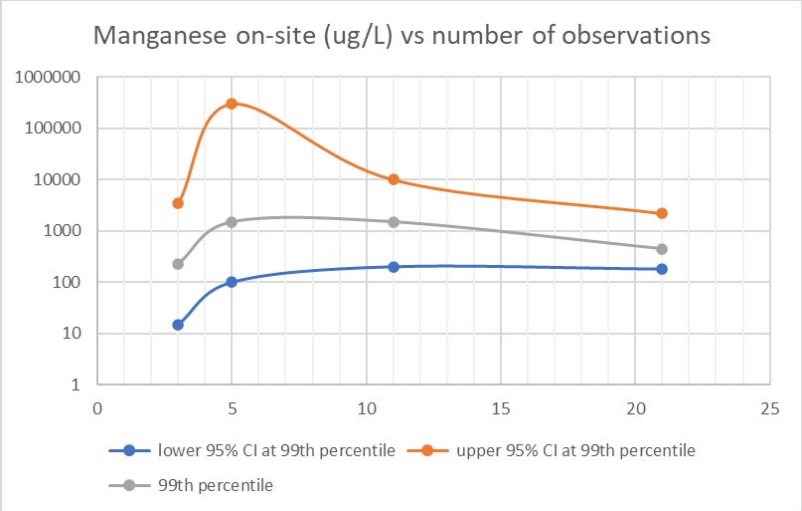


5 samples

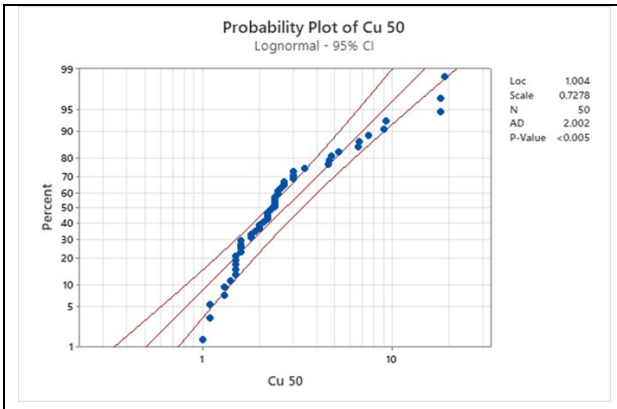


3 samples

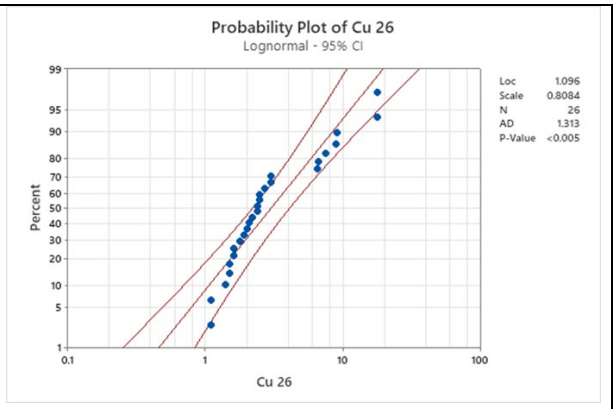
# of samples	lower 95% CI at 99th percentile	upper 95% CI at 99th percentile	99th percentile	AD p	Loc	Scale
21	180	2200	450	<0.005	2.85	1.17
11	200	10000	1500	0.013	3.35	1.71
5	100	300000	1500	0.096	3.52	2.16
3	15	3500	230	0.12	2.88	1.19



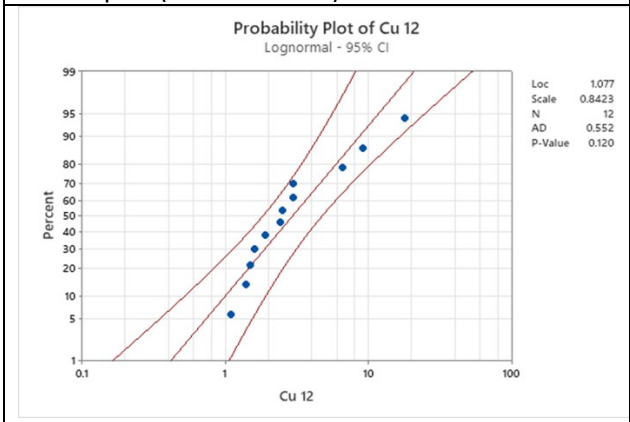
Copper on-site background concentrations (ug/L)



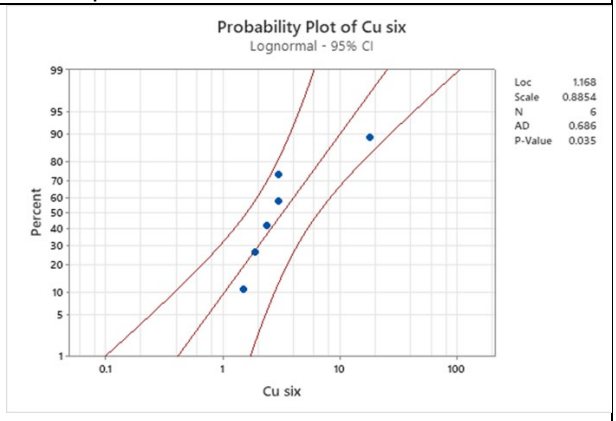
50 samples (0 non-detects)



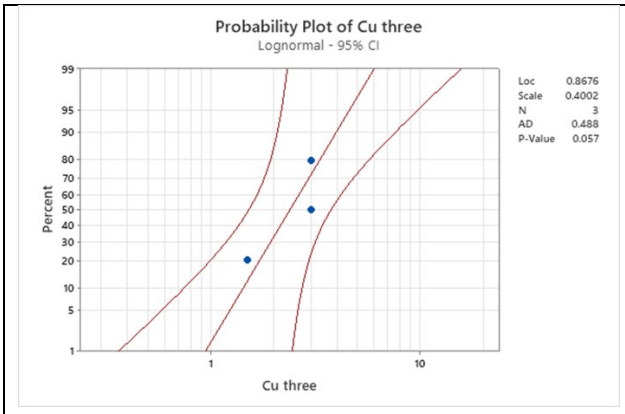
26 samples



12 samples

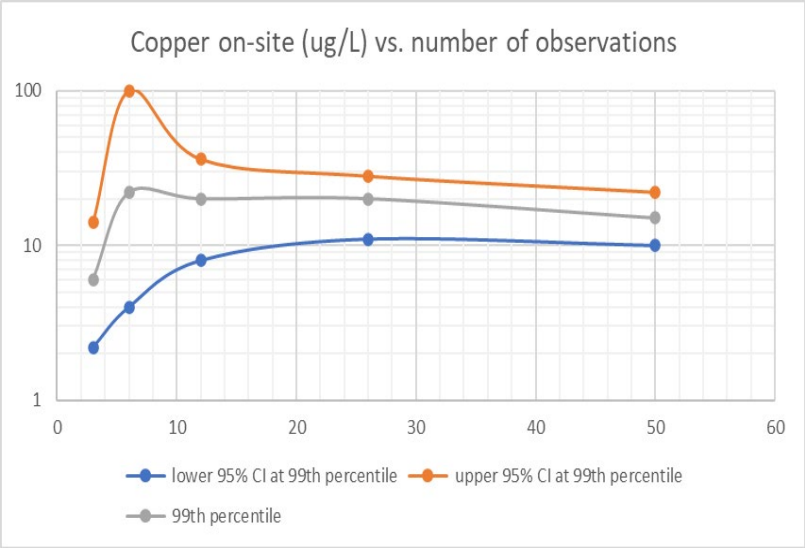


6 samples

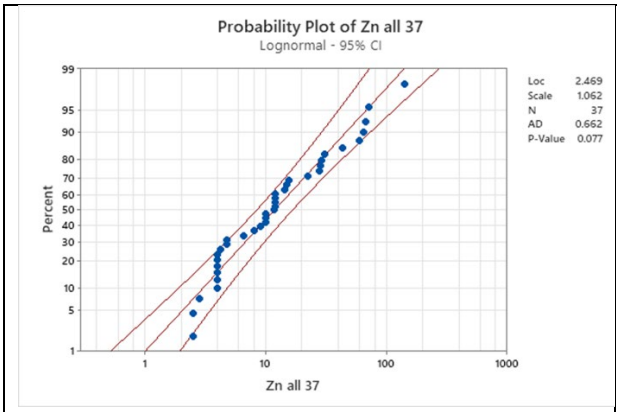


3 samples

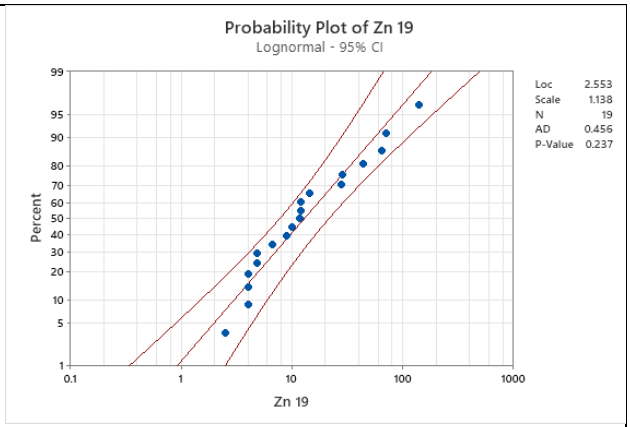
# of samples	lower 95% CI at 99th percentile	upper 95% CI at 99th percentile	99th percentile	AD p	Loc	Scale
50	10	22	15	<0.005	1	0.728
26	11	28	20	<0.005	1.1	0.808
12	8	36	20	0.12	1.08	0.842
6	4	100	22	0.035	1.17	0.884
3	2.2	14	6	0.057	0.87	0.4



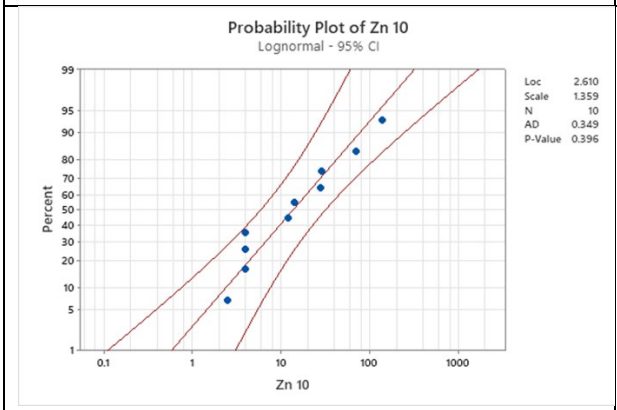
Zinc on-site background concentrations (ug/L)



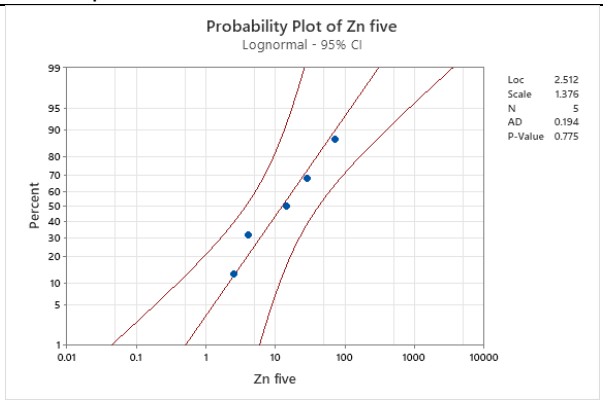
37 samples (13 non-detects)



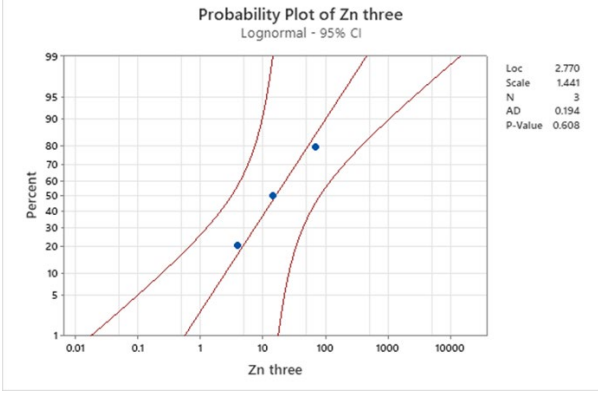
19 samples



10 samples

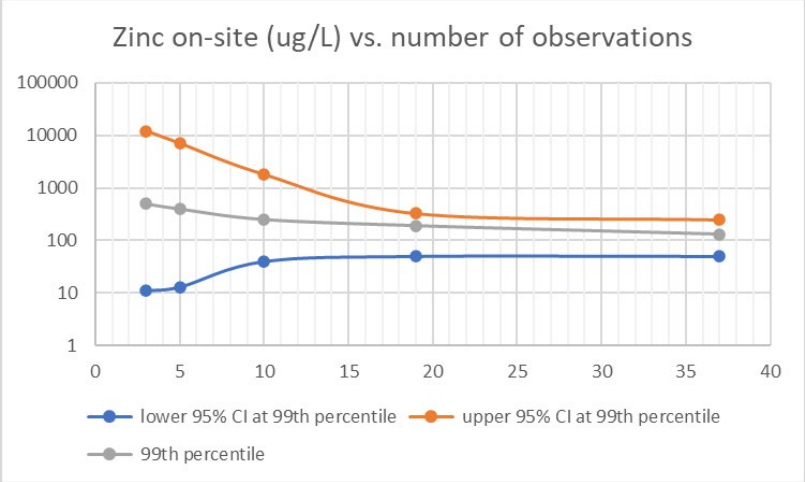


5 samples

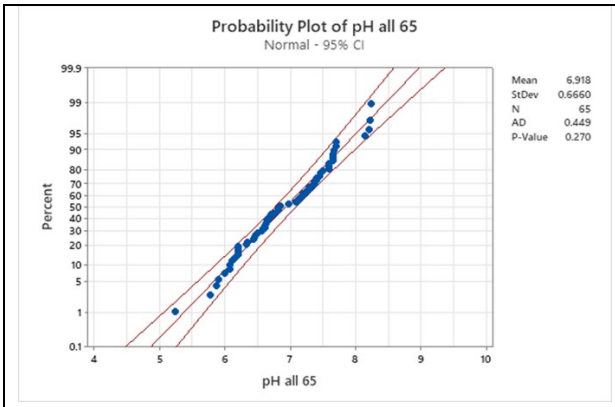


3 samples

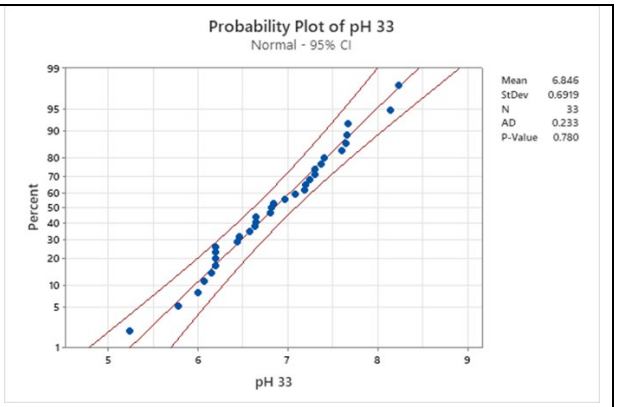
# of samples	lower 95% CI at 99th percentile	upper 95% CI at 99th percentile	99th percentile	AD p	Loc	Scale
37	50	250	130	0.077	2.47	1.06
19	50	330	190	0.237	2.55	1.14
10	40	1800	250	0.396	2.61	1.36
5	13	7000	400	0.775	2.51	1.38
3	11	12000	500	0.608	2.77	1.44



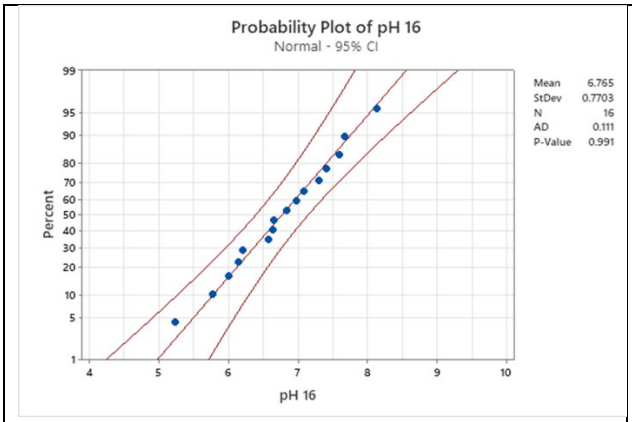
pH on-site background values



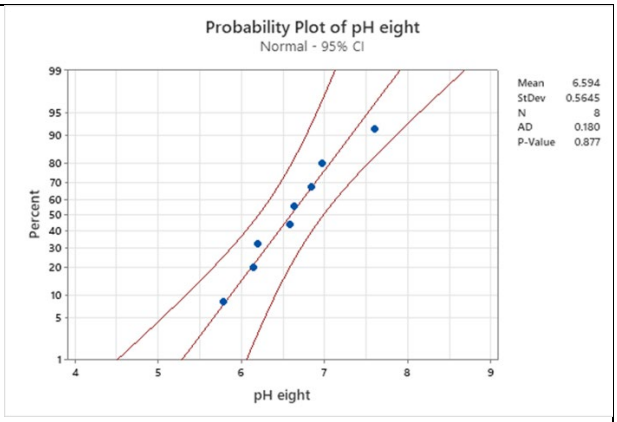
65 samples (0 non-detects)



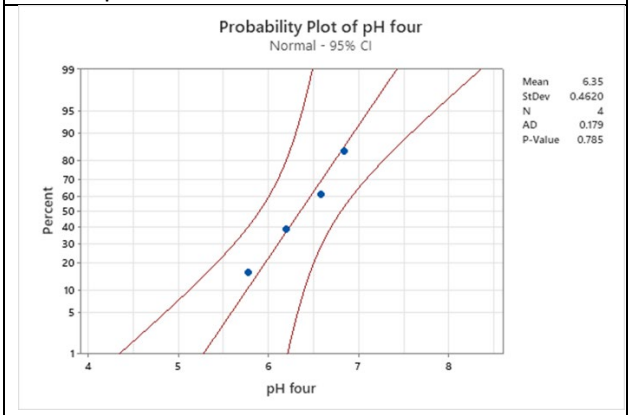
33 samples



16 samples



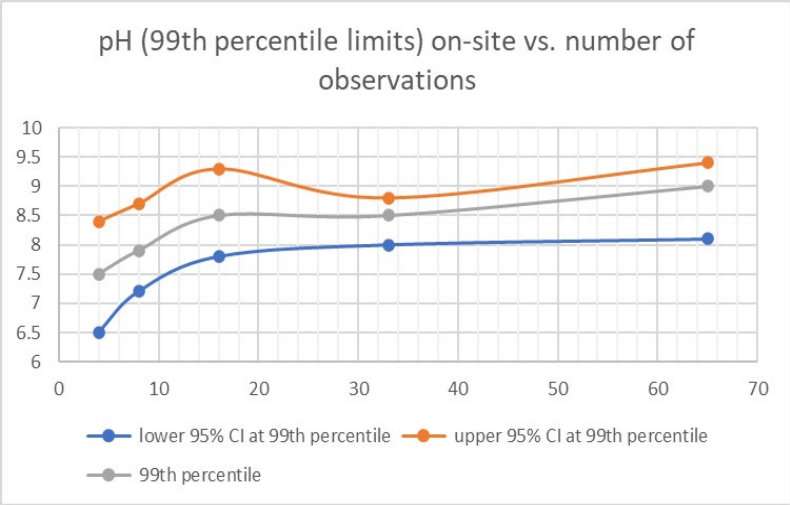
8 samples



4 samples

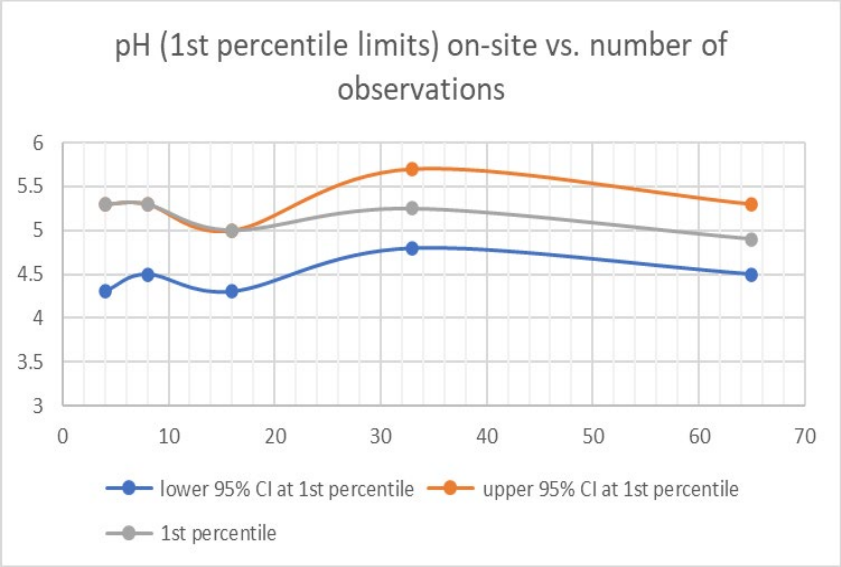
pH on-site background upper 99th percentile values

# of samples	lower 95% CI at 99th percentile	upper 95% CI at 99th percentile	99th percentile	AD p	mean	StDev
65	8.1	9.4	9	0.27	6.92	0.67
33	8	8.8	8.5	0.78	6.85	0.69
16	7.8	9.3	8.5	0.99	6.77	0.77
8	7.2	8.7	7.9	0.88	6.59	0.56
4	6.5	8.4	7.5	0.79	6.35	0.46



pH on-site background lower 1st percentile values

# of samples	lower 95% CI at 1st percentile	upper 95% CI at 1st percentile	1st percentile	AD p	mean	StDev
65	4.5	5.3	4.9	0.27	6.92	0.67
33	4.8	5.7	5.25	0.78	6.85	0.69
16	4.3	5	5	0.99	6.77	0.77
8	4.5	5.3	5.3	0.88	6.59	0.56
4	4.3	5.3	5.3	0.79	6.35	0.46



ATTACHMENT B – 99TH PERCENTILE CONFIDENCE INTERVALS FOR OFFSITE AND SSFL ON-SITE CONCENTRATIONS OF CONSTITUENTS OF CONCERN

R. Pitt
September 10, 2021

99th Percentile Confidential Intervals for Off-site and SSFL On-site Concentrations of Selected Constituents of Potential Concern

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Summary

On-site and off-site data representing background conditions (ambient conditions for dioxin off-site) of selected constituents of potential concern were evaluated using probability plots with Minitab version 20.3 and box and whisker plots and comparison statistics using SigmaPlot 14.5. Specifically, 95 percent confidence intervals were of interest to indicate the range of likely values of the 99th percentiles (and the 1st percentiles for the low range of pH). The confidence intervals and values at the 99th percentiles were calculated from the plots. The confidence intervals are useful as part of the weight-of-evidence supporting the overall most likely 99th percentile values using the alternative calculation methods. Some of the confidence intervals are quite wide at this extreme percentile value due to limited available data, especially if the percentages of non-detectable values are large.

The data were also examined to identify possible values that needed additional evaluation. These included:

- Off-site NL07 and NL22 values, especially for Zn, Mn, Pb, Fe, Cu, and Cr. These locations were determined not to represent background conditions and were therefore removed from the off-site data set.
- On-site SO_4 single very large value (64 mg/L at EPSW002BG01 collected on 2019-12-26 07:30:00, also has very high detection limit compared to other SO_4 values, indicating it was not analyzed using the standard procedures of the other samples). This sample was retained as it was determined to represent likely high on-site sulfate conditions.
- Off-site SO_4 very high concentration sites were reviewed, and several of the locations were removed as not representing similar geology as at SSFL.
- Off-site arsenic single very large value (44.9 µg/L conc at NL11, likely transcription or sampling error). This sample was removed.

The following table is a summary of the observations of these analyses, showing the sample numbers, numbers and percentages of non-detected results, the lower and upper values of the 95 percent confidence of the 99th percentile, the 99th percentile, the Anderson-Darling test statistic indicating how well the data fits the log-normal distribution (a low p value indicates a significant difference between the data plot and the fitted distribution), and location and scale values. The location relates to the relative absolute values of the plots, while the scale relates to the variability of the data and the slope of the probability distribution.

pH is different in that they were plotted on normal scales as the measurement is a log transformed value. Instead of location and slope, median and standard deviation are shown on those plots. Also, since pH criteria are expressed as an acceptable range, 1st percentiles were also calculated to represent the lower value for background conditions.

In many cases, the on-site and/or the off-site probability distributions show statistically significant departures from the fitted log-normal probability plots, based on the Anderson-Darling statistic. These conditions have greater uncertainty than for those distributions that have good fits and are high-lighted. In most cases, poor fits were associated with large fractions of the data not being detected. Previous research using the National Stormwater Quality Database indicated that non-detectable values greater

than about 15% of the data set can cause large departures of the fitted distributions and summary statistics. Therefore, those constituents having large fractions of non-detectable observations were also high-lighted on this table. The conditions having poor data fits to the log-normal probability distributions were also visually evaluated considering how well the confidence intervals described the upper range of the data, the range of most interest for these analyses of the 99th percentile values.

It should also be noted that the use of cumulative distribution functions (CDF) to identify high percentile values require large numbers of data to bracket the values of interest. This would require about 100, or more samples, more than available for these locations. The alternative is to use a fitted distribution (such as the log-normal distribution) to extrapolate the CDF. This is similar to the log-normal probability distributions presented here, but the CDF plots do not indicate confidence intervals.

Summary of Probability Distributions (bold fonts are for all data, regular fonts are possible alternatives)

Constituents of Potential Concern	# of samples	# (and percentage) of non-detected samples*	lower 95% CI at 99th percentile	upper 95% CI at 99th percentile	99th percentile	AD p**	Visual fit of upper region of distribution if low p***	Loc	Scale
Zn SSFL on-site	37	13 (35%)	71	266	137	0.08		2.47	1.06
Zn off-site	60	0 (0%)	233	1,000	492	0.23		2.54	1.18
SO_4 SSFL on-site	14	0 (0%)	46.7	748	186	<0.005	CI may overpredict values	2.10	1.35
SO_4 off-site	40	0 (0%)	335	1445	695	<0.005	CI may underpredict values	3.73	1.21
pH SSFL on-site – 99th	65	0 (0%)	8.58	9.38	8.97	0.27		6.9	0.67
pH off-site – 99th	11	0 (0%)	8.54	9.11	8.82	0.03	CI may overpredict values	8.3	0.25
pH SSFL on-site – 1st	65	0 (0%)	4.51	5.30	4.90	0.27		6.9	0.67
pH off-site – 1st	11	0 (0%)	7.37	7.96	7.66	0.03	CI may overpredict values	8.3	0.25
$NO_3 + NO_2$ SSFL on-site	24	2 (8%)	4.8	26.4	11.3	<0.005	CI may overpredict values	-0.14	1.11
$NO_3 + NO_2$ off-site	76	22 (28%)	18.2	132	50.1	<0.005	CI may overpredict values	-1.62	1.80
Mn SSFL on-site	21	6 (29%)	177	2,190	641	<0.005	CI may underpredict values	2.85	1.57
Mn off-site	30	1 (3%)	1,330	26,100	5,740	0.17		3.53	2.19
Pb SSFL on-site	62	14 (23%)	29.4	154	69.3	<0.005	CI may underpredict values	0.11	1.33
Pb off-site	30	4 (13%)	10.0	88.9	30.6	0.19		-0.36	1.62
Fe SSFL on-site	26	0 (0%)	16.5	296	71.0	0.38		-0.30	1.97
Fe off-site	30	0 (0%)	18.4	178	52.7	0.11		0.46	1.50
Gross alpha SSFL on-site	18	8 (44%)	6.59	24.3	12.8	<0.005	CI may underpredict values	0.86	0.73
Gross alpha off-site	35	1 (1%)	23.8	140	58.2	0.28		0.84	1.39
Cu SSFL on-site	50	0 (0%)	10.0	57.1	34.5	<0.005	CI may underpredict values	1.00	0.73
Cu off-site	30	0 (0%)	21.2	100	45.8	0.11		1.23	1.12
Cr SSFL on-site	24	16 (67%)	12.0	51.8	25.8	<0.005	CI may underpredict values	1.03	0.95
Cr off-site	30	0 (0%)	23.3	132	45.8	0.31		1.05	1.27
As SSFL on-site	26	19 (73%)	17.0	44.9	30.3	<0.005	Too variable	1.65	0.76
As off-site	29	0 (0%)	5.1	21.8	10.8	0.025	Good fit at upper values	0.07	0.99
Dioxin SSFL on-site	65	54 (83%)	1.2 X 10-9	1.7 X 10-8	4.3 X 10-9	<0.005	CI may underpredict values	-26.6	2.41
Dioxin off-site	12	4 (33%)	1.1 X 10-6	1.0	1.1 X 10-3	0.09		-20.84	6.14
Sb SSFL on-site	35	29 (83%)	0.8	1.3	1.0	<0.005	CI may underpredict values	-0.84	0.37
Sb off-site	30	7 (23%)	1.4	4.6	2.5	0.016	CI may overpredict values	-1.07	0.86

*excessive (>15%) non-detected percentages high-lighted

**poor fits ($p < 0.05$) to log-normal distributions high-lighted

***visual indication of fit of upper range of distribution, considering “stack” of non-detectable values at low distribution values

Observations by Constituent

The following comments summarize the observations for the constituents evaluated.

Zinc on-site and off-site probability distributions both had good fits (p = 0.08 and 0.23 respectively). However, 35% of the on-site data were not detected, while the off-site data set were all detected. The overall visual distributions look reasonable. It was also noted that two of the initial off-site locations (NL07 and NL22) had much larger concentrations than other locations. These two locations were subsequently removed as they were determined not to represent background conditions after reviewing the site location histories. NL22 was adjacent to SSFL and developed urban areas, while NL07 was determined to have historical industrial activity. The 95% confidence intervals (CIs) for on-site and off-site concentrations barely overlap at the 99th percentile, with the off-site value is 3.6 times greater than the on-site value at this high percentile.

All sulfate on-site and off-site observations were detected. However, the on-site distribution fit was poor due to a single extreme value (640 mg/L) in the on-site data set. This value was retained as it was confirmed and represent high on-site conditions. Sulfate off-site background concentrations were obtained from many locations. The data set has a poor log-normal distribution fit. The off-site locations were reviewed, and several were removed as not representing the sedimentary rock conditions found at SSFL. As noted, the combined off-site data plot had a poor fit, but likely represents the highest sulfate conditions on SSFL due to groundwater having high sulfates. The CI shown on the probability plot shows that it may underpredict the 99th percentile value.

pH values were plotted on normal scales on the probability distribution because pH is already a log measure of the hydrogen ion activity (molar concentration in dilute solutions). The p stands for -log10 and the H stands for hydrogen ion activity. Doing another log transformation of the pH values would result in an odd, double log distribution. All pH values were detected, with 65 available on site and 11 available at the off-site locations. The on-site distribution had a good fit, while the off-site locations had a poor fit to the normal probability distribution. The 1st percentile is also shown along with the 99th percentile ranges and values, as pH regulatory limits are usually specified as an acceptable range (such as 6 to 9). The CIs shown on the off-site plot appear to overpredict the 99th and 1st percentile values.

There were 24 nitrate plus nitrite on-site background values available, with 2 not detected, while there were 76 off-site nitrate plus nitrite values, with a much higher percentage of non-detected values (22 were not detected). Both on-site and off-site probability distributions had poor fits to the log-normal distributions. Even though the on-site data had few non-detected values, many were clustered in a narrow range. This behavior, like the many non-detected off-site values, resulted in a steep section on the distribution due to many values forming a vertical portion of the plot, making it difficult to fit the log-normal distribution. The poor fits result in greater uncertainty in the projected 99th percentile values. However, the CI for the on-site higher nitrate plus nitrite probability values appears to be a good fit, but with some curvature towards lower values. The off-site plot indicates that the fitted line generally passed through the majority of the sample values, but there was an obvious upward curvature in the data plot for the higher concentrations, with the confidence intervals possibly over-predicting the 99th percentile values.

There were no detected mercury concentrations available on-site (out of 24 samples) and off-site (out of 76 samples). It is therefore not possible to prepare probability distributions or determine 99th percentile values for mercury, except to note it is undetected (<0.1 µg/L which is the mercury reporting limit for these samples).

The on-site manganese data set included 21 samples, 6 with not detected values. The off-site data set included 30 samples, with only 1 not detected for manganese. The on-site data did not fit the log-normal distribution well (curvature towards higher values for the high percentiles, resulting in the CI possibly underpredicting the 99th percentile value), while the off-site data did have a good fit. As for many other off-site constituents, NL07 and NL22 off-site sampling locations were associated with many of the highest observed off-site concentrations for manganese. These were removed for the final off-site probability plot as they were determined not to represent background land use conditions. The on-site and off-site confidence intervals had some overlap at the high percentile values, with the off-site 99th percentile value about nine times greater than the on-site 99th percentile value.

Lead on-site data poorly fit the distribution (curvature towards higher values for the high percentiles, with the CI possibly underpredicting the 99th percentile value), while the off-site probability plot had a good fit. The 62 on-site lead samples had 14 non-detectable values, while the 30 off-site values had 4 non-detectable values. Again, the off-site NL07 and NL22 sampling locations were responsible for many of the highest off-set lead concentrations during the initial analyses. These were removed as not representing background land use conditions for the final off-site probability plot. There was substantial overlap of the on-site and off-site confidence intervals for lead and the on-site 99th percentile values were about double the off-site values (70 µg/L for on-site data and 30 µg/L for off-site data).

All on-site (26) and off-site (30) samples for iron were detected and both had good fits with the log-normal probability distribution. The on-site sampling locations were divided into high, intermediate, and low concentration categories, but their individual distribution confidence intervals had substantial overlaps and the Kruskal-Wallis one way analysis of variance on ranks test did not show any significant difference in the three groups. They were combined for the on-site plot. The off-site data also had high iron associated with NL07 and NL22 locations, which were removed as not representing background locations due to land use. The on-site and off-site confidence intervals for iron had substantial overlap, and the on-site 99th percentile value was about double the off-site 99th percentile value.

Gross alpha was represented with 18 on-site samples (8 not detected) and 35 off-site samples (1 not detected). The on-site data did not fit the distribution well, likely due to many non-detected values falling outside of the confidence interval. The CI band may underpredict the 99th percentile value. The off-site gross alpha values also did fit the distribution well. Neither the on-site nor the off-site gross alpha sampling locations had apparent differences due to sampling locations. The two confidence intervals were close at the 99th percentile value. The off-site 99th percentile gross alpha value was about 4.5 times the on-site 99th percentile value.

There were 50 on-site copper and 30 off-site copper observations, all detected. The on-site data did not fit the distribution well (much curvature in the plot, with the CI possibly underpredicting the 99th percentile value), while the off-site data had a good fit. The on-site data locations were separated into

low and medium concentration groups (after removing the high NL07 and NL22 location data due to land use issues). The Mann-Whitney statistical tests indicated a significant difference between these two on-site copper groups. They were combined into one probability distribution to represent the range of on-site concentrations at the site. The off-site NL07 and NL22 were removed as not representing background land use conditions. There was a small overlap of the confidence intervals at high percentile values between the on-site and off-site probability distribution plots. The 99th percentile off-site copper value was about 1.3 times the on-site 99th percentile value.

There were 24 on-site chromium observations (16 non-detected) and 30 off-site chromium observations (all detected). The on-site values had a poor fit to the probability distribution (likely due to the large number of non-detected values, with the CI possibly underpredicting the 99th percentile value), while the off-site data had a good fit. Again, offsite NL07 and NL22 were removed as not representing background land use conditions. There was a small overlap in the confidence intervals at the 99th percentile, and the off-site 99th percentile value was about twice the on-site 99th percentile value.

Arsenic was represented with 26 on-site samples, but most (19) were not detected. In contrast, the 29 off-site arsenic observations were all detected. Both probability distributions had poor fits. The on-site data had much variability with few detected values and therefore a large amount of uncertainty in the 99th percentile value. A single very large off-site value (44.9 µg/L at NL11) was removed from the off-site data along with the NL07 and NL22 locations as not being representative of background land use conditions (although their concentrations were not significantly different from the other off-site arsenic data, in contrast to the other constituents). The upper end of the off-site probability plot appears to be a good fit. There was a slight overlap in the on-site and off-site confidence intervals at the high percentile values, with the on-site 99th percentile value about three times greater than the off-site 99th percentile value.

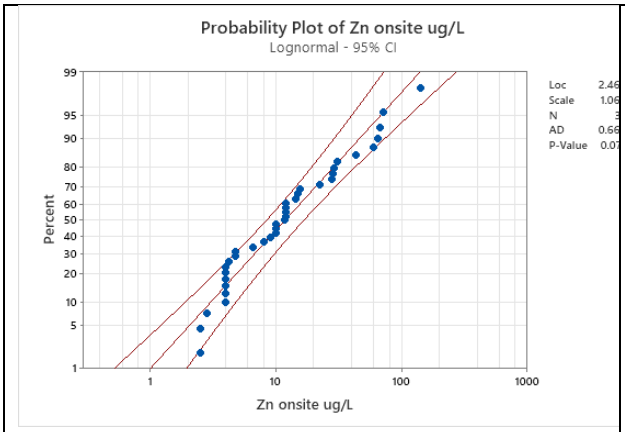
Dioxin (TCDD TEQ (no DEQ)) was represented by 65 on-site values, but almost all (54) were not detected. There were 12 off-site dioxin values, with 4 not detected. The probability distribution fit for the on-site data was poor, due to the large number of non-detected values (the on-site CI may underpredict the 99th percentile value), while the off-site data had an acceptable fit. The off-site data were from commercial and residential areas. The dioxin median concentration for the commercial locations was greater than the residential location median value, but their box and whisker plots had substantial overlaps and they were not significantly different (Mann-Whitney rank sum test $p = 0.94$). They were combined into one probability distribution for determining the off-site 99th percentile value. The resulting confidence interval and value for the off-site dioxin 99th percentile is very large, due to the large variation in the values and the few observations. The scale term relating to the probability line slope and data range is very large compared to the other constituents and extrapolating to the 99th percentile values with only 12 off-site data observations results in greater uncertainty than for the other constituents, especially with 4 non-detected observations.

Antimony was represented by 35 on-site observations, but almost all (29) were not detected. There were 30 off-site antimony observations with 7 non-detected values. Both sets of data had poor fits with the log-normal probability distributions. NL07 and NL22 location data were removed due to not representing background land use conditions. The three location groupings for the off-site antimony

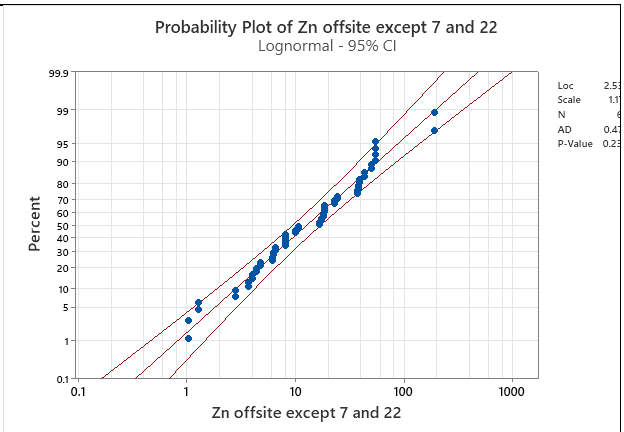
observations were combined to represent the overall concentration range on the off-site probability plot. The on-site CI may underpredict the 99th percentile value while the off-site CI may overpredict the 99th percentile value. The on-site and off-site confidence intervals were close at the high percentile values and the off-site 99th percentile value was 2.5 times the on-site 99th percentile value.

Calculated Confidence Intervals

Zinc



SSFL on-site

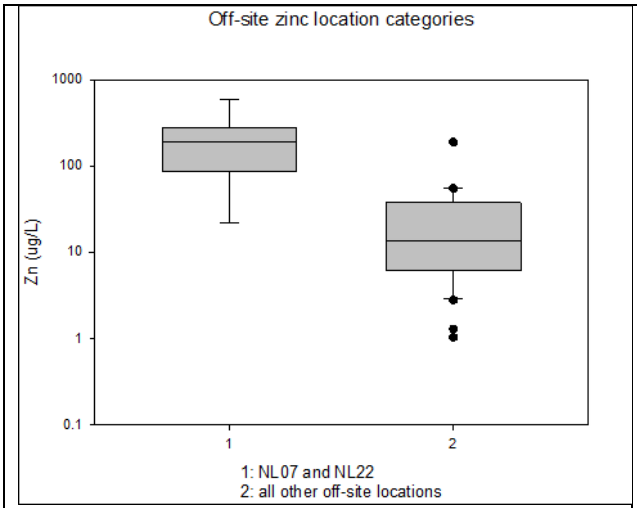


Off-site without NL07 and NL22

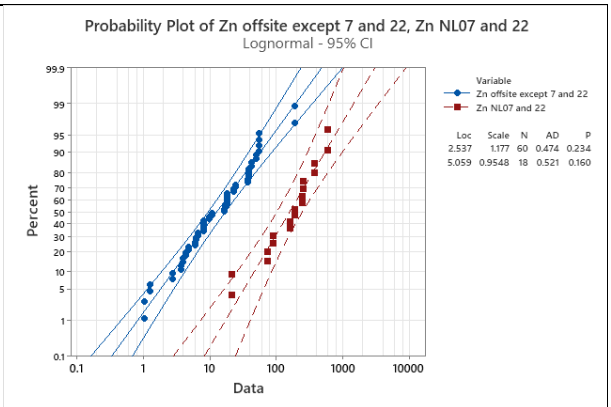
Zinc on-site and off-site concentrations (µg/L)

	# of samples	# of non-detected samples	lower 95% CI at 99th percentile	upper 95% CI at 99th percentile	99th percentile	AD p	Loc	Scale
Zn SSFL on-site	37	13	71	266	137	0.08	2.47	1.06
Zn Off-site w/o NL07 and NL22	60	0	233	1,000	492	0.23	2.54	1.18

Significant groupings of sites for zinc concentrations (p = <0.001)



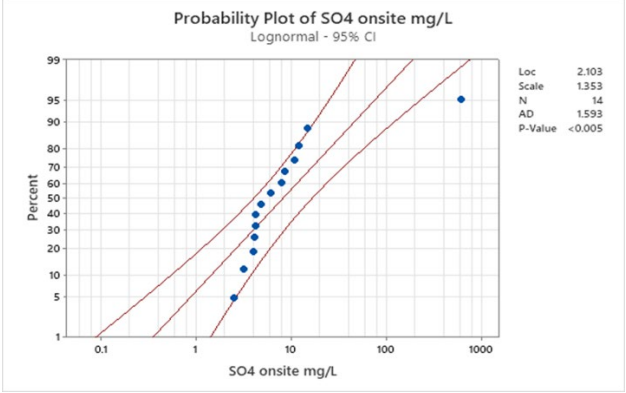
Mann-Whitney Rank Sum Test p<0.001



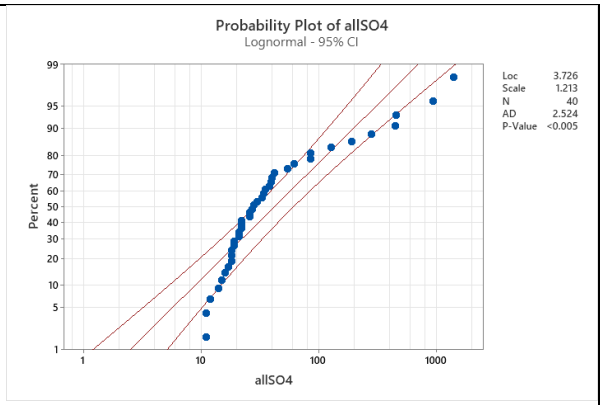
	Zn NL07 and 22	Zn offsite except 7 and 22
count	18	60
minimum	21.7	1.03
maximum	596	189
average	222	24.3
COV	0.77	1.44

NL07 and NL22 have significantly higher zinc concentrations than the other sites. These were removed for the final probability distribution as they were determined not to represent background land use conditions.

Sulfates



SSFL on-site



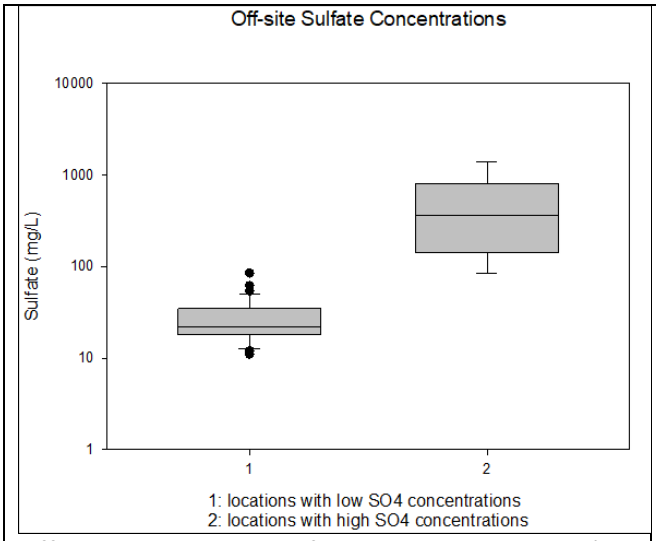
Off-site

Sulfate on-site and off-site concentrations (mg/L)

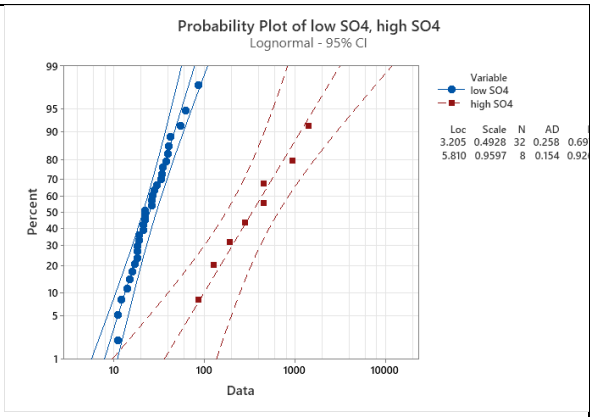
	# of samples	# of non-detected samples	lower 95% CI at 99th percentile	upper 95% CI at 99th percentile	99th percentile	AD p	Loc	Scale
SO_4 SSFL on-site	14	0	46.7	748	186	<0.005	2.10	1.35
SO_4 off-site	40	0	335	1445	695	<0.005	3.73	1.21

Off-site locations having low sulfate concentrations and sites having much larger sulfate concentrations

Off-site low sulfate values (11 to 85 mg/L; median 22 mg/L)	Off-site very high sulfate values (85 to 1400 mg/L; median 363mg/L)
• Arroyo de la Cruz at Highway 1 • Big Sur River at Andrew Molera foot bridge • Gazos Creek Lagoon at Highway 1 • Little Sur River @ Hwy 1 • Mill Creek @ Mill Creek Picnic Area • San Carpoforo Creek @ Hwy 1 • San Simeon Creek at San Simeon Creek Road • Scott Creek Lagoon at Highway 1 • Waddell Creek Lagoon at Highway 1 • Willow Creek at Highway 1	• Cuyama River at Highway 33 • Jalama Creek at County Park at RR trussells • Santa Ynez River at Paradise Road



Off-site low and high sulfate concentration sites*

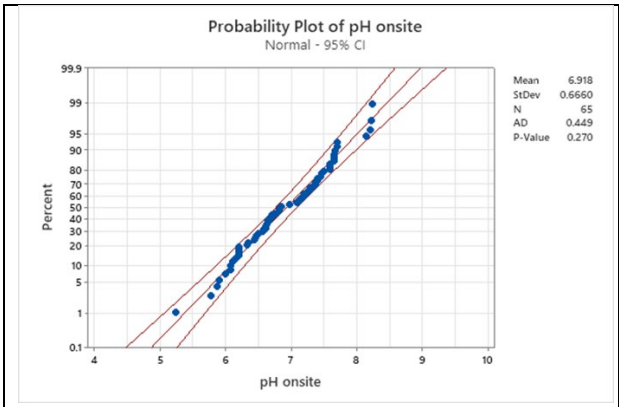


Off-site sulfate low and high concentration sites*

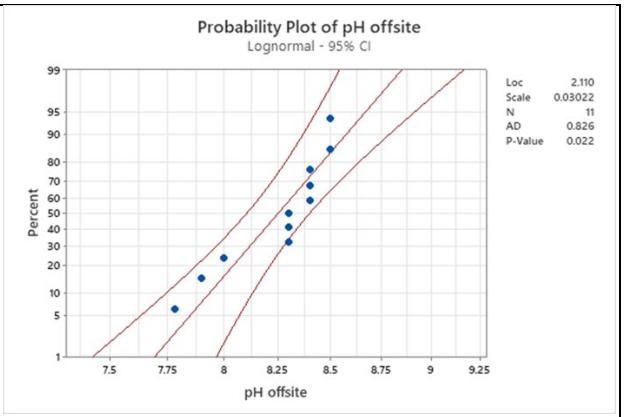
The fitted off-site sulfate probability plot with all data underpredicts the values for high probability values (>80%). The combined data set locations represent the geology and hydrogeology conditions at SSFL.

	# of samples	# of non-detected samples	lower 95% CI at 99th percentile	upper 95% CI at 99th percentile	99th percentile	AD p	Loc	Scale
SO_4 SSFL off-site low concentration sites	32	0	53	105	74	0.26	3.21	0.49
SO_4 off-site high concentration sites	8	0	805	12,000	3,090	0.15	5.81	0.96

pH



Note the "normal" scale for pH values SSFL on-site



Off-site

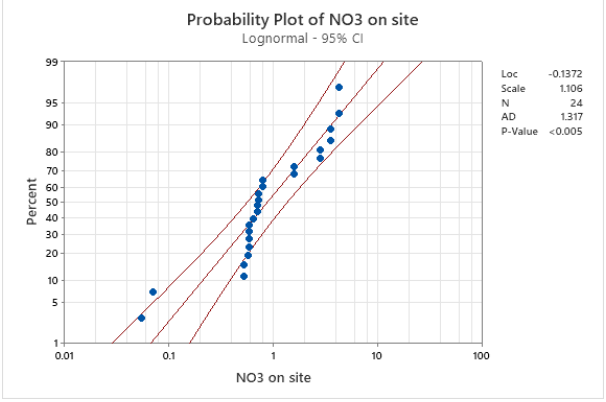
pH on-site and off-site concentrations (99th percentiles)

	# of samples	# of non-detected samples	lower 95% CI at 99th percentile	upper 95% CI at 99th percentile	99th percentile	AD p	Mean	Standard deviation
pH SSFL on-site	65	0	8.58	9.38	8.97	0.27	6.9	0.67
pH off-site	11	0	8.54	9.11	8.82	0.03	8.3	0.25

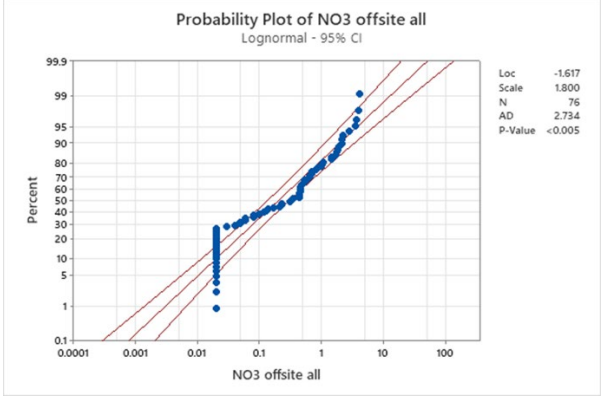
pH on-site and off-site concentrations (1st percentiles)

	# of samples	# of non-detected samples	lower 95% CI at 1st percentile	upper 95% CI at 1st percentile	99th percentile	AD p	Mean	Standard deviation
pH SSFL on-site	65	0	4.51	5.30	4.90	0.27	6.9	0.67
pH Off-site	11	0	7.37	7.96	7.66	0.03	8.3	0.25

Nitrate plus nitrite



SSFL on-site



Off-site

Note: the plots only show NO_3 labels, but actually represent NO_3+NO_2

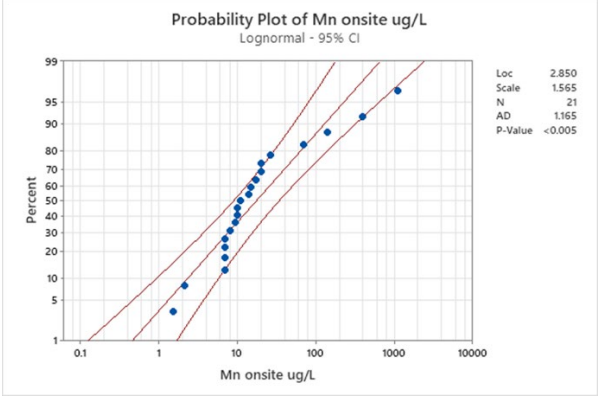
Nitrates on-site and off-site concentrations (mg/L)

	# of samples	# of non-detected samples	lower 95% CI at 99th percentile	upper 95% CI at 99th percentile	99th percentile	AD p	Loc	Scale
NO_3 + NO_2 SSFL on-site	24	2	4.8	26.4	11.3	<0.005	-0.14	1.11
NO_3 + NO_2 off-site	76	22	18.2	132	50.1	<0.005	-1.62	1.80

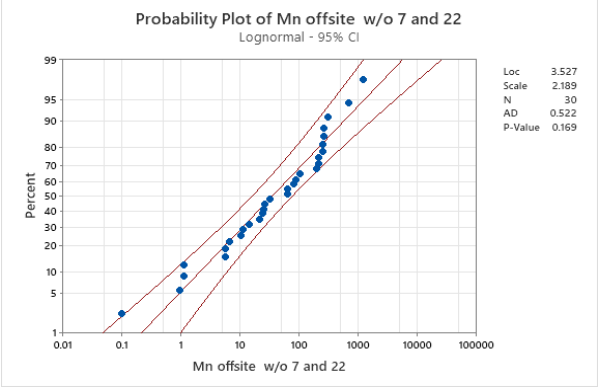
Mercury

SSFL on-site mercury values were all non-detected (44 samples, all <0.1 µg/L, the reporting limit).
Off-site mercury values were also all non-detected (39 samples, all <0.1 µg/L, the reporting limit).

Manganese



SSFL on-site

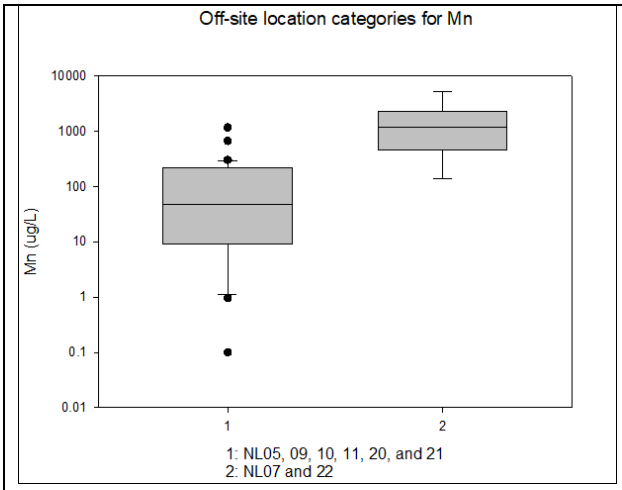


Off-site without NL07 and NL22 locations

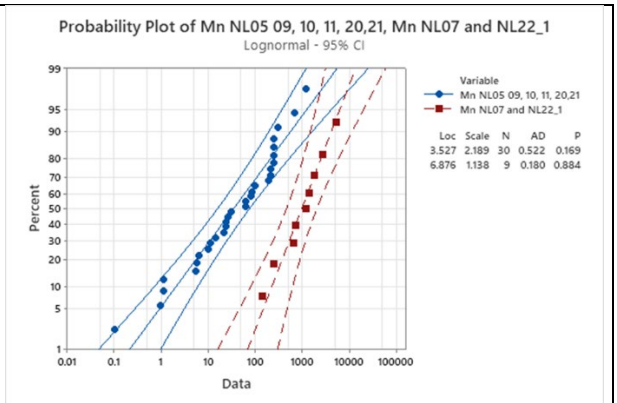
Manganese on-site and off-site concentrations (µg/L)

	# of samples	# of non-detected samples	lower 95% CI at 99th percentile	upper 95% CI at 99th percentile	99th percentile	AD p	Loc	Scale
Mn SSFL on-site	21	6	177	2,190	641	<0.005	2.85	1.57
Mn off-site without NL07 and NL22	30	1	1,330	26,100	5,740	0.17	3.53	2.19

NL07 and NL22 locations compared to other off-site locations:



NL07 and NL22 high concentration locations vs all other off-site Mn concentrations

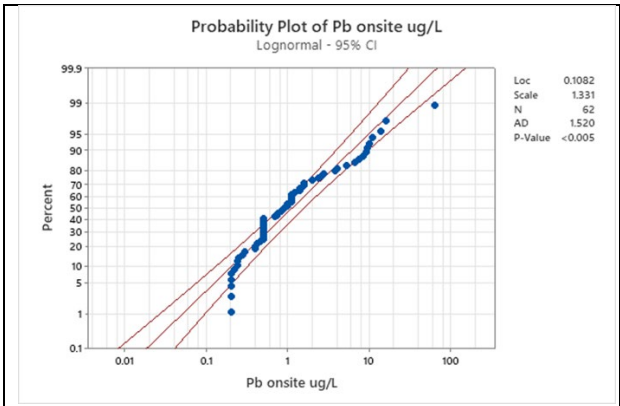


Mann-Whitney p <0.001

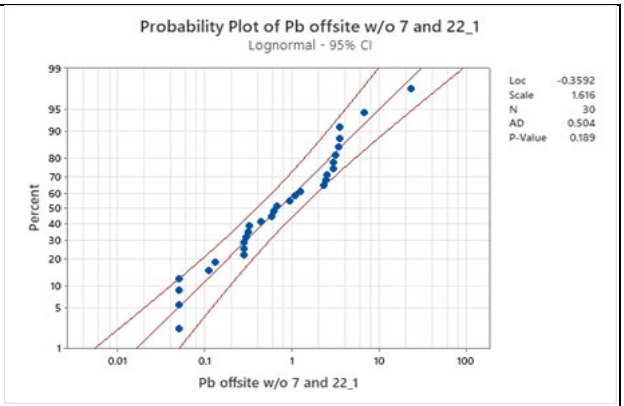
	Mn NL05 09, 10, 11, 20,21	Mn NL07 and NL22
count	30	9
minimum	0.1	142
maximum	1,180	5,340
average	145	1,585
COV	1.68	1.02

NL07 and NL22 have significantly higher manganese concentrations than the other sites. These were removed for the final probability distribution as they were determined not to represent background land use conditions.

Lead



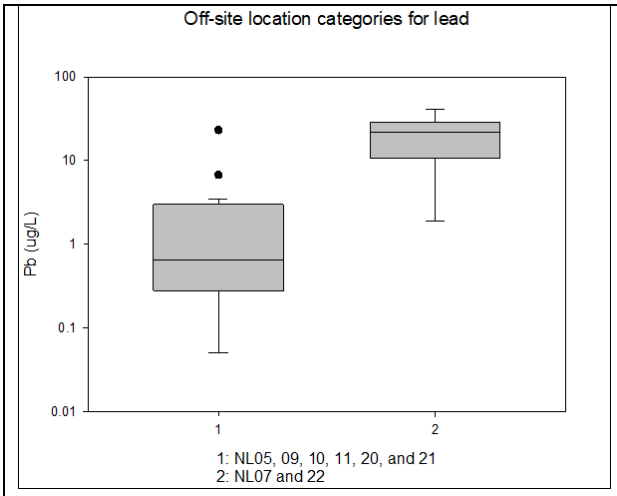
SSFL on-site



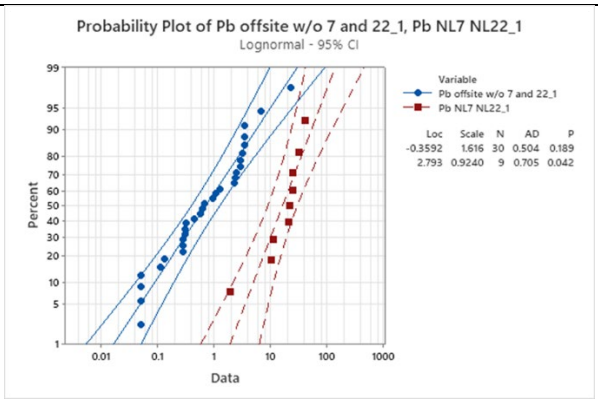
Off-site without NL07 and NL22 locations

Lead on-site and off-site concentrations (µg/L)

	# of samples	# of non-detected samples	lower 95% CI at 99th percentile	upper 95% CI at 99th percentile	99th percentile	AD p	Loc	Scale
Pb SSFL on-site	62	14	29.4	154	69.3	<0.005	0.11	1.33
Pb off-site without NL07 and NL22	30	4	10.0	88.9	30.6	0.19	-0.36	1.62



Different off-site location categories

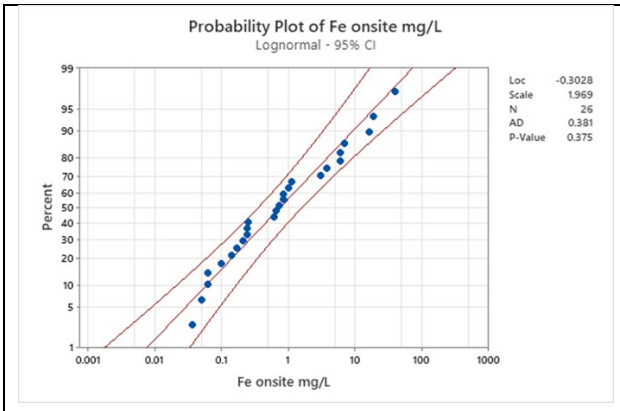


Mann-Whitney p <0.001

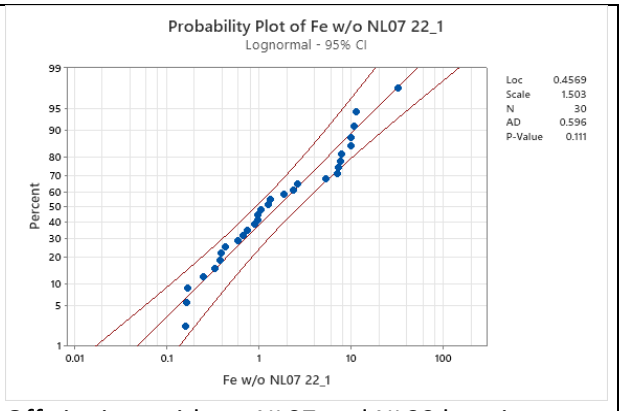
	Pb all off-site w/o 7 and 22	Pb NL7 NL22
count	24	9
minimum	0.1	1.9
maximum	23.2	41.3
average	2.2	21.1
COV	1.99	0.57

NL07 and NL22 have significantly higher lead concentrations than the other sites. These were removed for the final probability distribution as they were determined not to represent background land use conditions.

Iron



SSFL on-site



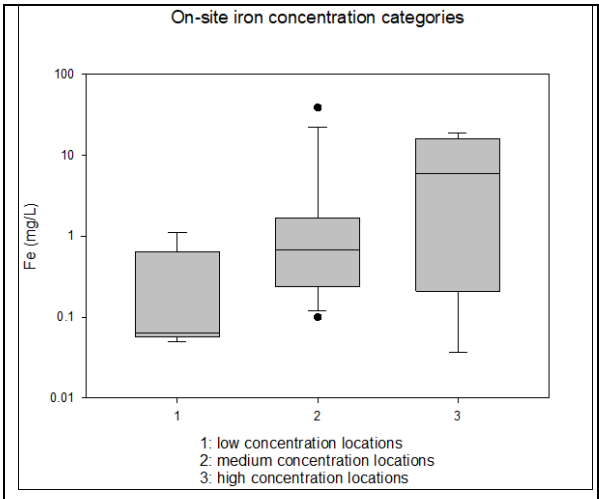
Off-site iron without NL07 and NL22 locations

Iron on-site and off-site concentrations (mg/L)

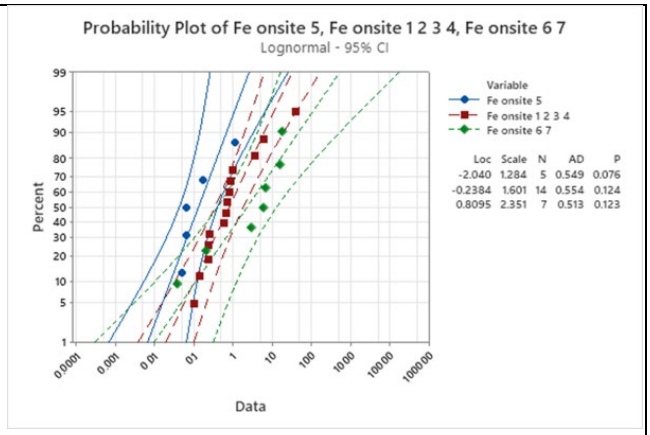
	# of samples	# of non-detected samples	lower 95% CI at 99th percentile	upper 95% CI at 99th percentile	99th percentile	AD p	Loc	Scale
Fe SSFL on-site	26	0	16.5	296	71.0	0.38	-0.30	1.97
Fe off-site without NL07 and NL22	30	0	18.4	178	52.7	0.11	0.46	1.50

Locations for on-site iron concentrations were grouped into three subcategories, corresponding to low, medium, and high concentrations.

Low (0.05 to 1.1 mg/L; median of 0.06 mg/L)	Medium (0.1 to 39 mg/L; median of 0.69 mg/L)	High (0.04 to 19 mg/L; median of 6 mg/L)
EPNDSW05	BGBMP0002 BGBMP0003 BGBMP0004 BGBMP0007	EPSW002BG01 Outfall 008



SSFL on-site

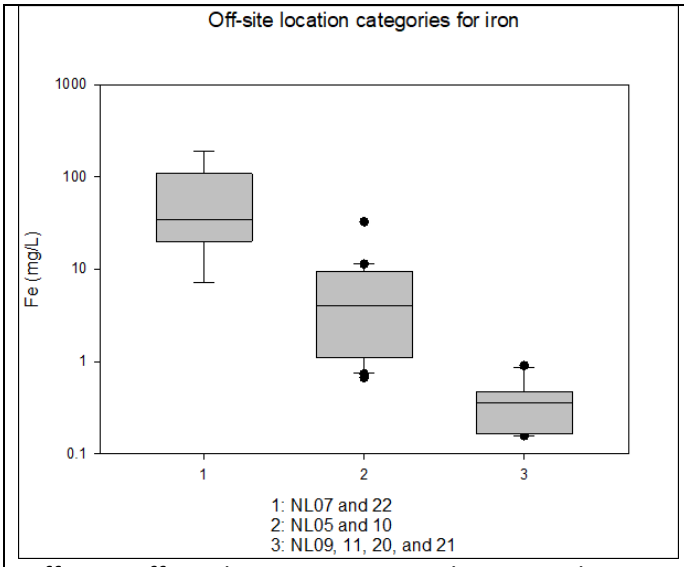


SSFL on-site

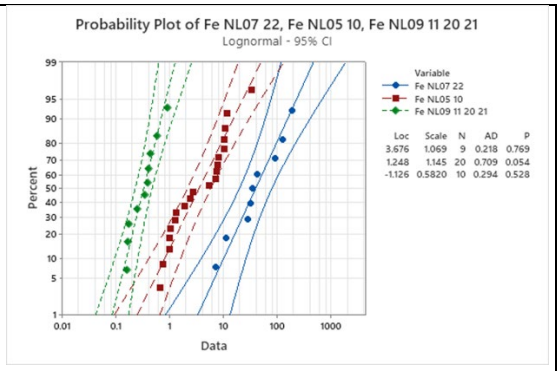
The three on-site iron concentration categories had median concentration differences of about 10X (0.06, 0.69, and 6 mg/L). However, when plotted on a grouped bar and whisker plot and on a grouped probability plot, the data show much overlapping. The Kruskal-Wallis One Way Analysis of Variance on Ranks test reported a p = 0.06, which was not lower than the 0.05 critical value usually used to indicate significant differences. Therefore, the differences in the median values between the treatment groups are not great enough to exclude the possibility that the differences are due to random sampling

variability for the number of data observations available. However, it is possible that continued monitoring at these locations may indicate significant differences when the sample numbers increase. These three categories were combined to represent the range of on-site iron concentrations.

Iron concentrations at NL07 and NL22 were compared to iron concentrations at other off-site locations:



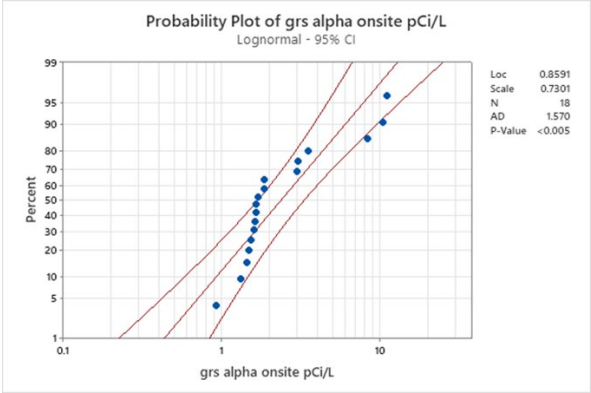
Different off-site locations. Mann-Whitney Rank Sum Test p = <0.001 for 2 smallest groups



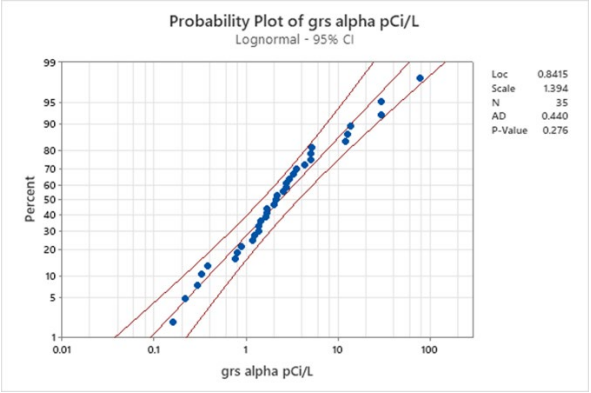
	Fe NL07 22	Fe NL05 10	Fe NL09 11 20 21
count	9	20	10
minimum	7.2	0.7	0.2
maximum	189.0	32.6	0.9
average	62.4	6.2	0.4
COV	0.98	1.18	0.61

NL07 and NL22 site iron concentrations were much greater than the other sites. They were removed due to their land use not representing background land use conditions. NL05 and NL10 were also significantly greater than NL09, NL11, NL20, and NL21, but were combined for the off-site iron concentration probability plot to represent the range of concentrations observed.

Gross Alpha



SSFL on-site

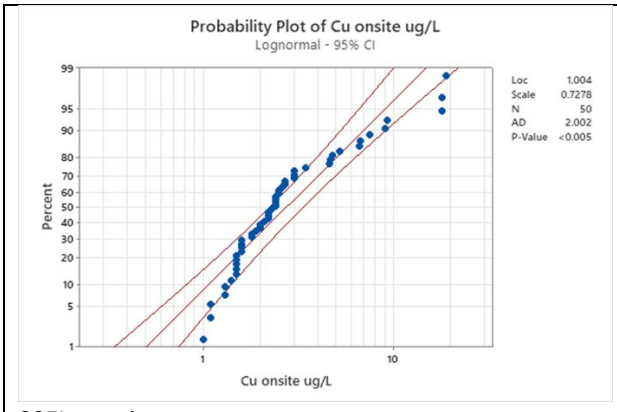


Off-site

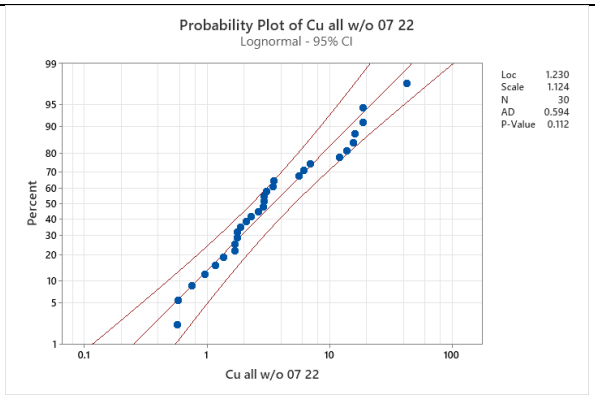
Gross alpha on-site and off-site concentrations (pCi/L)

	# of samples	# of non-detected samples	lower 95% CI at 99th percentile	upper 95% CI at 99th percentile	99th percentile	AD p	Loc	Scale
Gross alpha SSFL on-site	18	8	6.59	24.3	12.8	<0.005	0.86	0.73
Gross alpha off-site	35	1	23.8	140	58.2	0.28	0.84	1.39

Copper



SSFL on-site



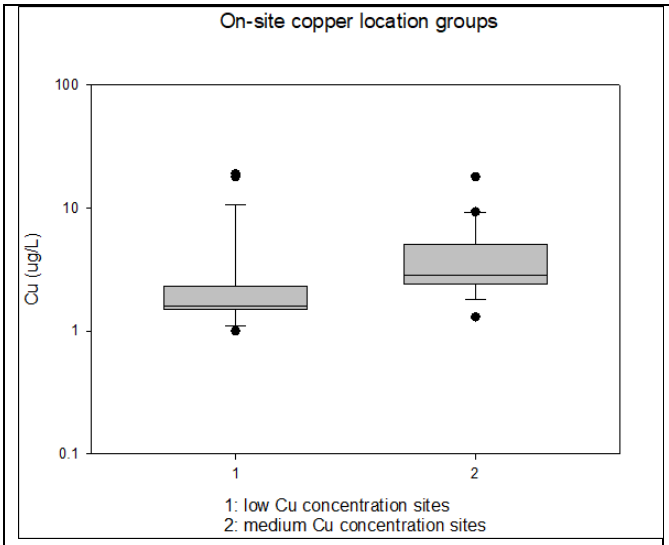
Off-site without NL07 and NL22 locations

Copper on-site and off-site concentrations (µg/L)

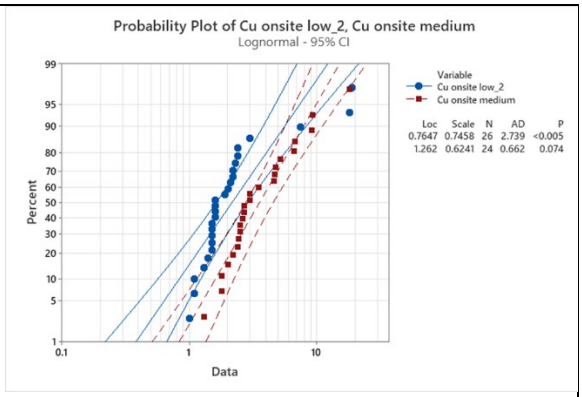
	# of samples	# of non-detected samples	lower 95% CI at 99th percentile	upper 95% CI at 99th percentile	99th percentile	AD p	Loc	Scale
Cu SSFL on-site	50	0	10.0	57.1	34.5	<0.005	1.00	0.73
Cu off-site without NL07 and NL22	30	0	21.2	100	45.8	0.11	1.23	1.12

Significantly different on-site locations for copper (p = <0.001)

Low concentrations (1 to 19 µg/L; median 1.6 µg/L)	Medium concentrations (1.3 to 18 µg/L; median 2.85 µg/L)
BGBMP0002 BGBMP0007 EPNDSW05 EPSW001BG01 HZSW0011 LXBMP0011 LXSW0001 LXSW0003	BGBMP0003 BGBMP0004 Outfall 008



SSFL Cu on-site sample groups box and whisker plots (Mann-Whitney rank sum test p <0.001)

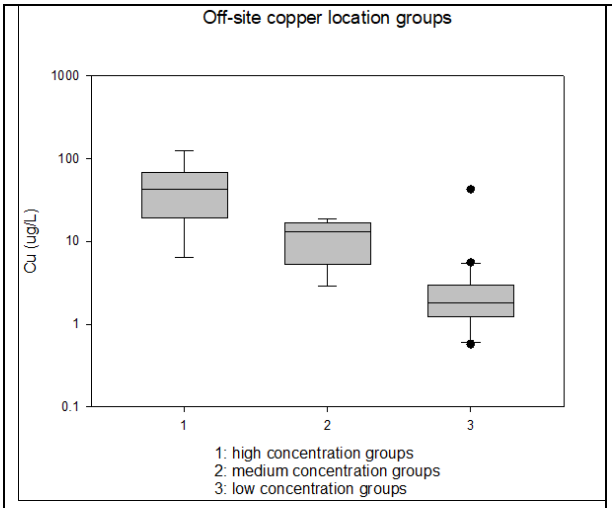


SSFL Cu on-site sample group probability plots

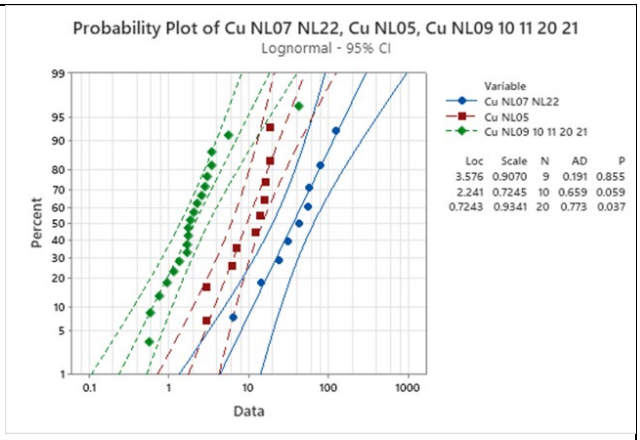
Two on-site location groups were identified that represent low copper concentrations and medium concentrations. The box and whisker plots show distinct groupings, while the grouped probability plots show substantial overlapping of the 95% confidence intervals (but with poor fits to the log-normal probability distribution). The Mann-Whitney statistical test indicated the median concentrations of

these two site groups were significantly different. These were all combined for the on-site copper probability distribution to represent the range of on-site concentrations.

Off-site location groups



Off-site location categories Kruskal-Wallis one way analysis of variance on ranks p <0.001



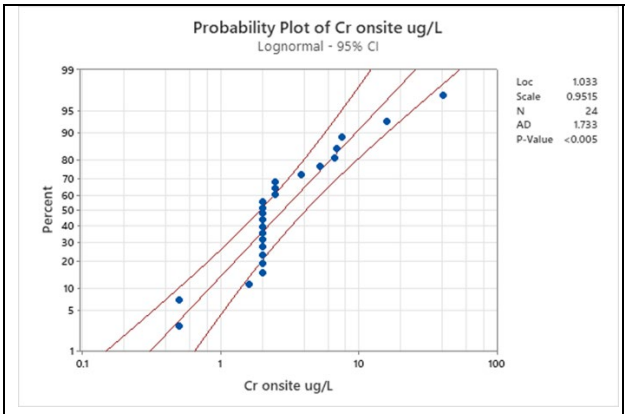
	Cu NL07 NL22	Cu NL05	Cu NL09 10 11 20 21
count	9	10	20
minimum	6.5	2.9	0.6
maximum	126.0	18.7	42.8
average	48.5	11.4	4.1
COV	0.76	0.54	2.23

NL07 and NL22 off-site copper concentrations were much greater than the other off-site locations. They were removed due to their land use not representing background land use conditions. NL05 was also significantly greater than NL09, NL10, NL11, NL20, and NL21, but were all combined for the off-site copper concentration probability plot to represent the range of concentrations observed.

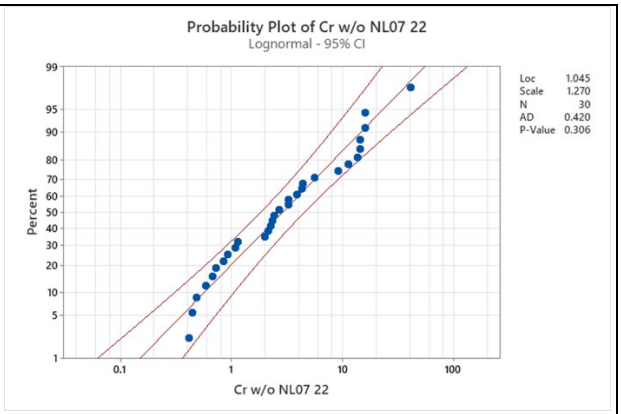
Chromium

Chromium on-site and off-site concentrations (µg/L)

	# of samples	# of non-detected samples	lower 95% CI at 99th percentile	upper 95% CI at 99th percentile	99th percentile	AD p	Loc	Scale
Cr SSFL on-site	24	16	12.0	51.8	25.8	<0.005	1.03	0.95
Cr off-site without NL07 and NL22	30	0	23.3	132	45.8	0.31	1.05	1.27

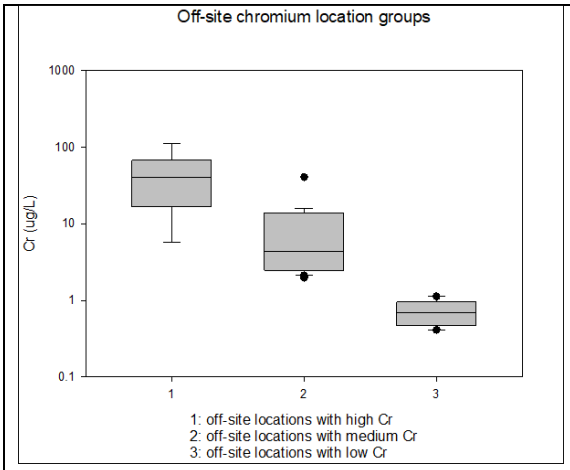


SSFL on-site

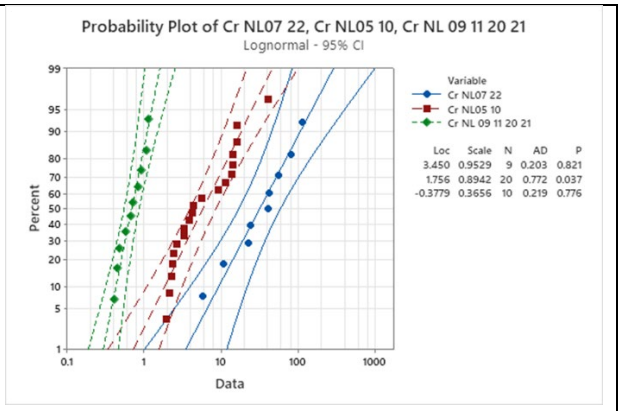


Off-site without NL07 and NL22 locations

Off-site chromium location categories



Off-site Cr location categories (Kruskal-Wallis One Way Analysis of Variance on Ranks p <0.001)



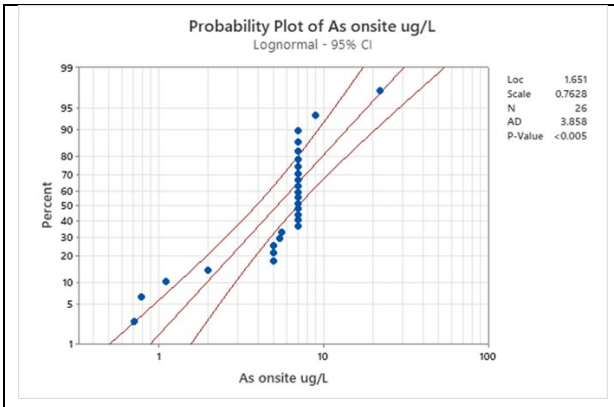
	Cr NL07 22	Cr NL05 10	Cr NL 09 11 20 21
count	9	20	10
minimum	5.7	2.0	0.4
maximum	114.0	40.9	1.1
average	44.2	8.7	0.7
COV	0.79	1.06	0.36

NL07 and NL22 off-site chromium concentrations were much greater than the other locations. They were removed as they did not represent background land use conditions. NL05 and NL10 were also significantly greater than NL09, NL11, NL20, and NL21, but were combined for the off-site chromium concentration probability plot to represent the range of concentrations observed.

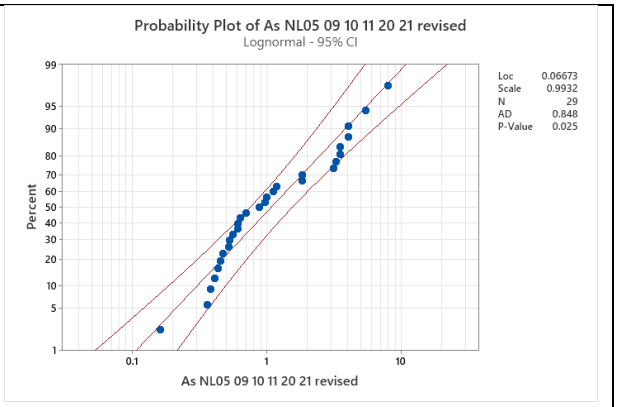
Arsenic

Arsenic on-site and off-site concentrations (µg/L)

	# of samples	# of non-detected samples	lower 95% CI at 99th percentile	upper 95% CI at 99th percentile	99th percentile	AD p	Loc	Scale
As SSFL on-site	26	19	17.0	44.9	30.3	<0.005	1.65	0.76
As off-site w/o single large value and NL07 and NL22	29	0	5.1	21.8	10.8	0.025	0.07	0.99

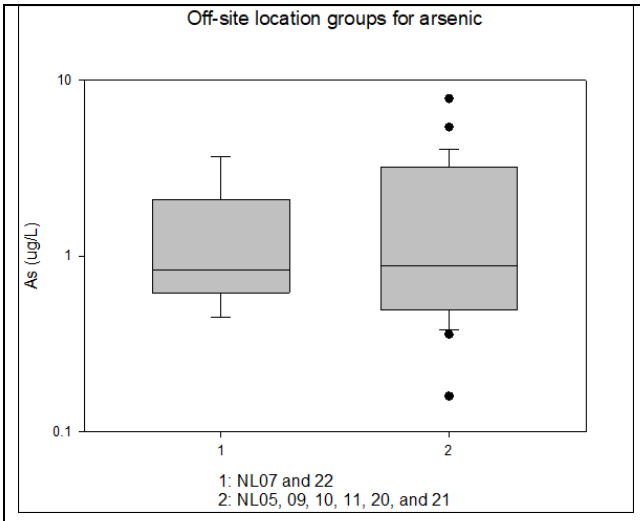


SSFL on-site

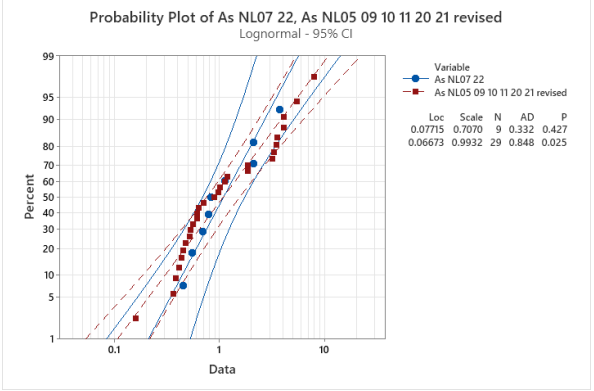


Off-site without NL07 and NL22 locations*

*without single very large value (44.9 µg/L conc at NL11, a likely transcription error)



Off-site arsenic concentrations (NL07 and 22 vs others) Mann-Whitney Rank Sum Test p = 0.74



Off-site location categories w/o large value

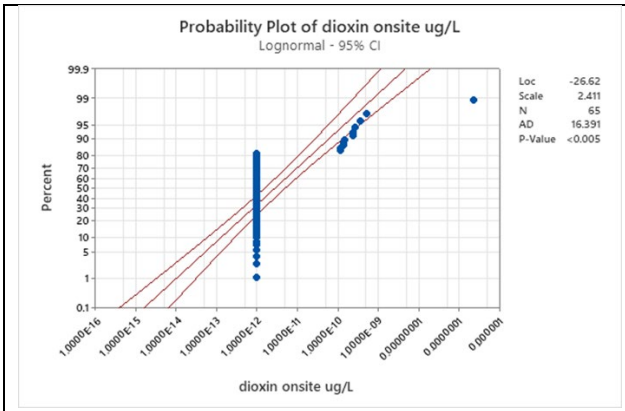
	As NL07 22	As NL05 09 10 11 20 21 revised	As all sites
count	9	29	38
minimum	0.45	0.16	0.16
maximum	3.70	7.90	7.90
average	1.37	1.74	1.65
COV	0.78	1.07	1.03

NL07 and NL22 arsenic concentrations had lower average and maximum concentrations compared to the other off-site locations. Mann-Whitney p = 0.74 indicating no significant difference, but they were removed from the off-site data set as their land uses were not in the background category.

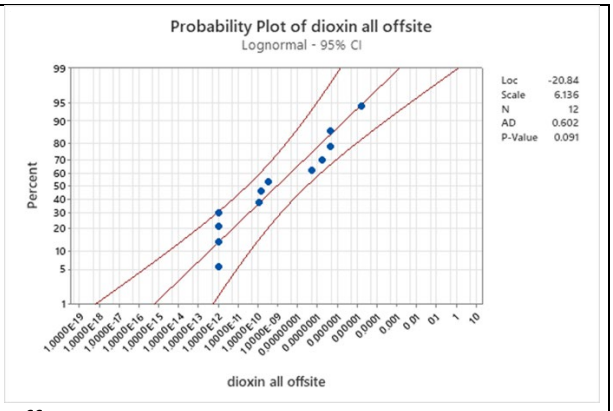
Dioxin (TCDD TEQ (no DNQ))

Dioxin on-site and off-site concentrations (µg/L)

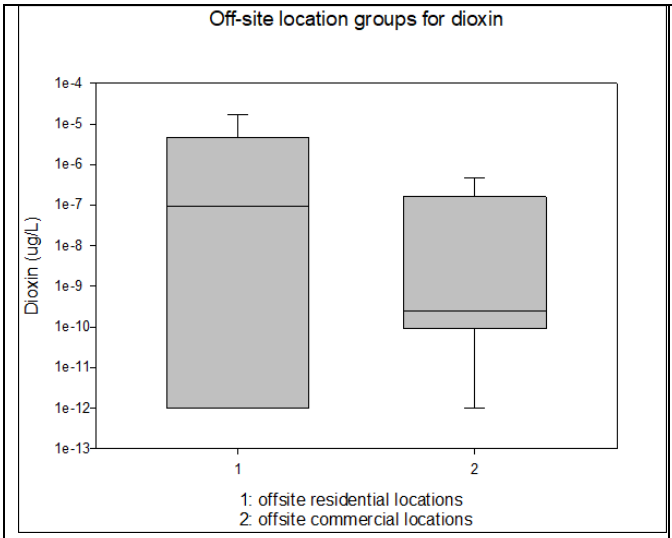
	# of samples	# of non-detected samples	lower 95% CI at 99th percentile	upper 95% CI at 99th percentile	99th percentile	AD p	Loc	Scale
Dioxin SSFL on-site	65	54	1.2×10^{-9}	1.7×10^{-8}	4.3×10^{-9}	<0.005	-26.6	2.41
Dioxin off-site	12	4	1.1×10^{-6}	1.0	1.1×10^{-3}	0.09	-20.84	6.14



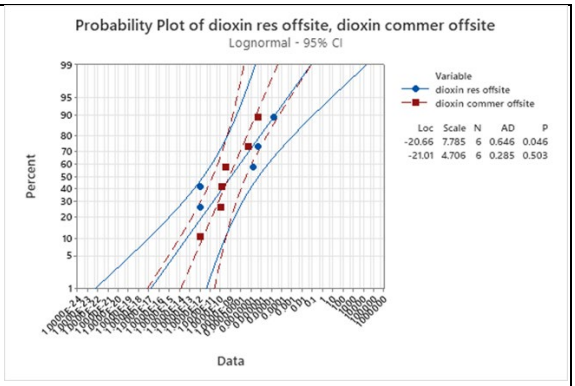
SSFL on-site



Off-site



Commercial vs. residential locations. Mann-Whitney Rank Sum Test p = 0.94



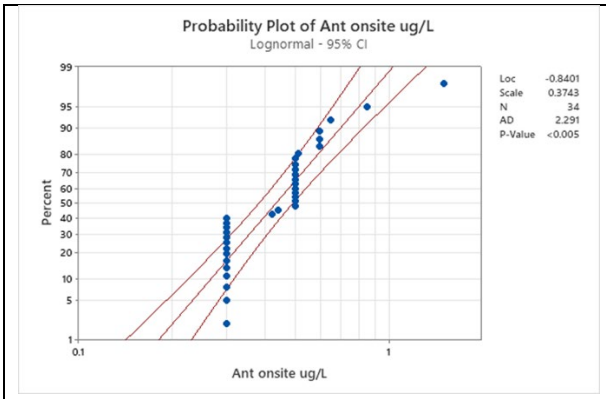
	dioxin residential offsite	dioxin commercial offsite
count	6	6
minimum	1E-12	1E-12
maximum	1.68E-05	4.8E-07
average	2.91E-06	8.95E-08
COV	2.34	2.15

The off-site commercial and residential dioxin concentrations were not significantly different due to the large overlap of their data ranges. There were combined to represent the range of off-site dioxin concentrations expected.

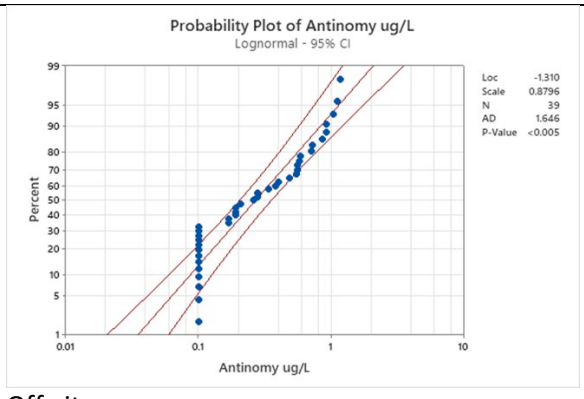
Antimony

Antimony on-site and off-site concentrations (µg/L)

	# of samples	# of non-detected samples	lower 95% CI at 99th percentile	upper 95% CI at 99th percentile	99th percentile	AD p	Loc	Scale
Sb SSFL on-site	35	29	0.8	1.3	1.0	<0.005	-0.84	0.37
Sb off-site	30	7	1.4	4.6	2.5	0.016	-1.07	0.86

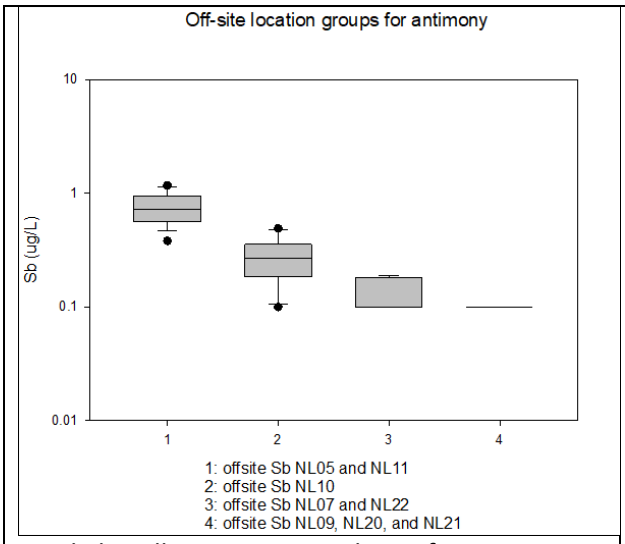


SSFL on-site

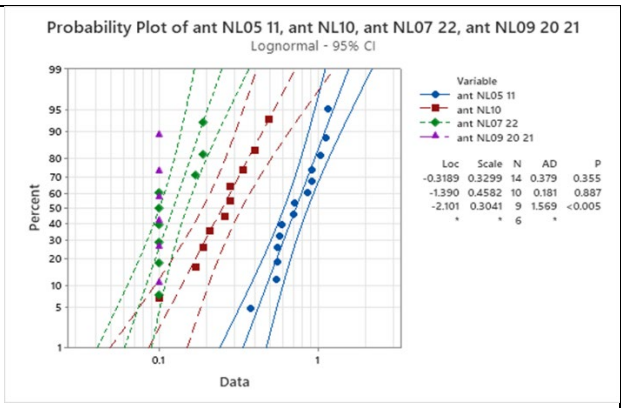


Off-site

Off-site antimony categories



Kruskal-Wallis One Way Analysis of Variance on Ranks p = 0.001



	ant NL05 11	ant NL10	ant NL07 22	ant NL09 20 21
count	14	10	9	6
minimum	0.38	0.10	0.10	0.10
maximum	1.17	0.49	0.19	0.10
average	0.76	0.27	0.13	0.10
COV	0.32	0.42	0.33	0.00

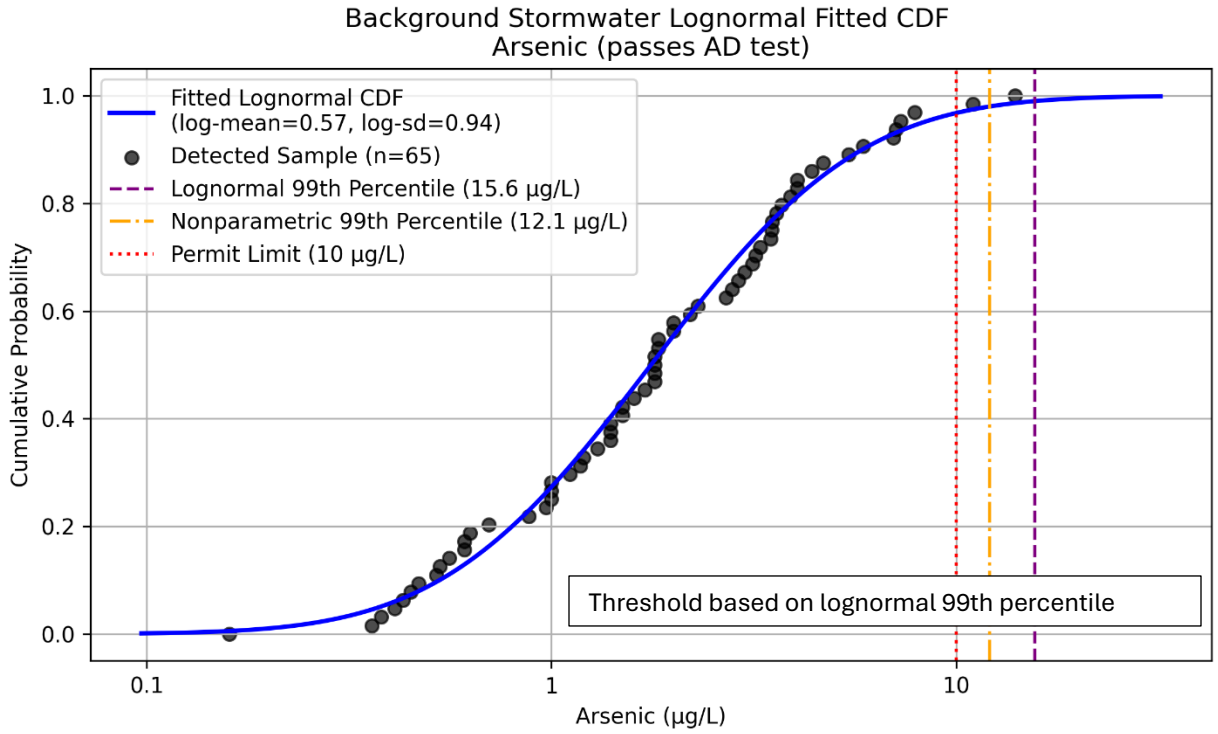
The four off-site antimony location categories had at least one significant difference. The NL07 and NL22 locations were removed as they did not represent background land use conditions. With NL07 and NL22 removed, the remaining three off-site categories still had at least one significant difference. These three location categories were combined to represent the overall off-site antimony concentration range.

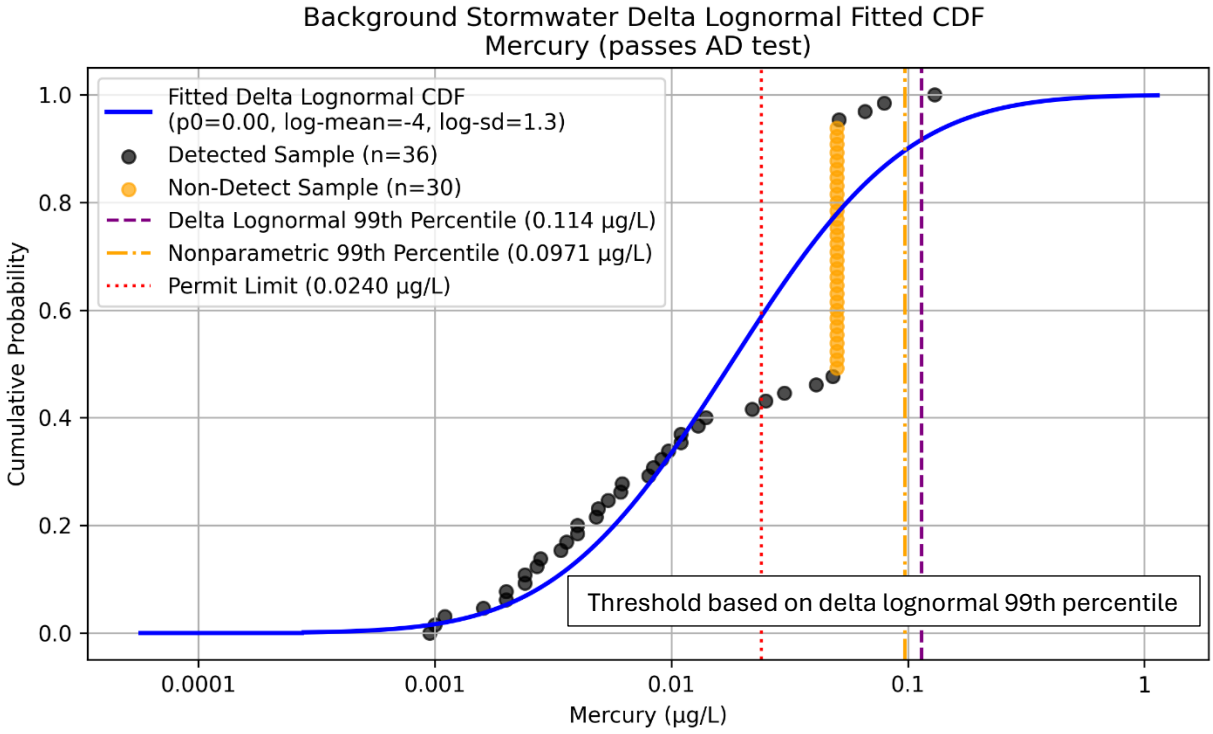
ATTACHMENT C – EXAMPLE ANALYTE DISTRIBUTIONS

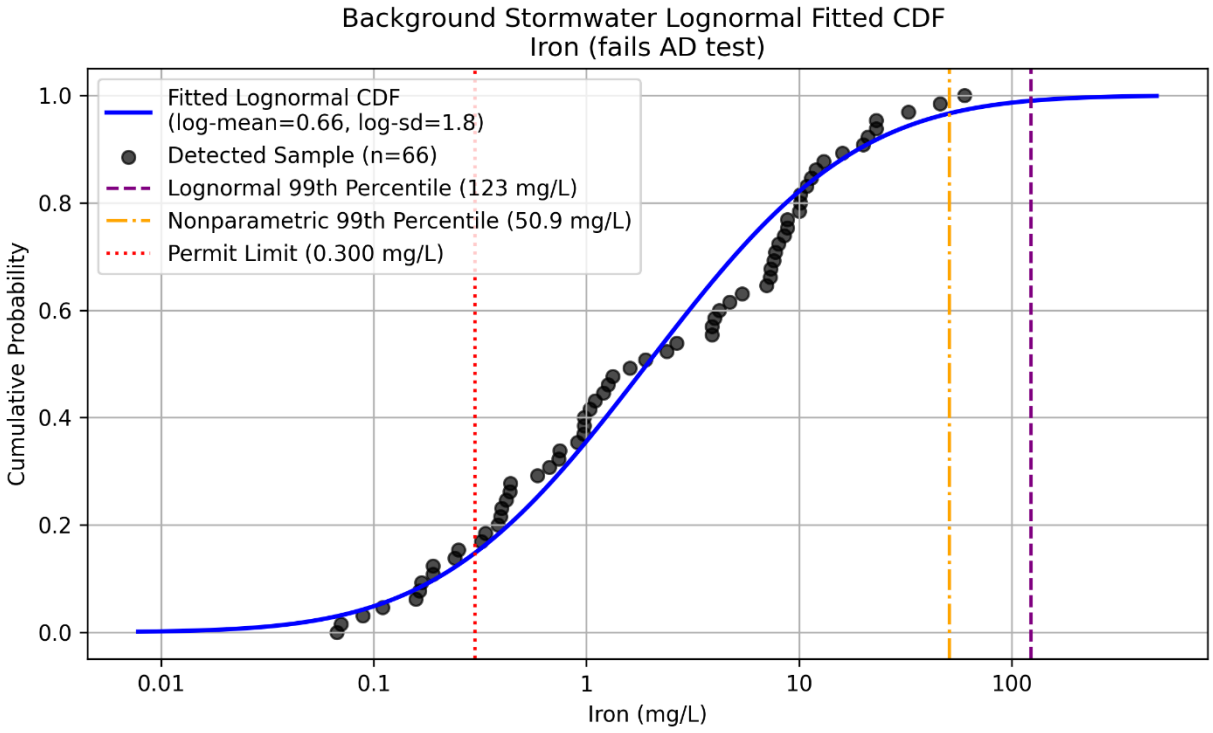
Attachment C – Example Analyte Distributions

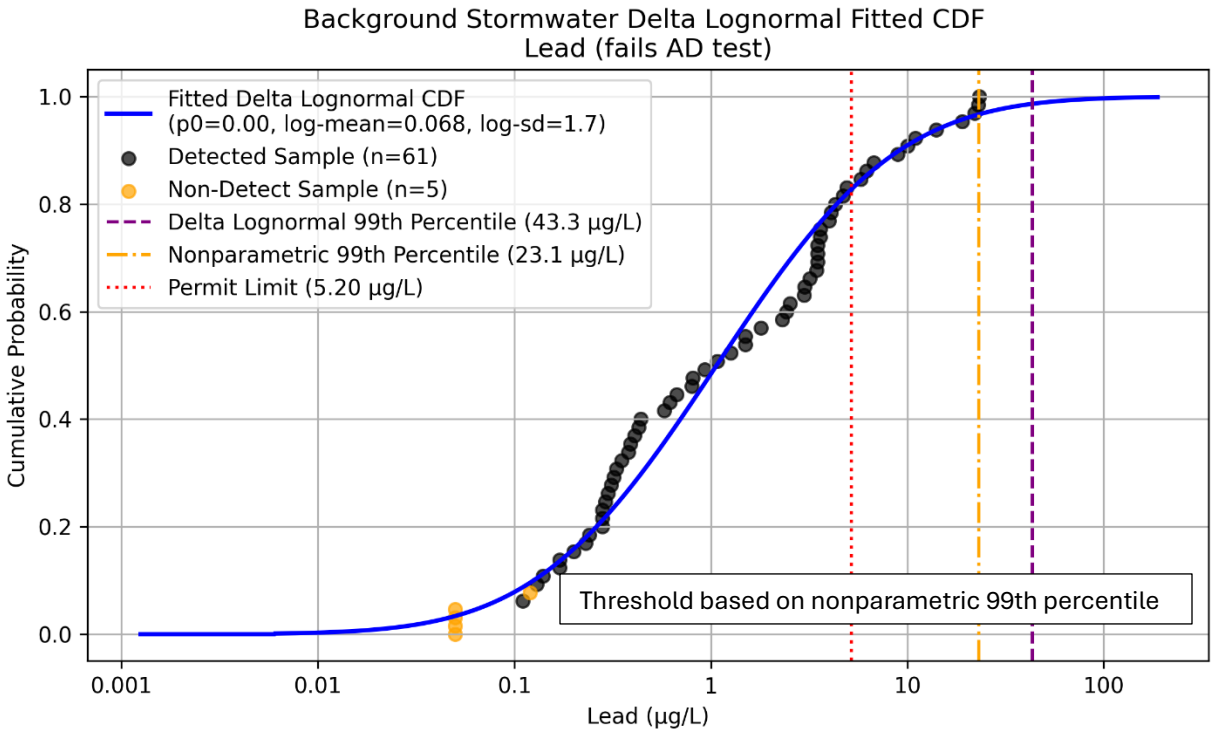
The following cumulative distribution frequency (CDF) plots present graphical depictions of the assumed distributions overlaid on the measured empirical data, for example constituents. They show detected (including both quantified and estimated) sample results as black dots and non-detects as yellow dots. Permit limits are shown as red lines and 99th percentile values are shown as purple lines following the lognormal calculation method and yellow following the nonparametric calculation method. Maximum observed values can be seen as the rightmost sample points. The example constituents shown here are:

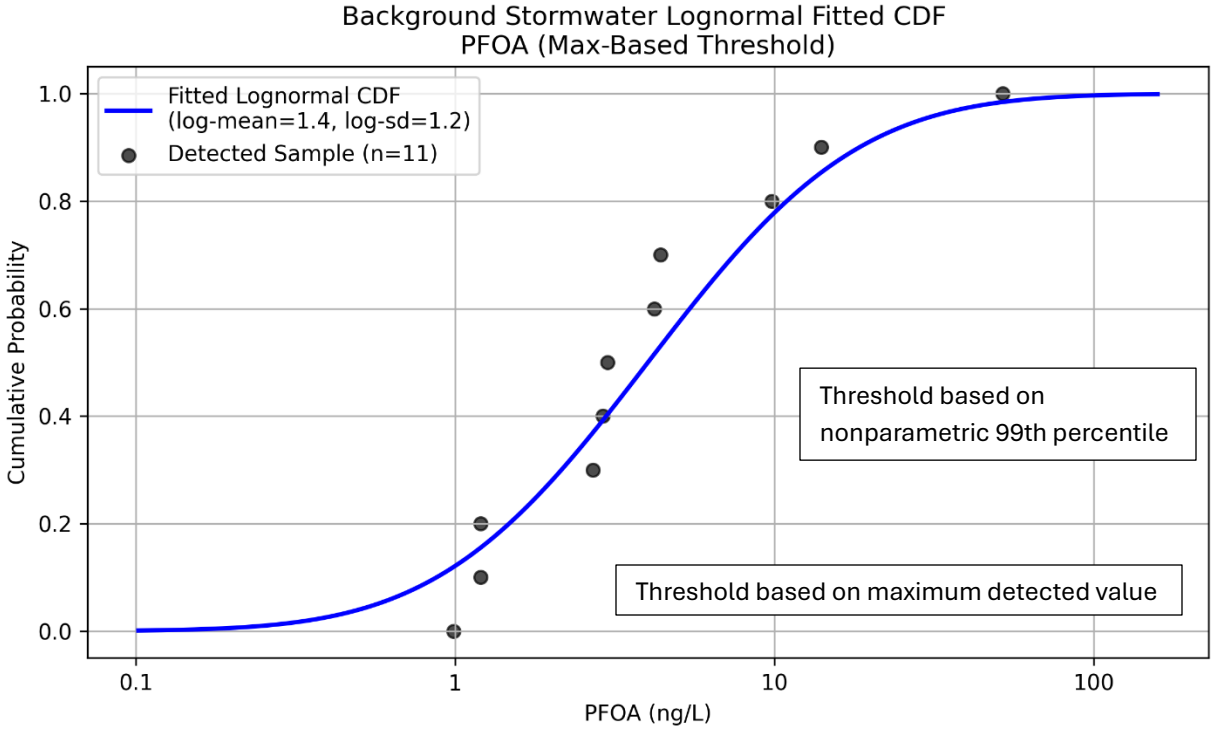
1. arsenic (100% detected) and mercury (55% detected) in background stormwater, which are examples of a constituent that passed the Anderson-Darling (AD) goodness-of-fit test for the delta lognormal distribution, therefore the delta lognormal 99th percentile was used;
2. iron (100% detected) and lead (92% detected) in background stormwater, which are examples of a constituent that failed the AD test for the lognormal distribution, therefore a nonparametric 99th percentile was used; and
3. PFOA in background stormwater (100% detected), which is an example of a constituent with insufficient data to calculate a 99th percentile (less than 12 sample results), so the maximum detected result was used.




Background Stormwater Delta Lognormal Fitted CDF
Mercury (passes AD test)
Fitted Delta Lognormal CDF
(p0=0.00, log-mean=-4, log-sd=1.3)
Detected Sample (n=36)
Non-Detect Sample (n=30)
Delta Lognormal 99th Percentile (0.114 µg/L)
Nonparametric 99th Percentile (0.0971 µg/L)
Permit Limit (0.0240 µg/L)
Threshold based on delta lognormal 99th percentile
Cumulative Probability
Mercury (µg/L)


Background Stormwater Lognormal Fitted CDF
Iron (fails AD test)
Fitted Lognormal CDF
(log-mean=0.66, log-sd=1.8)
Detected Sample (n=66)
Lognormal 99th Percentile (123 mg/L)
Nonparametric 99th Percentile (50.9 mg/L)
Permit Limit (0.300 mg/L)
Cumulative Probability
Iron (mg/L)


Background Stormwater Delta Lognormal Fitted CDF
Lead (fails AD test)
Fitted Delta Lognormal CDF
(p0=0.00, log-mean=0.068, log-sd=1.7)
Detected Sample (n=61)
Non-Detect Sample (n=5)
Delta Lognormal 99th Percentile (43.3 µg/L)
Nonparametric 99th Percentile (23.1 µg/L)
Permit Limit (5.20 µg/L)
Threshold based on nonparametric 99th percentile
Cumulative Probability
Lead (µg/L)
0.0
0.2
0.4
0.6
0.8
1.0
0.001
0.01
0.1
1
10
100


Background Stormwater Lognormal Fitted CDF
PFOA (Max-Based Threshold)
Fitted Lognormal CDF
(log-mean=1.4, log-sd=1.2)
Detected Sample (n=11)
Threshold based on
nonparametric 99th percentile
Threshold based on maximum detected value
Cumulative Probability
PFOA (ng/L)
0.0
0.2
0.4
0.6
0.8
1.0
0.1
1
10
100

ATTACHMENT D – SUMMARY STATISTICS, BACKGROUND THRESHOLDS, AND AMBIENT THRESHOLDS

Background and Ambient Stormwater Thresholds 2026 Update
October 31, 2026

Attachment D Table 1. Summary of Updated Preliminary Background and Ambient Thresholds for COPCs with NPDES Permit Limits

				Background Stormwater						Ambient Stormwater					
Constituent	Units	2015 NPDES Permit Limit[1]	2023 NPDES Permit Limit[1]	Number of Samples	Number of Detections	Max Result	99th Percentile[2]	Background Stormwater Threshold[3]	Threshold Basis[2,3]	Number of Samples	Number of Detections	Max Result	99th Percentile[2]	Ambient Stormwater Threshold[3]	Threshold Basis[2,3]
1,1-Dichloroethene	µg/L	6	6	20	0	<0.670	ND	ND	no detects	9	0	<0.330	ID	ND	no detects
1,2-Dichloroethane	µg/L	0.500	0.500	20	0	<0.300	ND	ND	no detects	9	0	<0.150	ID	ND	no detects
2,4,6-Trichlorophenol	µg/L	13	13	26	0	<6.40	ND	ND	no detects	13	0	<2.40	ND	ND	no detects
2,4-Dinitrotoluene	µg/L	18	18	26	0	<4.80	ND	ND	no detects	13	0	<0.720	ND	ND	no detects
3,3'-Dichlorobenzidine	µg/L	no limit	0.0770	26	0	<3.10	ND	ND	no detects	13	0	<3.10	ND	ND	no detects
4,4'-DDE	µg/L	no limit	0.00059	23	0	<0.0100	ND	ND	no detects	12	0	<0.0370	ND	ND	no detects
alpha-BHC	µg/L	0.0300	0.0300	23	0	<0.100	ND	ND	no detects	12	0	<0.100	ND	ND	no detects
Aluminum	**µg/L**	**no limit**	**1,000**	**31**	**31**	**25,000**	**128,436**	**128,436**	Lognormal 99th percentile	**16**	**16**	**79,000**	**229,657**	**229,657**	Lognormal 99th percentile
Ammonia as Nitrogen (N)	mg/L	10.1	10.1	56	44	2.17	2.04	2.04	Nonparametric 99th percentile	13	10	0.180	0.245	0.245	Lognormal 99th percentile
Antimony	µg/L	6	6	66	44	4.40	3.03	3.03	Lognormal 99th percentile	19	15	16	2.21	2.21	Lognormal 99th percentile
Arsenic	**µg/L**	**10**	**10**	**65**	**65**	**14**	**15.6**	**15.6**	Lognormal 99th percentile	**19**	**19**	**19**	**19.0**	**19.0**	Lognormal 99th percentile
Barium	**mg/L**	**1**	**1**	66	66	0.480	0.402	0.402	Lognormal 99th percentile	**19**	**19**	**1.10**	**1.08**	**1.08**	Nonparametric 99th percentile
Benzidine	µg/L	no limit	0.00054	26	0	<6.60	ND	ND	no detects	13	0	<6.80	ND	ND	no detects
Beryllium	µg/L	4	4	66	25	2.86	2.08	2.08	Lognormal 99th percentile	19	8	4.70	3.69	3.69	Lognormal 99th percentile
Biochemical Oxygen Demand (BOD)	**mg/L**	**30**	**30**	26	11	25	6.13	6.13	Lognormal 99th percentile	**13**	**8**	**880**	**598**	**598**	Lognormal 99th percentile
bis (2-ethylhexyl) Phthalate	**µg/L**	**4**	**4**	**33**	**3**	**5.40**	**5.24**	**5.24**	Nonparametric 99th percentile	**18**	**1**	**4.70**	**4.53**	**4.53**	Nonparametric 99th percentile
Boron	**mg/L**	**1**	**1**	**31**	**31**	**3.60**	**7.01**	**7.01**	Lognormal 99th percentile	17	16	0.640	0.702	0.702	Lognormal 99th percentile
Cadmium	**µg/L**	**3.10**	**3.10**	**66**	**50**	**7.90**	**8.24**	**8.24**	Lognormal 99th percentile	**19**	**13**	**5.30**	**6.45**	**6.45**	Lognormal 99th percentile
Chloride	**mg/L**	**150**	**150**	**26**	**26**	**400**	**553**	**553**	Lognormal 99th percentile	**13**	**13**	**190**	**306**	**306**	Lognormal 99th percentile
Chromium	**µg/L**	**16**	**16**	**66**	**65**	**56**	**82.2**	**82.2**	Lognormal 99th percentile	**19**	**19**	**150**	**272**	**272**	Lognormal 99th percentile
Chromium VI	µg/L	16	16	36	13	1.10	1.10	1.10	Nonparametric 99th percentile	19	17	0.490	0.674	0.674	Lognormal 99th percentile
Combined Radium-226 and Radium-228	**pCi/L**	**5**	**5**	**33**	**27**	**6.47**	**7.48**	**7.48**	Lognormal 99th percentile	**18**	**12**	**11.8**	**17.3**	**17.3**	Lognormal 99th percentile
Copper	**µg/L**	**13**	**31**	**66**	**66**	**73**	**84.1**	**84.1**	Lognormal 99th percentile	**19**	**19**	**140**	**142**	**142**	Lognormal 99th percentile
Cesium-137	pCi/L	200	200	32	0	<7.51	ND	ND	no detects	17	0	<5.68	ND	ND	no detects
Cyanide	µg/L	8.50	8.50	36	2	5	5	5	Nonparametric 99th percentile	18	3	4.30	4.23	4.23	Nonparametric 99th percentile
Fluoride	mg/L	1.60	1.60	33	31	1	1.33	1.33	Lognormal 99th percentile	18	14	0.710	0.815	0.815	Lognormal 99th percentile
Gross Alpha	**pCi/L**	**15**	**15**	**56**	**45**	**136**	**104**	**104**	Nonparametric 99th percentile	**18**	**10**	**85.1**	**142**	**142**	Lognormal 99th percentile
Gross Beta	**pCi/L**	**50**	**50**	**69**	**50**	**93.5**	**116**	**116**	Lognormal 99th percentile	**18**	**17**	**83.9**	**118**	**118**	Lognormal 99th percentile
Heptachlor	µg/L	no limit	0.00042	23	0	<0.0120	ND	ND	no detects	12	0	<0.0500	ND	ND	no detects
Indeno(1,2,3-cd)pyrene	µg/L	no limit	0.100	26	0	<1	ND	ND	no detects	13	0	<0.430	ND	ND	no detects
Iron	**mg/L**	**0.300**	**no limit**	**66**	**66**	**60**	**50.9**	**50.9**	Nonparametric 99th percentile	**19**	**19**	**120**	**295**	**295**	Lognormal 99th percentile
Lead	**µg/L**	**5.20**	**5.20**	**66**	**61**	**23.2**	**23.1**	**23.1**	Nonparametric 99th percentile	**19**	**19**	**140**	**280**	**280**	Lognormal 99th percentile
Manganese	**µg/L**	**50**	**50**	**66**	**65**	**1,180**	**5,021**	**5,021**	Lognormal 99th percentile	**19**	**19**	**3,600**	**4,342**	**4,342**	Lognormal 99th percentile
Mercury	**µg/L**	**0.1**	**0.0240**	**66**	**36**	**0.130**	**0.114**	**0.114**	Lognormal 99th percentile	**19**	**19**	**0.210**	**0.280**	**0.280**	Lognormal 99th percentile
Nickel	**µg/L**	**86**	**86**	**64**	**62**	**100**	**133**	**133**	Lognormal 99th percentile	**19**	**19**	**140**	**151**	**151**	Lognormal 99th percentile
Nitrate + Nitrite as N	mg/L	8	8	33	28	3.40	3.34	3.34	Nonparametric 99th percentile	18	18	7.09	6.85	6.85	Lognormal 99th percentile
Nitrate as N	mg/L	8	8	63	58	3.40	3.28	3.28	Nonparametric 99th percentile	18	18	7	6.73	6.73	Lognormal 99th percentile
Nitrite as N	mg/L	1	1	63	19	2.21	1.39	1.39	Nonparametric 99th percentile	18	2	0.220	0.220	0.220	Nonparametric 99th percentile
n-Nitrosodimethylamine	µg/L	16	16	26	0	<2.10	ND	ND	no detects	13	0	<2.10	ND	ND	no detects
Oil & Grease	**mg/L**	**15**	**15**	26	9	1.50	1.76	1.76	Lognormal 99th percentile	**13**	**7**	**12**	**15.1**	**15.1**	Lognormal 99th percentile
Pentachlorophenol	µg/L	16.5	1	26	0	<9.20	ND	ND	no detects	13	2	6.40	5.74	5.74	Nonparametric 99th percentile
Perchlorate	**µg/L**	**6**	**6**	**33**	**3**	**58**	**47.1**	**47.1**	Nonparametric 99th percentile	18	0	<4.30	ND	ND	no detects
pH (field)	**SU**	**6.5 - 8.5**	**6.5 - 8.5**	**25**	**25**	**5.93 - 9.42**	**5.60 - 9.78**	**5.60 - 9.78**	Normal 1st - 99th percentile	**14**	**14**	**5.91 - 8.96**	**5.73 - 9.62**	**5.73 - 9.62**	Normal 1st - 99th percentile
Selenium	**µg/L**	**5**	**5**	**65**	**64**	**63**	**41.2**	**41.2**	Nonparametric 99th percentile	**19**	**12**	**9.70**	**9.50**	**9.50**	Nonparametric 99th percentile
Silver	µg/L	4.10	4.10	66	8	0.600	0.712	0.712	Lognormal 99th percentile	19	6	7.10	2.26	2.26	Lognormal 99th percentile
Strontium-90	pCi/L	8	8	33	2	1.59	1.37	1.37	Nonparametric 99th percentile	18	1	1.23	1.09	1.09	Nonparametric 99th percentile
Sulfate	**mg/L**	**250**	**250**	**33**	**33**	**2,000**	**1,968**	**1,968**	Nonparametric 99th percentile	**18**	**18**	**300**	**369**	**369**	Lognormal 99th percentile
Surfactants (MBAS)	mg/L	0.500	0.500	26	14	0.110	0.122	0.122	Lognormal 99th percentile	13	4	0.150	0.169	0.169	Lognormal 99th percentile
TCDD TEQ (no DNQ)	**µg/L**	**2.80e-08**	**2.80e-08**	34	0	ND	ND	ND	no detects	**19**	**13**	**2.50e-07**	**4.26e-06**	**4.26e-06**	Lognormal 99th percentile
Temperature	°F	86	80	25	25	66.6	66.7	66.7	Lognormal 99th percentile	14	14	69.5	66.7	66.7	Lognormal 99th percentile
Thallium	µg/L	2	2	66	25	0.790	0.532	0.532	Lognormal 99th percentile	19	9	1.40	1.97	1.97	Lognormal 99th percentile
Total Dissolved Solids	**mg/L**	**850**	**850**	**55**	**55**	**4,300**	**3,976**	**3,976**	Nonparametric 99th percentile	**13**	**13**	**1,600**	**1,832**	**1,832**	Lognormal 99th percentile
Total PCBs Arochlor Method	µg/L	0.00017	0.00017	23	0	ND	ND	ND	no detects	12	0	<0.00e+00	ND	ND	no detects
Trichloroethene	µg/L	5	5	27	0	<1.60	ND	ND	no detects	14	0	<1.60	ND	ND	no detects
Tritium	pCi/L	20,000	20,000	68	35	279	241	241	Nonparametric 99th percentile	18	0	<190	ND	ND	no detects
Uranium, Total	**pCi/L**	**20**	**20**	**32**	**32**	**21.4**	**37.3**	**37.3**	Lognormal 99th percentile	17	17	7.50	10.3	10.3	Lognormal 99th percentile
Zinc	**µg/L**	**119**	**120**	**66**	**59**	**190**	**253**	**253**	Lognormal 99th percentile	**19**	**18**	**690**	**1,209**	**1,209**	Lognormal 99th percentile

Notes:

0. The maximum detection limit of the nondetect results was greater than the permit limit

1. Where there are multiple permit limits for different outfalls, the lowest one is shown here.

2. 99th percentile calculated following Appendix E of the US EPA Technical Support Document (TSD) for Water Quality-based Toxics Control. EPA/505/2-90-001.
The calculation assumes a lognormal distribution for results that are detected 100% of the time or a deltalognormal distribution if there are any nondetects.
If the data fail the Anderson-Darling test for lognormality, then the nonparametric 99th percentile is calculated.

3. The threshold is based on the 99th percentile if sufficient data is available, otherwise the max result is used.

ID = insufficient data to calculate a 99th percentile (i.e., <12 samples)

ND = no detected results, cannot calculate a threshold

The threshold values presented here remain preliminary and subject to change as additional samples are collected.

Bolded COPCs and thresholds indicate instances where the background and/or ambient stormwater threshold is higher than the permit limit.

Background and Ambient Stormwater Thresholds 2026 Update
October 31, 2026
Attachment D Table 2. Summary of Updated Preliminary Background and Ambient Thresholds for COPCs without NPDES Permit Limits

				Background Stormwater						Ambient Stormwater					
Constituent	Units	CA Primary MCL[1]	CA Toxics Rule	Number of Samples	Number of Detections	Max Result	99th Percentile[2]	Background Stormwater Threshold[3]	Threshold Basis[2,3]	Number of Samples	Number of Detections	Max Result	99th Percentile[2]	Ambient Stormwater Threshold[3]	Threshold Basis[2,3]
Total PCBs Congener Method	**µg/L**	**0.5**	**0.00017**	**13**	**13**	**0.000313**	**0.000275**	**0.000275**	Nonparametric 99th percentile	**6**	**6**	**0.0375**	**ID**	**0.0375**	**max result**
Mixture of PFAS Congeners	**Hazard Index**	**1**	--	**11**	**11**	**1.24**	**ID**	**1.24**	**max result**	6	6	0.452	ID	0.452	max result
HFPO-DA	ng/L	10	--	11	0	<1.40	ID	ND	no detects	6	0	<2	ID	ND	no detects
PFBS	ng/L	--	--	11	11	17	ID	17	max result	6	6	5.60	ID	5.60	max result
PFHxS	ng/L	10	--	11	4	2.50	ID	2.50	max result	6	6	1.40	ID	1.40	max result
PFNA	ng/L	10	--	11	6	9.80	ID	9.80	max result	6	6	3.20	ID	3.20	max result
PFOA	**ng/L**	**4**	**--**	**11**	**11**	**52**	**ID**	**52**	max result	**6**	**6**	**16**	**ID**	**16**	max result
PFOS	**ng/L**	**4**	**--**	**11**	**11**	**19**	**ID**	**19**	max result	**6**	**6**	**12**	**ID**	**12**	max result
1,2,3,4,6,7,8-HpCDD	µg/L	--	--	36	10	0.0000120	0.0000136	0.0000136	Lognormal 99th percentile	19	12	0.000470	0.00120	0.00120	Lognormal 99th percentile
1,2,4-Trichlorobenzene	µg/L	5	--	26	2	0.130	0.130	0.130	Nonparametric 99th percentile	13	0	<0.130	ND	ND	no detects
1,3-Dichlorobenzene	µg/L	--	--	26	1	0.160	0.150	0.150	Nonparametric 99th percentile	13	0	<0.120	ND	ND	no detects
1,4-Dichlorobenzene	µg/L	5	--	26	1	0.140	0.140	0.140	Nonparametric 99th percentile	13	0	<0.120	ND	ND	no detects
2,4-Dichlorophenol	µg/L	--	93	26	2	1.60	1.53	1.53	Nonparametric 99th percentile	13	0	<1.30	ND	ND	no detects
2,4-Dimethylphenol	µg/L	--	540	26	2	6.90	5.63	5.63	Nonparametric 99th percentile	13	0	<7.10	ND	ND	no detects
2,6-Dinitrotoluene	**µg/L**	**--**	**0.11**	**26**	**2**	**5.80**	**5.47**	**5.47**	Nonparametric 99th percentile	13	0	<5.90	ND	ND	no detects
2-Chloronaphthalene	µg/L	--	1700	26	2	1.10	1.01	1.01	Nonparametric 99th percentile	13	0	<1.10	ND	ND	no detects
4-Nitrophenol	µg/L	--	--	26	1	7.20	6.28	6.28	Nonparametric 99th percentile	13	0	<7.30	ND	ND	no detects
Acenaphthene	µg/L	--	1200	26	2	0.950	0.867	0.867	Nonparametric 99th percentile	13	0	<0.970	ND	ND	no detects
Anthracene	µg/L	--	9600	26	1	0.800	0.708	0.708	Nonparametric 99th percentile	13	0	<0.440	ND	ND	no detects
Benzo(a)pyrene	**µg/L**	**0.2**	**0.0044**	**26**	**1**	**0.920**	**0.853**	**0.853**	Nonparametric 99th percentile	13	0	<0.670	ND	ND	no detects
Benzyl alcohol	µg/L	--	--	9	1	2	ID	2	max result	5	1	2.10	ID	2.10	max result
Chrysene	**µg/L**	**--**	**0.0044**	**26**	**1**	**0.620**	**0.605**	**0.605**	Nonparametric 99th percentile	13	0	<0.640	ND	ND	no detects
Cobalt	µg/L	--	--	29	29	25	23.0	23.0	Nonparametric 99th percentile	14	14	63	110	110	Lognormal 99th percentile
Endosulfan I	µg/L	--	0.22	23	0	<0.100	ND	ND	no detects	12	1	0.100	0.0911	0.0911	Nonparametric 99th percentile
Fluoranthene	µg/L	--	300	26	1	0.820	0.730	0.730	Nonparametric 99th percentile	13	0	<0.470	ND	ND	no detects
Fluorene	µg/L	--	1300	26	2	0.860	0.828	0.828	Nonparametric 99th percentile	13	0	<0.880	ND	ND	no detects
Formaldehyde	µg/L	--	--	4	1	11	ID	11	max result	2	0	<7.80	ID	ND	no detects
Hexachloroethane	µg/L	--	1.9	26	2	1.30	1.28	1.28	Nonparametric 99th percentile	13	0	<1.30	ND	ND	no detects
Isophorone	µg/L	--	8.4	26	1	1.70	1.62	1.62	Nonparametric 99th percentile	13	0	<1.40	ND	ND	no detects
Lithium	mg/L	--	--	6	6	0.220	ID	0.220	max result	3	0	<0.0260	ID	ND	no detects
Molybdenum	µg/L	--	--	6	4	46	ID	46	max result	3	1	5.90	ID	5.90	max result
Nitrobenzene	µg/L	--	17	26	2	1.50	1.50	1.50	Nonparametric 99th percentile	13	0	<1.50	ND	ND	no detects
Phenanthrene	µg/L	--	--	26	3	0.660	0.625	0.625	Nonparametric 99th percentile	13	0	<0.530	ND	ND	no detects
Phenol	µg/L	--	21,000	26	0	<1.10	ND	ND	no detects	13	2	1.10	1.03	1.03	Nonparametric 99th percentile
Pyrene	µg/L	--	960	26	3	0.670	0.618	0.618	Nonparametric 99th percentile	13	0	<0.470	ND	ND	no detects
Strontium	mg/L	--	--	4	4	5.70	ID	5.70	max result	2	2	0.390	ID	0.390	max result
Styrene	µg/L	100	--	18	0	<0.380	ND	ND	no detects	8	1	0.280	ID	0.280	max result
Titanium	µg/L	--	--	6	6	230	ID	230	max result	3	3	540	ID	540	max result
Vanadium	µg/L	--	--	6	6	18	ID	18	max result	2	2	19	ID	19	max result

Notes:
0. The maximum detection limit of the nondetect results was greater than the CA MCL or CTR value
1. Note the CA MCL for PFAS constituents will go into effect in 2029.

2. 99th percentile calculated following Appendix E of the US EPA Technical Support Document (TSD) for Water Quality-based Toxics Control. EPA/505/2-90-001.
The calculation assumes a lognormal distribution for results that are detected 100% of the time or a deltalognormal distribution if there are any nondetects.
If the data fail the Anderson-Darling test for lognormality, then the nonparametric 99th percentile is calculated.
3. The threshold is based on the 99th percentile if sufficient data is available, otherwise the max result is used.
ID = insufficient data to calculate a 99th percentile (i.e., <12 samples)
ND = no detected results, cannot calculate a threshold
The threshold values presented here remain preliminary and subject to change as additional samples are collected.
Bolded COPCs and thresholds indicate instances where the background and/or ambient stormwater threshold is higher than the lower water quality objective (MCL or CTR).