Annual Industrial Stormwater Monitoring Report

Seattle-Tacoma International Airport

For the Period July 1, 2022 through June 30, 2023

September 29, 2023

Prepared by

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Port of Seattle

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1.0 INTRODUCTION

The Port of Seattle's (Port) National Pollutant Discharge Elimination System (NPDES) permit WA0024651 is broken down into three sections: Part 1: Industrial Wastewater, Part 2: Industrial Stormwater and Part 3: Construction Stormwater. NPDES Permit Part 2 Special Condition 2S1.G requires an annual summary of industrial stormwater monitoring results. The twelve-month period is defined as July 1, 2022 through June 30, 2023. This report provides a summary of industrial monitoring and permit compliance results for the stormwater drainage system outfalls identified in Part 2 of the NPDES permit during this period.

Outfall sampling results summarized in this report include data previously submitted to Washington State Department of Ecology (ECY) in the NPDES permit Part 2 Discharge Monitoring Reports (DMRs), plus additional stormwater sample data such as quality assurance sampling and samples that were analyzed for additional parameters not required by the Permit. Toxicity monitoring as required by Part 2 of the NPDES permit is discussed but results are found in separate toxicity report submittals to ECY.

The Port met all required sampling collection and reporting requirements in the NPDES permit for the 2022-2023 data collection period. Stormwater samples are collected from eleven (11) outfalls which discharge to five (5) different receiving waters; Lake Reba, Miller Creek, Walker Creek, Northwest Ponds, and Des Moines Creek. A total of thirty-eight (38) grab and thirty-eight (38) composite stormwater samples from 8 storm events were collected in the past year with results reported on quarterly DMRs. There were two (2) instances of permit limit exceedances associated with 228 individual constituent analyses from collected samples.

This report is organized into four sections following the introduction. Section 2 describes background conditions at the Seattle-Tacoma International Airport including descriptions of each drainage subbasin and outfall sampling location. Section 3 presents all the DMR related grab sample and composite sample analytical data collected during the reporting period and the rainfall totals for the period. Additional monitoring for compliance related reasons in also included. Section 4 provides a summary of the effluent limit compliance and best management practices (BMP) implementation during the monitoring period. A summary and conclusion are provided in Section 5.

2.0 BACKGROUND

2.1 Seattle-Tacoma International Airport Drainage

Located mid-way between the cities of Seattle and Tacoma, Washington, The Seattle-Tacoma International Airport (SEA) was built in the 1940s and is owned and operated by the Port. According to the Port's 2022 Key Facts and Figures, SEA handled 456,294 metric tons of air cargo, and 46 million passengers. SEA is ranked the eleventh busiest U.S. passenger airports and has a regional impact of more than $22.5 billion in business revenue, generating more than 151,400 jobs.

Stormwater drainage at SEA is separated into two different collection systems, the Industrial Wastewater System (IWS) and the Storm Drainage System (SDS). The IWS receives stormwater runoff from the ramp and other areas involved with aircraft servicing and maintenance, providing treatment before discharge to Puget Sound through a separate outfall. SEA also has the ability to discharge through an outfall to King County's South Treatment Plant for additional treatment when required. This outfall is regulated by Industrial Wastewater Discharge Permit #7810-05 issued by King County. Approximately 372 acres are diverted to the IWS.

The SDS drains over 1,200 acres.Half of this area is impervious and primarily associated with airport runways, taxiways, parking lots, roads and roof tops.The remainder is pervious which consists of landscaped or fallow open spaces and areas associated with stormwater treatment best management practices (BMPs) such as runway filter strips. About 25 percent of the area drained by the SDS flows to Miller Creek. This drainage area represents about 7 percent of Miller Creek's watershed. Approximately 71 percent of the total SDS area drains to the Northwest Ponds and Des Moines Creek, which represents about 21 percent of the creek's watershed.

2.2 SEA Storm Drainage Subbasins, Activities, and Outfall Descriptions

The Airport's SDS is segregated into separate stormwater subbasins that each drain to individual outfall locations. The NPDES permit lists a total of thirteen (13) outfalls in two categories: Existing & New Outfalls and Subbasins, and Future Outfalls to be activated during future development. As of June 30, 2023, eleven (11) of the thirteen (13) outfalls are active and discharge stormwater related to industrial activity.

SEA stormwater subbasins are categorized according to their dominant activities: landside or airfield. These categories group subbasins together by similar land use and other characteristics. In general, passenger vehicle operations are absent from the airfield drainage subbasins while aircraft operations are absent from the landside subbasins. SDE4/S1 subbasin is an exception in that it includes both airfield and landside activities. Previous reports found that concentrations of total petroleum (TPH), total suspended solids (TSS) and other constituent concentrations were

different for the landside and airfield categories (POS 1996a, 1997a.). **Table 1**, *SEA Subbasin Characteristics*, describes each active subbasin, receiving water, activities within each subbasin, stormwater management BMPs, and total pervious and impervious surface areas. The physical location of the outfalls listed in **Table 1** are shown on **Figure 1** along with additional receiving water monitoring locations used for sublethal toxicity and *in situ* toxicity testing.

2.3 Permit Effluent Limits

The 2021 NPDES permit specifies effluent limits for turbidity, pH, oil and grease, total copper, and total zinc (see **Table 2**). The major changes from the previous permit effluent limits are the removal of lead analysis and an adjusted pH range for outfalls SDN3A, SDW1A, SDW1B, and SDW2. The pH range for these listed outfalls was widened to 6.3-9.0 with concurrent receiving water monitoring after a study showed discharge within this range would not cause a violation of water quality standards in the receiving water. Lead was removed from the sampling effort for this permit based on Port studies that identified lead exceedances as extremely unlikely.

Effluent limits for industrial stormwater became effective several permits ago on December 31, 2007. The site-specific study and subsequent derivation of site-specific water quality based effluent limits for copper and zinc are described in the 2016 NPDES Permit fact sheet. A 25 NTU effluent limit for turbidity was added in the April 1, 2009 permit as a replacement for an earlier TSS benchmark.

The permit specifies effluent limits for ammonia and nitrates/nitrites; however monitoring for these parameters is only required if urea is applied as an anti-icing agent. Urea was not applied in this reporting year and has not been utilized at the Airport since 1996.

Table 1. SEA Subbasins Characteristics

Outfall Name	Receiving Water	General Category	Industrial Activity	Non-Industrial Activity	Pervious Area[b] (acres)	Impervious Area[b] (acres)	Total Area[b, c] (acres)
SDE4/S1	Des Moines Creek (East Branch)	Landside	Limited portions of the airfield taxiways.	Public roads, vehicle parking areas, rooftops (terminal, hangar, cargo) and landscaped areas.	41.5	138.1	179.6
SDD-06A	Des Moines Creek (East Branch)	Landside	Loading docks, vehicle maintenance, vehicle washing, equipment parking and maintenance.	Public roads, vehicle parking areas, rooftops (terminal, hangar, cargo) and landscaped areas.	18.2	27.2	45.3
SDN1	Miller Creek via Lake Reba	Landside	Flight service kitchen.	Public roads, building rooftops and vehicle parking.	3.8	14.8	18.6
SDS3/5	NW Ponds and Des Moines Creek West	Airfield	Ground surface deicing/anti-icing, aircraft taxi, takeoff and landings.	Perimeter road, open areas and building rooftops.	206.3	250.6	456.8

Table 1. SEA Subbasins Characteristics

Outfall Name	Receiving Water	General Category	Industrial Activity	Non-Industrial Activity	Pervious Area[b] (acres)	Impervious Area[b] (acres)	Total Area[b, c] (acres)
SDS4	NW Ponds and Des Moines Creek West	Airfield	Ground surface deicing/anti-icing, aircraft taxi, takeoff and landings.	Runway infield and open areas.	40.5	25.9	66.3
SDS6/7	NW Ponds and Des Moines Creek West	Airfield	Ground surface deicing/anti-icing, aircraft taxi, takeoff and landings.	Access roads, runway infield and open areas.	63.9	45.7	109.6
SDN2/3/4[a]	Miller Creek via Lake Reba	Airfield	Ground surface deicing/anti-icing, aircraft taxi, takeoff and landings.	Perimeter road, access road, taxiway infield and open areas.	71.3	44.6	115.9
SDN3A	Miller Creek	Airfield	Ground surface deicing/anti-icing, aircraft taxi, takeoff and landings.	Perimeter road, runway infield and open areas.	23.1	8.1	31.2
SDW1A	Miller Creek	Airfield	Ground surface deicing/anti-icing, aircraft taxi, takeoff and landings.	Perimeter road, runway infield and open areas.	44.1	26.0	70.1

Table 1. SEA Subbasins Characteristics

Outfall Name	Receiving Water	General Category	Industrial Activity	Non-Industrial Activity	Pervious Area[b] (acres)	Impervious Area[b] (acres)	Total Area[b, c] (acres)
SDW1B	Miller Creek	Airfield	Ground surface deicing/anti-icing, aircraft taxi, takeoff and landings.	Perimeter road, runway infield and open areas.	59.5	25.0	84.5
SDW2	Walker Creek	Airfield	Ground surface deicing/anti-icing, aircraft taxi, takeoff and landings.	Perimeter road, runway infield and open areas.	30.9	10.8	41.7
Note:				**Total Area**	**584.9**	**639.3**	**1224.1**

a) The SDN2 runoff is pumped to IWS for all flows up to the 6 month /24-hour event. The SDN2 subbasin comprises approximately 46.5 acres, 36.6 of which are impervious. This area is included in acreages reported to the IWS.
b) Subbasin areas as described in the 2020 NPDES permit renewal application. Based on 2018 GIS analysis completed by Aspect consulting predominantly using a 2017 aerial.
c) Stormwater pond areas were not included in total acres. It is anticipated that ongoing changes resulting from planned construction will alter subbasin totals in the future.

Figure 1. Sampling Locations

3.0 SAMPLING RESULTS AND DISCUSSION

This section of the Annual Report summarizes the results of SDS outfall monitoring. All data summarized in this section has been reported to ECY on quarterly DMRs and is included in **Appendix A**. Data generated from grab and composite samples are presented and discussed. These types of samples employ different protocols that represent different temporal periods of the particular stormwater discharge event and are therefore evaluated separately. Grab samples represent an instantaneous or short duration sampling period, while composites are collected over the storm event hydrograph to provide an event mean concentration (EMC).

In addition to the DMR data, this report summarizes other data collected at the outfalls listed in Part 2, 2S1 of the NPDES permit. These other data consist of field equipment blank samples, field duplicate samples, and other parameters collected during the monitoring period. These other data are presented in **Appendix B**. Section 3.2 of this report summarizes *in situ* toxicity testing at receiving water sites downstream of SEA outfalls, and Section 3.3 provides a summary of additional monitoring completed for compliance related issues.

3.1 Monitoring of Industrial Stormwater Discharges

3.1.1 Sampling Objectives and Procedures

Sampling protocols and locations have been selected to provide data consistent with the requirements of the NPDES permit and the representativeness criteria set forth in the *Quality Assurance Program Plan for Seattle-Tacoma International Airport Industrial Stormwater Discharge Monitoring Program* (QAPP) (Aspect Consulting, Inc. 2021). The monitoring locations were selected to represent stormwater downstream of the last Best Management Practice (BMP) within each subbasin.

The QAPP describes the criteria for sampling storm events and describes all relevant sampling, programming, and handling necessary to satisfy the monitoring requirements of the permit. **Table 2** lists the current constituents measured or analyzed, methods used, and detection limits. The Port reports results on DMRs from storms and samples that were considered representative according to criteria specified in the QAPP.

The Port uses telemetry-based automatic samplers to collect a grab sample followed by a flow-weighted composite sample during rainstorms of 0.10 inches or greater that are preceded by less than 0.10 inch of rainfall in the previous 24 hours. These rainfall and antecedent sampling conditions are specified in the NPDES permit, Part 2, 2S2.B. Each grab or composite sample is analyzed for the constituents listed in **Table 2** based on sample type as specified in the NPDES permit.

Table 2. Constituents, Methods and Detection Limits

Constituent	Method	Detection limit (MDL)	Sample Type	Effluent Limits
pH	150.1[(1)]	0.01 S.U.	Grab	6.5 – 8.5 S.U.[3]
Oil & Grease - TPH (by GC)	NWTPH-Dx[(2)]	0.75 mg/l	Grab	15 mg/L – no sheen
Turbidity	180.1[(1)]	0.05 NTU	Grab	25 NTUs
Total Recoverable Copper	200.8[(1)]	0.5 µg/l	flow-wt comp.	25.6 to 59.2 µg/l
Total Recoverable Zinc	200.8[(1)]	4.0 µg/l	flow-wt comp.	71.4 to 117 µg/l

1. Method refers to EPA-600/4-79-020 (U.S. EPA 1983 and updates).
2. Method reports both a motor oil fraction and diesel fraction. TPH-Dx is the sum of these two fractions.
3. Approved limits for pH at stations SDN3A, SDW1A, SDW1B, SDW2 are 6.3 to 9.0 S.U. with concurrent monitoring of the receiving water.

3.1.2 Field Quality Control Samples

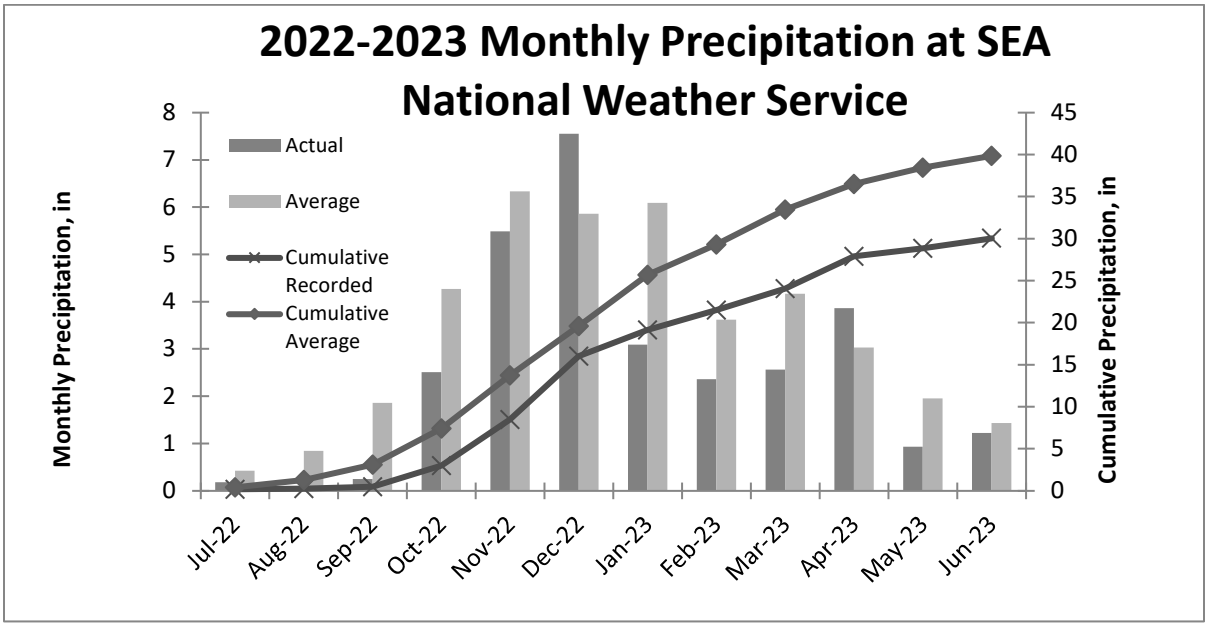
The Port routinely collects field duplicate and equipment blank samples during NPDES sampling events in accordance with the QAPP. **Appendix B** summarizes these results. The results reflect on the efficacy of the Port's "clean" sampling methods developed for stormwater monitoring relative to metals (POS 1999). Ten (10) Field Quality Control samples were collected in the 2022 – 2023 reporting period. There were no anomalies associated with samples collected during these same storm events.

3.1.3 Storm Events and Precipitation

During this reporting period, the Port sampled eight (8) precipitation events with precipitation ranging from 0.12 to 1.72 inches. Dry weather preceding these sampling events ranged from 23 hours (December 8, 2022) to 14.5 days (November 22, 2022). The tabular sample data in **Appendix A** includes storm event data such as precipitation depth, antecedent precipitation amounts, and length of antecedent dry period.

During the current permit's annual reporting schedule, 30.03 inches of precipitation fell at SEA; 9.82 inches less than the historical (2002-2022) average of 39.87 inches and 18.88 inches less than the previous monitoring year of 48.93 inches. Monthly precipitation totals were below average for all months other than December and April (**Figure 2**).

Figure 2. Precipitation Summary



3.1.4 Grab Sample Results and Discussion

The following discussion includes results from 38 grab samples collected in the past year. Grab samples are analyzed for pH, TPH, and turbidity per current permit requirements. Tabular results are presented at the end of this section and summary statistics are contained in **Appendix A**.

3.1.4.1 pH

The median pH value from all outfalls was 7.3 Standard Units (S.U.). Sample results fell consistently within the effluent limit range of 6.5 to 8.5 S.U. (6.3-9.0 at SDN3A, SDW1A, SDW1B and SDW2) with the exception of one (1) sample.

The depressed pH sample occurred at SDE4/S1 during the April 6, 2023 monitoring event, measuring 6.2 S.U. Site inspections did not identify any obvious operations or conditions that would result in depressed pH stormwater runoff.

The Port has continued its investigation of possible sources of depressed pH values in the SDE4/S1 and SDD06A basins during this reporting period. To date, no obvious sources of low pH have been identified in these basins; but some data suggests that existing BMPs would benefit from retrofits to increase their effectiveness at buffering pH. Oyster shell beds in the SDD06A swales were replaced during the summer of 2023 and a project is underway to add limestone spalls to the SDD06A pond. For the SDS1 swale, a project is also underway to add an oyster shell bed at the inlet of the

swale to provide additional pH buffering capacity. A summary of these actions is being documented in a low pH source tracing study and will be provided to ECY upon completion.

3.1.4.2 Total Petroleum Hydrocarbons (TPH)

Total Petroleum Hydrocarbons is determined by the ECY method NWTPH-Dx; the summation of the diesel and motor oil range TPH quantified by this method resembles the concentration of oil & grease. TPH ranged from less than 0.15 mg/L to 0.95 mg/L. The estimated median TPH concentration at all outfalls was 0.15 mg/L. However, the actual median TPH concentration may have been lower since TPH was only detected in 6 of the 38 samples. All sample results were well below the TPH effluent limit of 15 mg/L.

3.1.4.3 Turbidity

The median turbidity for all outfalls was 2.3 NTU with a range from 0.7 NTU to 16.1 NTU. There were no permit limit exceedances for turbidity at any outfalls during the monitoring period.

Table 3. Grab Sample Data

Outfall	Storm Date	Precipitation Depth (in)	Duration (hr)	Max Intensity (in/hr)	24hr Antecedant (hr)	48hr Antecedant (hr)	Dry Antecedant (hr)	pH (S.U.)	Turbidity (NTU)	Sheen (Yes/No)	TPH-D (mg/l)	TPH-Dx (mg/l)	TPH-MO (mg/l)
SDE4/SDS1	9/16/2022	0.13	1.58	0.12	0	0	317.5	6.5	11.5	No Sheen	0.32	0.899	0.579
SDE4/SDS1	11/22/2022	1.14	9	0.28	0	0	347	6.5	2	No Sheen	< 0.05	< 0.15	< 0.1
SDE4/SDS1	11/29/2022	1.72	32	0.24	0	0.04	28	7.1	3.5	No Sheen	< 0.05	< 0.15	< 0.1
SDE4/SDS1	1/11/2023	1	56.33	0.08	0	0.02	45.167	6.9	4.2	No Sheen	< 0.05	< 0.15	< 0.1
SDE4/SDS1	3/1/2023	0.19	20.33	0.05	0	0.2	40.667	6.9	6.8	No Sheen	0.259	0.466	0.207
SDE4/SDS1	4/6/2023	0.53	25	0.07	0	0	66	6.2	5	No Sheen	< 0.05	< 0.15	< 0.1
SDE4/SDS1	4/20/2023	0.36	15	0.07	0	0.1	31	6.7	5.8	No Sheen	< 0.05	< 0.15	< 0.1
SDS3/5	12/8/2022	0.12	9	0.03	0.01	0.03	23	7	1.2	No Sheen	< 0.05	< 0.15	< 0.1
SDS3/5	1/11/2023	1	56.33	0.08	0	0.02	45.167	7.6	4.4	No Sheen	< 0.05	< 0.15	< 0.1
SDS3/5	4/6/2023	0.53	25	0.07	0	0	66	7.3	2	No Sheen	< 0.05	< 0.15	< 0.1
SDS4	11/22/2022	1.14	9	0.28	0	0	347	6.5	1.5	No Sheen	< 0.05	< 0.15	< 0.1
SDS4	1/11/2023	1	56.33	0.08	0	0.02	45.167	7.2	1.6	No Sheen	< 0.05	< 0.15	< 0.1
SDS4	4/20/2023	0.36	15	0.07	0	0.1	31	6.9	1.6	No Sheen	< 0.05	< 0.15	< 0.1
SDS6/7	9/16/2022	0.13	1.58	0.12	0	0	317.5	7.8	6.9	No Sheen	0.498	0.946	0.448
SDS6/7	11/29/2022	1.72	32	0.24	0	0.04	28	7.5	2.6	No Sheen	< 0.05	< 0.15	< 0.1
SDS6/7	1/11/2023	1	56.33	0.08	0	0.02	45.167	7.1	2	No Sheen	< 0.05	< 0.15	< 0.1
SDS6/7	4/6/2023	0.53	25	0.07	0	0	66	7.5	0.9	No Sheen	< 0.05	< 0.15	< 0.1
SDN1	11/22/2022	1.14	9	0.28	0	0	347	6.7	16.1	No Sheen	0.199	0.508	0.309
SDN1	1/11/2023	1	56.33	0.08	0	0.02	45.167	7.4	8.2	No Sheen	0.101	0.201	< 0.1
SDN1	4/6/2023	0.53	25	0.07	0	0	66	7.6	4	No Sheen	0.165	0.366	0.201
SDW2	11/22/2022	1.14	9	0.28	0	0	347	7.9	1.7	No Sheen	< 0.05	< 0.15	< 0.1
SDW2	1/11/2023	1	56.33	0.08	0	0.02	45.167	7.8	1.4	No Sheen	< 0.05	< 0.15	< 0.1
SDW2	4/6/2023	0.53	25	0.07	0	0	66	8.2	2.3	No Sheen	< 0.05	< 0.15	< 0.1
SDW1B	11/22/2022	1.14	9	0.28	0	0	347	7.8	0.7	No Sheen	< 0.05	< 0.15	< 0.1
SDW1B	1/11/2023	1	56.33	0.08	0	0.02	45.167	7.6	1.4	No Sheen	< 0.05	< 0.15	< 0.1
SDW1B	4/6/2023	0.53	25	0.07	0	0	66	7.6	2.6	No Sheen	< 0.05	< 0.15	< 0.1
SDW1A	11/22/2022	1.14	9	0.28	0	0	347	7.2	1	No Sheen	< 0.05	< 0.15	< 0.1
SDW1A	3/1/2023	0.19	20.33	0.05	0	0.2	40.667	7.3	1.2	No Sheen	< 0.05	< 0.15	< 0.1
SDW1A	4/6/2023	0.53	25	0.07	0	0	66	7.4	1.9	No Sheen	< 0.05	< 0.15	< 0.1
SDN3A	11/22/2022	1.14	9	0.28	0	0	347	6.8	2.2	No Sheen	< 0.05	< 0.15	< 0.1
SDN3A	1/11/2023	1	56.33	0.08	0	0.02	45.167	7.3	3.2	No Sheen	< 0.05	< 0.15	< 0.1
SDN3A	4/6/2023	0.53	25	0.07	0	0	66	7.4	2.3	No Sheen	< 0.05	< 0.15	< 0.1
SDN2/3/4	11/29/2022	1.72	32	0.24	0	0.04	28	7.8	5.7	No Sheen	< 0.05	< 0.15	< 0.1
SDN2/3/4	1/11/2023	1	56.33	0.08	0	0.02	45.167	7.7	3	No Sheen	< 0.05	< 0.15	< 0.1
SDN2/3/4	4/6/2023	0.53	25	0.07	0	0	66	7.8	1.2	No Sheen	< 0.05	< 0.15	< 0.1
SDD06A	11/22/2022	1.14	9	0.28	0	0	347	7	1.8	No Sheen	< 0.05	< 0.15	< 0.1
SDD06A	1/11/2023	1	56.33	0.08	0	0.02	45.167	7	2.7	No Sheen	< 0.05	< 0.15	< 0.1
SDD06A	4/6/2023	0.53	25	0.07	0	0	66	6.7	2.6	No Sheen	< 0.05	< 0.15	< 0.1

3.1.5 Composite Sample Results and Discussion

For the 2022-2023 sampling period, the Port collected a total of 38 flow-weighted composite samples. Composite sample results are described separately from grab samples because grab samples represent an isolated segment of the storm event runoff. Composite sample results represent a flow-weighted average value over a longer time period. All composite sample data contained within this report and on the DMRs met the representativeness criteria of the Port's QAPP, which provides samples comparable with EPA methods (U.S. EPA 1992). Tabular results are presented at the end of this section and summary statistics are contained in **Appendix A**.

3.1.5.1 Copper

All data reported below are for total recoverable copper. The median copper concentration for all outfalls was 7.0 µg/L, with individual storm sample concentrations ranging from 1.0 µg/L to 30.9 µg/L. The permit effluent limit for copper at each outfall is variable based on a site-specific study and ranges from 25.6 µg/L to 59.2 µg/L depending on receiving water location.

There was only one (1) permit limit exceedance for copper during the monitoring year which occurred at the SDE4/S1 outfall on September 17, 2022. The copper exceedance is likely attributed to the long dry antecedent period prior to this first qualifying rain event. The Port cleans the SDE4 pond and replaces the SDE4 filter vault cartridges once a year during the summer months. This maintenance was performed in July 2022, well in advance of the September 17, 2022 rain event. The Port is researching if an initial soaking period of the filters could help with utilizing the full treatment capacity of the media for these first flush events, as the filter media generally arrives dry and remains dry until the wet season.

3.1.5.2 Zinc

All data reported are for total recoverable zinc. The median zinc concentration at all outfalls was 9 µg/L. Zinc concentrations ranged from 3 µg/L to 80 µg/L. There were no permit limit exceedances for zinc during the monitoring period.

Table 4. Composite Sample Data

Outfall	Storm Date	Precipitation Depth (in)	Duration (hr)	Max Intensity (in/hr)	24hr Antecedant (hr)	48hr Antecedant (hr)	Dry Antecedant (hr)	Cu Total mg/l	Zn Total mg/l
SDE4/SDS1	9/16/2022	0.13	1.58	0.12	0	0	317.5	0.0309	0.0411
SDE4/SDS1	11/22/2022	1.14	9	0.28	0	0	347	0.00959	0.0406
SDE4/SDS1	11/29/2022	1.72	32	0.24	0	0.04	28	0.00851	0.0447
SDE4/SDS1	1/11/2023	1	56.33	0.08	0	0.02	45.167	0.00744	0.0599
SDE4/SDS1	3/1/2023	0.19	20.33	0.05	0	0.2	40.667	0.00938	0.0802
SDE4/SDS1	4/6/2023	0.53	25	0.07	0	0	66	0.0109	0.0706
SDE4/SDS1	4/20/2023	0.36	15	0.07	0	0.1	31	0.0114	0.0642
SDS3/5	11/29/2022	1.72	32	0.24	0	0.04	28	0.0148	0.00882
SDS3/5	1/11/2023	1	56.33	0.08	0	0.02	45.167	0.0131	0.00605
SDS3/5	4/6/2023	0.53	25	0.07	0	0	66	0.00968	0.00629
SDS4	11/22/2022	1.14	9	0.28	0	0	347	0.0133	0.0131
SDS4	1/11/2023	1	56.33	0.08	0	0.02	45.167	0.0106	< 0.003
SDS4	4/20/2023	0.36	15	0.07	0	0.1	31	0.00542	< 0.003
SDS6/7	9/16/2022	0.13	1.58	0.12	0	0	317.5	0.0146	< 0.003
SDS6/7	11/29/2022	1.72	32	0.24	0	0.04	28	0.00533	0.00698
SDS6/7	1/11/2023	1	56.33	0.08	0	0.02	45.167	0.00566	< 0.003
SDS6/7	4/6/2023	0.53	25	0.07	0	0	66	0.00738	< 0.003
SDN1	11/22/2022	1.14	9	0.28	0	0	347	0.0113	0.0596
SDN1	1/11/2023	1	56.33	0.08	0	0.02	45.167	0.00748	0.0538
SDN1	4/6/2023	0.53	25	0.07	0	0	66	0.0109	0.0511
SDW2	11/22/2022	1.14	9	0.28	0	0	347	0.0061	0.00825
SDW2	1/11/2023	1	56.33	0.08	0	0.02	45.167	0.00444	0.00885
SDW2	4/6/2023	0.53	25	0.07	0	0	66	0.00478	< 0.003
SDW1B	11/22/2022	1.14	9	0.28	0	0	347	0.00828	0.00733
SDW1B	1/11/2023	1	56.33	0.08	0	0.02	45.167	0.00501	< 0.003
SDW1B	4/6/2023	0.53	25	0.07	0	0	66	0.0059	< 0.003
SDW1A	11/22/2022	1.14	9	0.28	0	0	347	0.00525	< 0.003
SDW1A	3/1/2023	0.19	20.33	0.05	0	0.2	40.667	0.00333	0.0227
SDW1A	4/6/2023	0.53	25	0.07	0	0	66	0.00363	< 0.003
SDN3A	11/22/2022	1.14	9	0.28	0	0	347	0.00317	0.0507
SDN3A	1/11/2023	1	56.33	0.08	0	0.02	45.167	0.00305	< 0.003
SDN3A	4/6/2023	0.53	25	0.07	0	0	66	0.00132	0.0123
SDN2/3/4	11/29/2022	1.72	32	0.24	0	0.04	28	0.0108	J 0.0198
SDN2/3/4	1/11/2023	1	56.33	0.08	0	0.02	45.167	0.00839	< 0.003
SDN2/3/4	4/6/2023	0.53	25	0.07	0	0	66	0.00705	< 0.003
SDD06A	11/22/2022	1.14	9	0.28	0	0	347	0.00419	0.0301
SDD06A	1/11/2023	1	56.33	0.08	0	0.02	45.167	0.00348	0.00676
SDD06A	4/6/2023	0.53	25	0.07	0	0	66	0.0048	0.00949

3.2 In Situ Toxicity Monitoring

The following sections discusses stormwater monitoring data related to the *in situ* monitoring program that was completed during fall 2022 and spring 2023.

The in situ monitoring approach utilizes the early life stage (ELS) salmonid bioassay testing procedure using rainbow trout that can be applied in a laboratory or field (i.e., in situ) context. The test encompasses a number of developmental milestones (e.g., hatching, yolk-sac absorption, etc.), and provides a variety of biological endpoints, such as survival and growth, that can be used to assess water quality.

Results from the in situ bioassays and supporting analytical data are intended to provide an indication of attainment of receiving water quality standards and associated beneficial uses related to salmonid spawning and rearing. Initial Phase 1 testing conducted previously demonstrated that the Rainbow Trout in situ ELS bioassay is an effective instream biological monitoring tool for assessing the potential effects of stormwater discharges on the receiving environment.

The sampling events conducted during this reporting period were completed under the Port's Permit, WA0024651, Part 2. 2S9, and are required to be conducted biannually in the fall and spring, corresponding to the spawning regimes of local salmonid species. Sampling was performed using the revised *Quality Assurance Program Plan: Storm Drainage System Receiving Water In-Situ Toxicity Testing* (Aspect 2021).

For a full discussion on results of the sampling, please refer to *Rainbow Trout Early Life Stages In Situ Monitoring Testing, Fall 2022 and Spring 2023 Testing Events* (Nautilus, 2023).

3.3 Additional Monitoring

The Port notified ECY of two additional incidents which led to monitoring and voluntary corrective actions. These incidents are summarized below.

3.3.1 SDN2/3/4 Pond Bypass

During a routine field inspection on November 22, 2022, it was discovered that a stormwater valve was improperly aligned which resulted in a portion of the SDN2/3/4 basin runoff to bypass the SDN2/3/4 pond and discharge directly to the rock lined outfall just east of the SDN2/3/4 Pond outlet.

Flows from the rock lined ditch are conveyed to Lake Reba and then to the Miller Creek Detention Facility which provides a large amount of detention to this basin

before discharging to the receiving waters. As a precaution, the Port sampled downstream of the SDN2/3/4 pond at the Lake Reba outfall and found that turbidity was 8.31 NTU and pH was 7.5 S.U. which are both in compliance with Part 2 permitted limits.

To address the issue of the valve being misaligned an internal investigation was completed but the Port was unable to determine the final cause. Takeaways from the investigation did result in corrective actions that will help prevent a reoccurrence, including:

- Removing valve wheel handle and locking to the structure
- Additional signage on the structure and adjacent structures communicating that adjustments of valves should be authorized by Aviation Environmental prior to adjustment
- Visual verification of valve adjustments by Aviation Environmental stuff during alignments
- Holistic evaluation of other valves that might be vulnerable to misalignment and implementation of the above steps for any identified structures
- Continued routine inspections of infrastructure which resulted in us finding this issue sooner rather than later

3.3.2 SDE4/S1 Des Moines Creek – Glycol Investigation

The Port was notified on March 3, 2023 that an unknown “gooey” substance had been observed in the east branch of Des Moines Creek just downstream of the SDE4/S1 outfall. An immediate investigation of the site and source tracing to identify the source was completed by Port staff.

The initial investigation led to the conclusion that the “goo” was likely a byproduct of microorganisms consuming propylene glycol. The source tracing identified a location on the airfield where deicing fluid was bypassing the Industrial Wastewater System (IWS) drainage infrastructure and entering the Storm Drainage System (SDS). The deicing fluid used at SEA contains propylene glycol as the active ingredient and is diluted with water to the desired ratio for application to aircraft. Subsequent samples from this site showed high Biochemical Oxygen Demand (BOD) levels that are indicative of the presence of propylene glycol.

Once the Port determined the substance was likely related to propylene glycol and not a naturally occurring bacterial slime, the Port contacted the ECY spill hotline on March

8th, 2023 to report the incident and received ERTS Incident #721270. The ECY Spill Response Program sent two staff on Thursday, March 9th to observe the affected areas of Des Moines Creek and provide recommendations on actions to mitigate the issue. Consultation between ECY and the Department of Fish and Wildlife resulted in a recommendation to clean goo from the creek in the areas of highest impact. The Port contracted with US Ecology, Inc. to perform creek cleaning on March 10, 2023. The contractor spent two days removing goo from rocks and tree roots along the creek banks and streambed. Care was taken not to disturb the streambed and create unnecessary turbidity in the creek.

To address the source of the propylene glycol upstream, a request was sent to Aviation Operations (AVOps) to determine if Deicing Pad 4 could be closed for the rest of the winter season until a permanent infrastructure fix could be implemented. AVOps confirmed with the airlines that this was operationally achievable, and the Port's Facilities and Infrastructure team began working on a temporary fix for this area. The Port also completed cleaning of the pipes between the source and the SDE4/S1 outfall. The temporary infrastructure fix has been completed as of July 27, 2023 and involved plugging the affected SDS catch basin and piping runoff from this catch basin across the infield area to a catch basin that is part of the IWS basin. This fix will allow for use of the deicing pad until a permanent fix can be provided in a future capital improvement project planned for 2025. The Port plans to monitor this area closely in the upcoming winter deicing season to ensure this temporary fix is working as intended.

The Port collected water quality data on dissolved oxygen, pH and BOD levels of the receiving water during the investigation and cleanup activities. A summary of this data was provided to ECY on July 20, 2023. No exceedances of the Port's NPDES permitted effluent limits were identified.

4.0 BMP Implementation

As outlined in the Comprehensive Stormwater Management Plan (2000), the Port evaluated, designed and constructed stormwater flow control and treatment BMPs to retrofit the entire airport which were phased in over several years from 2000 to 2006. The purpose of these efforts were to improve flow regimes in the receiving waters and implement BMPs that would allow the Port to meet or exceed stormwater quality treatment standards.

As development and re-development of SEA continues, stormwater requirements are assessed on a project by project basis using the Port's Stormwater Management Manual to determine applicable minimum requirements. During the design process, opportunities to implement Low Impact Development technologies are explored.

During the period covered by this report there were no significant changes or additions to the Port's BMPs triggered by capital projects; however, the oyster shell media in the SDD06A bioswales was replaced as part of the ongoing source tracing study of low pH in this basin. There are two upcoming projects to be implemented in the next 6 months at the SDD06A pond and the SDS1 swale with the same goal of increasing the pH buffering capacity of these basins through the addition of limestone spalls or oyster shell media.

5.0 SUMMARY AND CONCLUSIONS

During the reporting period from July 1, 2022 to June 30, 2023 the Port fulfilled all requirements for outfall monitoring under the current NPDES permit. The Port collected a total of 38 grab samples and 38 composite stormwater samples during 8 storm events. Outfalls were sampled quarterly for rain events that met the minimum rainfall criteria of 0.10 inches or greater that are preceded by less than 0.10 inch of rainfall in the previous 24 hours. There were two (2) instances of permit limit exceedances associated with 76 samples and 228 individual constituent analyses that were tested to meet the monitoring requirements of the NPDES permit.

To address the low pH non-compliances, the Port is implementing retrofits to the SDD06A and SDS1 BMPs which will include the addition of oyster shell media or limestone spalls to increase the pH buffering capacity of these basins.

The Port encountered two (2) incidents during this reporting period; the SDN2/3/4 pond bypass and the Des Moines Creek Glycol Investigation. These incidents resulted in notifications to ECY but ultimately did not result in any permit violations. The Port performed corrective actions and will continue to monitor areas as needed for continued compliance.

The Port has achieved a high level of compliance during this reporting period which is demonstrated by the two (2) instances of non-compliance across the hundreds of parameters that are being monitored. The Port's robust monitoring, response and adaptive management programs at SEA continue to be effective at mitigating impacts from airport operations on the adjacent receiving waters.

REFERENCES

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U.S. EPA 1993a. Stormwater discharges potentially addressed by Phase II of the NPDES program. Draft report to Congress. October 1993.

WDOE 2016. National Pollutant Discharge Elimination System permit No. WA0024651, effective January 1, 2016 by Washington Department of Ecology, Olympia, WA.

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APPENDIX A

TABULAR NPDES SAMPLE DATA SUMMARIES and STATISTICS

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Port of Seattle

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Summary of Storms Sampled 9/16/2022 - 4/20/2023

Storm Date	Depth, in.	Dur, hr	Max Int, in/hr	24hrant, in	48hrant, in	Dryant, hr	Dryant, Days	Load Factor	Event Type	Comment
4/20/2023	0.36	15	0.07	0	0.1	31	1.3	2.2	NPDES-Part II	
4/6/2023	0.53	25	0.07	0	0	66	2.8	4.6	NPDES-Part II	
3/1/2023	0.19	20.33	0.05	0	0.2	40.667	1.7	2.0	NPDES-Part II	
1/11/2023	1	56.33	0.08	0	0.02	45.167	1.9	3.6	NPDES-Part II	
12/8/2022	0.12	9	0.03	0.01	0.03	23	1.0	0.7	NPDES-Part II	
11/29/2022	1.72	32	0.24	0	0.04	28	1.2	6.7	NPDES-Part II	
11/22/2022	1.14	9	0.28	0	0	347	14.5	97.2	NPDES-Part II	
9/16/2022	0.13	1.58	0.12	0	0	317.5	13.2	38.1	NPDES-Part II	
Count	8	8	8	8	8	8	8	8		
Median	0.445	17.67	0.08	0	0.025	43	1.8	4.1		
Average	0.65	21	0.12	0.00	0.05	112	4.7	19.4		

load factor = maxint (in/hr)*dryant(hrs)

Event Type defined in Procedure Manual for Stormwater Monitoring

"dur" = rainfuall duration in hours

"24hrant" and "48hrant" is the total rainfall in the 24 and 48 hours preceding the event respectively

"dryant" is the duration of the antecedent dry period to the last measurable (0.01 in.) rainfall

Port of Seattle
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NPDES Grab Statistics 7/1/2022 - 6/30/2023

CONCENTRATION, mg/L

		pH	Sheen	TPH-Dx	TPH-D	TPH-MO	Turb
All Outfalls	Count	38	38	38	38	38	38
	Max	8.2		0.95	0.50	0.58	16.1
	95th	7.8		0.57	0.27	0.33	9
	75th	7.6		0.15	0.05	0.10	4
	Median	7.3		0.15	0.05	0.10	2.3
	25th	6.9		0.15	0.05	0.10	2
	Min	6.2		0.15	0.05	0.10	0.7
	SD	0.4		0.23	0.09	0.14	4
	CV%	6%		81%	85%	82%	73%
	#NonDetects	0	0	32	32	33	0
	%NonDetects	0%	0%	84%	84%	87%	0%
	#Trimmed	0	0	0	0	0	0
	%Trimmed	0%	0%	0%	0%	0%	0%
SDE4/SDS1 (002)	Count	7	7	7	7	7	7
	Max	7.1		0.90	0.32	0.58	11.5
	95th	7.0		0.77	0.30	0.47	10
	75th	6.9		0.31	0.15	0.15	6
	Median	6.7		0.15	0.05	0.10	5
	25th	6.5		0.15	0.05	0.10	4
	Min	6.2		0.15	0.05	0.10	2
	SD	0.3		0.29	0.12	0.18	3
	CV%	5%		95%	100%	97%	55%
	#NonDetects	0	0	5	5	5	0
	%NonDetects	0%	0%	71%	71%	71%	0%
	#Trimmed	0	0	0	0	0	0
	%Trimmed	0%	0%	0%	0%	0%	0%

Values qualified as non-detect (<) calculated at 1/2 the reported detection limit.

Port of Seattle
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NPDES Grab Statistics 7/1/2022 - 6/30/2023

CONCENTRATION, mg/L

		pH	Sheen	TPH-Dx	TPH-D	TPH-MO	Turb
SDS3/5 (005)	Count	3	3	3	3	3	3
	Max	7.6		0.15	0.05	0.10	4.4
	95th	7.6		0.15	0.05	0.10	4
	75th	7.4		0.15	0.05	0.10	3
	Median	7.3		0.15	0.05	0.10	2
	25th	7.2		0.15	0.05	0.10	2
	Min	7.0		0.15	0.05	0.10	1.2
	SD	0.3		0.00	0.00	0.00	2
	CV%	4%		0%	0%	0%	66%
	#NonDetects	0	0	3	3	3	0
	%NonDetects	0%	0%	100%	100%	100%	0%
	#Trimmed	0	0	0	0	0	0
	%Trimmed	0%	0%	0%	0%	0%	0%
SDS4 (009)	Count	3	3	3	3	3	3
	Max	7.2		0.15	0.05	0.10	1.6
	95th	7.2		0.15	0.05	0.10	2
	75th	7.1		0.15	0.05	0.10	2
	Median	6.9		0.15	0.05	0.10	1.6
	25th	6.7		0.15	0.05	0.10	2
	Min	6.5		0.15	0.05	0.10	1.5
	SD	0.4		0.00	0.00	0.00	0
	CV%	5%		0%	0%	0%	4%
	#NonDetects	0	0	3	3	3	0
	%NonDetects	0%	0%	100%	100%	100%	0%
	#Trimmed	0	0	0	0	0	0
	%Trimmed	0%	0%	0%	0%	0%	0%

Values qualified as non-detect (<) calculated at 1/2 the reported detection limit.

NPDES Grab Statistics 7/1/2022 - 6/30/2023

CONCENTRATION, mg/L

		pH	Sheen	TPH-Dx	TPH-D	TPH-MO	Turb
SDS6/7 (014)	Count	4	4	4	4	4	4
	Max	7.8		0.95	0.50	0.45	6.9
	95th	7.8		0.83	0.43	0.40	6
	75th	7.6		0.35	0.16	0.19	4
	Median	7.5		0.15	0.05	0.10	2.3
	25th	7.4		0.15	0.05	0.10	2
	Min	7.1		0.15	0.05	0.10	0.9
	SD	0.3		0.40	0.22	0.17	3
	CV%	4%		114%	138%	93%	85%
	#NonDetects	0	0	3	3	3	0
	%NonDetects	0%	0%	75%	75%	75%	0%
	#Trimmed	0	0	0	0	0	0
	%Trimmed	0%	0%	0%	0%	0%	0%
SDN1 (006)	Count	3	3	3	3	3	3
	Max	7.6		0.51	0.20	0.31	16.1
	95th	7.6		0.49	0.20	0.30	15
	75th	7.5		0.44	0.18	0.25	12
	Median	7.4		0.37	0.17	0.20	8.2
	25th	7.1		0.28	0.13	0.15	6
	Min	6.7		0.20	0.10	0.10	4
	SD	0.5		0.15	0.05	0.10	6
	CV%	7%		43%	32%	51%	65%
	#NonDetects	0	0	0	0	1	0
	%NonDetects	0%	0%	0%	0%	33%	0%
	#Trimmed	0	0	0	0	0	0
	%Trimmed	0%	0%	0%	0%	0%	0%

Values qualified as non-detect (<) calculated at 1/2 the reported detection limit.

Port of Seattle
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NPDES Grab Statistics 7/1/2022 - 6/30/2023

CONCENTRATION, mg/L

		pH	Sheen	TPH-Dx	TPH-D	TPH-MO	Turb
SDW2 (016)	Count	3	3	3	3	3	3
	Max	8.2		0.15	0.05	0.10	2.3
	95th	8.2		0.15	0.05	0.10	2
	75th	8.1		0.15	0.05	0.10	2
	Median	7.9		0.15	0.05	0.10	1.7
	25th	7.8		0.15	0.05	0.10	2
	Min	7.8		0.15	0.05	0.10	1.4
	SD	0.2		0.00	0.00	0.00	0
	CV%	3%		0%	0%	0%	25%
	#NonDetects	0	0	3	3	3	0
	%NonDetects	0%	0%	100%	100%	100%	0%
	#Trimmed	0	0	0	0	0	0
	%Trimmed	0%	0%	0%	0%	0%	0%
SDW1B (017)	Count	3	3	3	3	3	3
	Max	7.8		0.15	0.05	0.10	2.6
	95th	7.8		0.15	0.05	0.10	2
	75th	7.7		0.15	0.05	0.10	2
	Median	7.6		0.15	0.05	0.10	1.4
	25th	7.6		0.15	0.05	0.10	1
	Min	7.6		0.15	0.05	0.10	0.7
	SD	0.1		0.00	0.00	0.00	1
	CV%	2%		0%	0%	0%	61%
	#NonDetects	0	0	3	3	3	0
	%NonDetects	0%	0%	100%	100%	100%	0%
	#Trimmed	0	0	0	0	0	0
	%Trimmed	0%	0%	0%	0%	0%	0%

Values qualified as non-detect (<) calculated at 1/2 the reported detection limit.

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NPDES Grab Statistics 7/1/2022 - 6/30/2023

CONCENTRATION, mg/L

		pH	Sheen	TPH-Dx	TPH-D	TPH-MO	Turb
SDW1A (018)	Count	3	3	3	3	3	3
	Max	7.4		0.15	0.05	0.10	1.9
	95th	7.4		0.15	0.05	0.10	2
	75th	7.3		0.15	0.05	0.10	2
	Median	7.3		0.15	0.05	0.10	1.2
	25th	7.3		0.15	0.05	0.10	1
	Min	7.2		0.15	0.05	0.10	1
	SD	0.1		0.00	0.00	0.00	0
	CV%	1%		0%	0%	0%	35%
	#NonDetects	0	0	3	3	3	0
	%NonDetects	0%	0%	100%	100%	100%	0%
	#Trimmed	0	0	0	0	0	0
	%Trimmed	0%	0%	0%	0%	0%	0%
SDN3A (019)	Count	3	3	3	3	3	3
	Max	7.4		0.15	0.05	0.10	3.2
	95th	7.4		0.15	0.05	0.10	3
	75th	7.3		0.15	0.05	0.10	3
	Median	7.3		0.15	0.05	0.10	2.3
	25th	7.1		0.15	0.05	0.10	2
	Min	6.8		0.15	0.05	0.10	2.2
	SD	0.3		0.00	0.00	0.00	1
	CV%	4%		0%	0%	0%	21%
	#NonDetects	0	0	3	3	3	0
	%NonDetects	0%	0%	100%	100%	100%	0%
	#Trimmed	0	0	0	0	0	0
	%Trimmed	0%	0%	0%	0%	0%	0%

Values qualified as non-detect (<) calculated at 1/2 the reported detection limit.

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NPDES Grab Statistics 7/1/2022 - 6/30/2023

CONCENTRATION, mg/L

		pH	Sheen	TPH-Dx	TPH-D	TPH-MO	Turb
SDN2/3/4 (007)	Count	3	3	3	3	3	3
	Max	7.8		0.15	0.05	0.10	5.7
	95th	7.8		0.15	0.05	0.10	5
	75th	7.8		0.15	0.05	0.10	4
	Median	7.8		0.15	0.05	0.10	3
	25th	7.8		0.15	0.05	0.10	2
	Min	7.7		0.15	0.05	0.10	1.2
	SD	0.1		0.00	0.00	0.00	2
	CV%	1%		0%	0%	0%	69%
	#NonDetects	0	0	3	3	3	0
	%NonDetects	0%	0%	100%	100%	100%	0%
	#Trimmed	0	0	0	0	0	0
	%Trimmed	0%	0%	0%	0%	0%	0%
SDD06A (020)	Count	3	3	3	3	3	3
	Max	7.0		0.15	0.05	0.10	2.7
	95th	7.0		0.15	0.05	0.10	3
	75th	7.0		0.15	0.05	0.10	3
	Median	7.0		0.15	0.05	0.10	2.6
	25th	6.8		0.15	0.05	0.10	2
	Min	6.7		0.15	0.05	0.10	1.8
	SD	0.2		0.00	0.00	0.00	0
	CV%	3%		0%	0%	0%	21%
	#NonDetects	0	0	3	3	3	0
	%NonDetects	0%	0%	100%	100%	100%	0%
	#Trimmed	0	0	0	0	0	0
	%Trimmed	0%	0%	0%	0%	0%	0%

Values qualified as non-detect (<) calculated at 1/2 the reported detection limit.

Port of Seattle

EMIS

NPDES Grab Statistics 7/1/2022 - 6/30/2023

CONCENTRATION, mg/L

		pH	Sheen	TPH-Dx	TPH-D	TPH-MO	Turb
Landside (SDE4/SDS1, SDN1, SDD06A)	Count	13	13	13	13	13	13
	Max	7.6		0.90	0.32	0.58	16.1
	95th	7.5		0.66	0.28	0.42	13
	75th	7.0		0.37	0.17	0.20	7
	Median	6.9		0.15	0.05	0.10	4.2
	25th	6.7		0.15	0.05	0.10	3
	Min	6.2		0.15	0.05	0.10	1.8
	#NonDetects	0	0	8	8	9	0
	%NonDetects	0%	0%	62%	62%	69%	0%
	#Trimmed	0	0	0	0	0	0
	%Trimmed	0%	0%	0%	0%	0%	0%
Airfield (SDS3/5, SDS4, SDS6/7, SDW2, SDW1B, SDW1A, SDN3A, SDN2/3/4)	Count	25	25	25	25	25	25
	Max	8.2		0.95	0.50	0.45	6.9
	95th	7.9		0.15	0.05	0.10	5
	75th	7.8		0.15	0.05	0.10	3
	Median	7.5		0.15	0.05	0.10	1.9
	25th	7.2		0.15	0.05	0.10	1
	Min	6.5		0.15	0.05	0.10	0.7
	SD	0.4		0.16	0.09	0.07	1
	CV%	5%		88%	132%	61%	65%
	#NonDetects	0	0	24	24	24	0
	%NonDetects	0%	0%	96%	96%	96%	0%
	#Trimmed	0	0	0	0	0	0
	%Trimmed	0%	0%	0%	0%	0%	0%

load factor = maxint (in/hr)*dryant(hrs)

Values qualified as non-detect (<) calculated at 1/2 the reported detection limit.

Port of Seattle

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NPDES Grab Statistics 7/1/2022 - 6/30/2023

CONCENTRATION, mg/L

		TSS	Turb, NTU		E-Glycol	P-Glycol	Total Glycol	Cu	Pb	Zn
All Outfalls	Count							38		38
	Max							0.031		0.080
	95th							0.015		0.065
	75th							0.011		0.041
	Median							0.007		0.009
	25th							0.005		0.003
	Min							0.001		0.003
	SD							0.007		0.022
	CV%							68%		46%
	#NonDetects							0		13
	%NonDetects							0%		34%
	#Trimmed							0		0
	%Trimmed							0%		0%
SDE4/SDS1 (002)	Count							7		7
	Max							0.031		0.080
	95th							0.025		0.077
	75th							0.011		0.067
	Median							0.010		0.060
	25th							0.009		0.043
	Min							0.007		0.041
	SD							0.008		0.016
	CV%							65%		27%
	#NonDetects							0		0
	%NonDetects							0%		0%
	#Trimmed							0		0
	%Trimmed							0%		0%

Values qualified as non-detect (<) calculated at 1/2 the reported detection limit.

Port of Seattle
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NPDES Composite Statistics 7/1/2022 - 6/30/2023

CONCENTRATION, mg/L

		TSS	Turb, NTU		E-Glycol	P-Glycol	Total Glycol	Cu	Pb	Zn
SDS3/5 (005)	Count							3		3
	Max							0.015		0.009
	95th							0.015		0.009
	75th							0.014		0.008
	Median							0.013		0.006
	25th							0.011		0.006
	Min							0.010		0.006
	SD							0.003		0.002
	CV%							21%		22%
	#NonDetects							0		0
	%NonDetects							0%		0%
	#Trimmed							0		0
	%Trimmed							0%		0%
SDS4 (009)	Count							3		3
	Max							0.013		0.013
	95th							0.013		0.012
	75th							0.012		0.008
	Median							0.011		0.003
	25th							0.008		0.003
	Min							0.005		0.003
	SD							0.004		0.006
	CV%							41%		92%
	#NonDetects							0		2
	%NonDetects							0%		67%
	#Trimmed							0		0
	%Trimmed							0%		0%

Values qualified as non-detect (<) calculated at 1/2 the reported detection limit.

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NPDES Composite Statistics 7/1/2022 - 6/30/2023

CONCENTRATION, mg/L

		TSS	Turb, NTU		E-Glycol	P-Glycol	Total Glycol	Cu	Pb	Zn
SDS6/7 (014)	Count							4		4
	Max							0.015		0.007
	95th							0.014		0.006
	75th							0.009		0.004
	Median							0.007		0.003
	25th							0.006		0.003
	Min							0.005		0.003
	SD							0.004		0.002
	CV%							53%		50%
	#NonDetects							0		3
	%NonDetects							0%		75%
	#Trimmed							0		0
	%Trimmed							0%		0%
SDN1 (006)	Count							3		3
	Max							0.011		0.060
	95th							0.011		0.059
	75th							0.011		0.057
	Median							0.011		0.054
	25th							0.009		0.052
	Min							0.007		0.051
	SD							0.002		0.004
	CV%							21%		8%
	#NonDetects							0		0
	%NonDetects							0%		0%
	#Trimmed							0		0
	%Trimmed							0%		0%

Values qualified as non-detect (<) calculated at 1/2 the reported detection limit.

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NPDES Composite Statistics 7/1/2022 - 6/30/2023

CONCENTRATION, mg/L

		TSS	Turb, NTU		E-Glycol	P-Glycol	Total Glycol	Cu	Pb	Zn
SDW2 (016)	Count							3		3
	Max							0.006		0.009
	95th							0.006		0.009
	75th							0.005		0.009
	Median							0.005		0.008
	25th							0.005		0.006
	Min							0.004		0.003
	SD							0.001		0.003
	CV%							17%		48%
	#NonDetects							0		1
	%NonDetects							0%		33%
	#Trimmed							0		0
	%Trimmed							0%		0%

SDW1B (017)	Count							3		3
	Max							0.008		0.007
	95th							0.008		0.007
	75th							0.007		0.005
	Median							0.006		0.003
	25th							0.005		0.003
	Min							0.005		0.003
	SD							0.002		0.002
	CV%							26%		56%
	#NonDetects							0		2
	%NonDetects							0%		67%
	#Trimmed							0		0
	%Trimmed							0%		0%

Values qualified as non-detect (<) calculated at 1/2 the reported detection limit.

NPDES Composite Statistics 7/1/2022 - 6/30/2023

CONCENTRATION, mg/L

		TSS	Turb, NTU		E-Glycol	P-Glycol	Total Glycol	Cu	Pb	Zn
SDW1A (018)	Count							3		3
	Max							0.005		0.023
	95th							0.005		0.021
	75th							0.004		0.013
	Median							0.004		0.003
	25th							0.003		0.003
	Min							0.003		0.003
	SD							0.001		0.011
	CV%							25%		119%
	#NonDetects							0		2
	%NonDetects							0%		67%
	#Trimmed							0		0
	%Trimmed							0%		0%

SDN3A (019)	Count							3		3
	Max							0.003		0.051
	95th							0.003		0.047
	75th							0.003		0.032
	Median							0.003		0.012
	25th							0.002		0.008
	Min							0.001		0.003
	SD							0.001		0.025
	CV%							41%		115%
	#NonDetects							0		1
	%NonDetects							0%		33%
	#Trimmed							0		0
	%Trimmed							0%		0%

Values qualified as non-detect (<) calculated at 1/2 the reported detection limit.

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NPDES Composite Statistics 7/1/2022 - 6/30/2023

CONCENTRATION, mg/L

		TSS	Turb, NTU		E-Glycol	P-Glycol	Total Glycol	Cu	Pb	Zn
SDN2/3/4 (007)	Count							3		3
	Max							0.011		0.020
	95th							0.011		0.018
	75th							0.010		0.011
	Median							0.008		0.003
	25th							0.008		0.003
	Min							0.007		0.003
	SD							0.002		0.010
	CV%							22%		113%
	#NonDetects							0		2
	%NonDetects							0%		67%
	#Trimmed							0		0
	%Trimmed							0%		0%
SDD06A (020)	Count							3		3
	Max							0.005		0.030
	95th							0.005		0.028
	75th							0.004		0.020
	Median							0.004		0.009
	25th							0.004		0.008
	Min							0.003		0.007
	SD							0.001		0.013
	CV%							16%		83%
	#NonDetects							0		0
	%NonDetects							0%		0%
	#Trimmed							0		0
	%Trimmed							0%		0%

Values qualified as non-detect (<) calculated at 1/2 the reported detection limit.

Port of Seattle

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NPDES Composite Statistics 7/1/2022 - 6/30/2023

CONCENTRATION, mg/L

		TSS	Turb, NTU		E-Glycol	P-Glycol	Total Glycol	Cu	Pb	Zn
Landside (SDE4/SDS1, SDN1, SDD06A)	Count							13		13
	Max							0.031		0.080
	95th							0.019		0.074
	75th							0.011		0.060
	Median							0.009		0.051
	25th							0.007		0.041
	Min							0.003		0.007
	#NonDetects							0		0
	%NonDetects							0%		0%
	#Trimmed							0		0
	%Trimmed							0%		0%
Airfield (SDS3/5, SDS4, SDS6/7, SDW2, SDW1B, SDW1A, SDN3A, SDN2/3/4)	Count							25		25
	Max							0.015		0.051
	95th							0.014		0.022
	75th							0.010		0.009
	Median							0.006		0.003
	25th							0.005		0.003
	Min							0.001		0.003
	SD							0.004		0.010
	CV%							53%		123%
	#NonDetects							0		13
	%NonDetects							0%		52%
	#Trimmed							0		0
	%Trimmed							0%		0%

load factor = maxint (in/hr)*dryant(hrs)

Values qualified as non-detect (<) calculated at 1/2 the reported detection limit.

APPENDIX B

Quality Control Samples

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QC Samples Dups - 7/1/2022-6/30/2023

																Metals	
Outfall	Sample	Storm	depth	dur	maxint	ant24	ant48	dryant	Event Type	Sub Type	Comp Type	Type	Purpose	Grnd Deice	Comment	Cu Total mg/l	Zn Total mg/l
SDE4/SDS1	SDE4/S1091722DUPC	9/16/2022	0.13	1.58	0.12	0	0	317.5	NPDES-Part II	flow-wt comp	EMC	FD	FldQC	No		0.031	0.0377
SDE4/SDS1	SDE4/S1113022DUPC	11/29/2022	1.72	32	0.24	0	0.04	28	NPDES-Part II	flow-wt comp	EMC	FD	FldQC	No		0.00844	0.0468
SDS3/5	SDS3/5113022DUPC	11/29/2022	1.72	32	0.24	0	0.04	28	NPDES-Part II	flow-wt comp	EMC	FD	FldQC	No		0.0151	0.00913
SDS6/7	SDS6/7113022DUPC	11/29/2022	1.72	32	0.24	0	0.04	28	NPDES-Part II	flow-wt comp	EMC	FD	FldQC	No		0.00501	0.00851
SDN1	SDN1040723DUPC	4/6/2023	0.53	25	0.07	0	0	66	NPDES-Part II	flow-wt comp	SMC	FD	FldQC	No		0.0114	0.0507
SDW2	SDW2040723DUPC	4/6/2023	0.53	25	0.07	0	0	66	NPDES-Part II	flow-wt comp	SMC	FD	FldQC	No		0.00465	< 0.003
SDN2/3/4	SDN2/3/4113022DUPC	11/29/2022	1.72	32	0.24	0	0.04	28	NPDES-Part II	flow-wt comp	SMC	FD	FldQC	No		0.0102	
SDN2/3/4	SDN2/3/4113022DUPC	11/29/2022	1.72	32	0.24	0	0.04	28	NPDES-Part II	flow-wt comp	SMC	FD	FldQC	No	Results are J flagged due to RPD >20% of primary and duplicates samples. Batch LCS was within recovery acceptance and both samples are well below exceedance criteria, therefore results are deemed acceptable.		J 0.015

QC Samples Blanks - 7/1/2022-6/30/2023

																Metals	
Outfall	Sample	Storm	depth	dur	maxint	ant24	ant48	dryant	Event Type	Sub Type	Type	Comp Type	Purpose	Grnd Deice	Comment	Cu Total mg/l	Zn Total mg/l
SDN8	SDN8091722COMP	9/16/2022	0.13	1.58	0.12	0	0	317.5	NPDES-Part II	discreet series	EB		FldQC	No		< 0.00025	< 0.003
SDN8	SDN8113022COMP	11/29/2022	1.72	32	0.24	0	0.04	28	NPDES-Part II	discreet series	EB		FldQC	No		< 0.00025	< 0.003
SDN8	SDN8041023COMP	4/6/2023	0.53	25	0.07	0	0	66	NPDES-Part II	discreet series	EB		FldQC	No		< 0.00025	< 0.003

Selected Date Range; 7/1/2022-6/30/2023; Values Qualified as (<) are included as 1/2 the reported Detection Limit; Rejected Values not included.