Seattle's Source Control Plan for the Lower Duwamish Waterway (2021 – 2026) December 2020 Update


Before inspection


After inspection

Seattle

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Acronyms and Abbreviations

AKART	All known, available and reasonable methods of prevention, control and treatment
AOC	Administrative Order on Consent
As	Arsenic
BA	Benzoic acid
BAl	Benzyl alcohol
BBP	Butyl benzyl phthalate
BEHP	Bis(2-ethylhexyl)phthalate
CB	Catch basin
Cu	Copper
COC	Chemical of concern
cPAH	Carcinogenic polycyclic aromatic hydrocarbons = sum of benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene
CSCSL	Confirmed and suspected contaminated site list
CSL	Cleanup screening level per Washington State Department of Ecology Sediment Management Standards (WAC 173-204)
CSO	Combined sewer overflow
DMP	Dimethyl phthalate
Ecology	Washington State Department of Ecology
EOF	Emergency overflow
EPA	U.S. Environmental Protection Agency
ERTS	Environmental report tracking system
HPAH	High molecular weight polycyclic aromatic hydrocarbons = sum of benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k) fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, pyrene
KC	King County
LAET	Lowest apparent effects threshold (dry weight equivalent of the sediment cleanup objective)
2LAET	Second lowest apparent effects threshold (dry weight equivalent of cleanup screening level)
LDW	Lower Duwamish Waterway
LDWG	Lower Duwamish Waterway Group (City of Seattle, King County, Port of Seattle, and The Boeing Company)
LPAH	Low molecular weight polycyclic aromatic hydrocarbons = sum of acenaphthene, acenaphthylene, anthracene, fluorene, naphthalene, phenanthrene
Hg	Mercury
MEP	Maximum extent practicable
mg/kg	milligrams per kilogram
MH	Maintenance hole

MS4	Municipal separated storm sewer system per the National Pollutant Discharge Elimination System program
MTCA	Washington State Model Toxics Control Act (WAC 173-340)
NEP	Near end-of-pipe
ng/kg	nanogram per kilogram
NOV	Notice of violation
NPDES	National Pollutant Discharge Elimination System
ODS	Outside drainage system. For source tracing purposes, ODS samples include soil, surface dirt, or other material such as paint or caulk.
Parks	Seattle Department of Parks and Recreation
Pb	Lead
PCBs	Polychlorinated biphenyls
PS	Pump station
RAL	Remedial action level
RCB	Catch basin located in the public right-of-way
ROW	Right of way
RI/FS	Remedial Investigation/Feasibility Study
SCIP	Source Control Implementation Plan.
SCIP 1	City of Seattle Source Control Implementation Plan for 2015-2020
SCIP 2	City of Seattle Source Control Implementation Plan for 2021-2026
SCO	Sediment cleanup objective per Washington State Department of Ecology Sediment Management Standards (WAC 173-204)
SD	Storm drain
SDCI	Seattle Department of Construction and Inspections
SDOT	Seattle Department of Transportation
SMS	Sediment Management Standards (WAC 173-204)
SPU	Seattle Public Utilities
TEQ	Toxicity equivalent. Calculated using the following toxicity equivalency factors for cPAH per Lower Duwamish Water Group:

benzo(a)anthracene:	0.1
benzo(a)pyrene	1
benzo(b)fluoranthene	0.1
benzo(k)fluoranthene	0.1
chrysene	0.01
dibenz(a,h)anthracene	0.4
indeno(1,2,3-cd)pyrene	0.1

TPH	Total petroleum hydrocarbons per method NWTPH-Dx (diesel extended)
ug/kg dw	micrograms per kilogram, dry weight
WSDOT	Washington State Department of Transportation
Zn	Zinc

1. INTRODUCTION

This report presents Seattle's Source Control Implementation Plan (SCIP) for the Lower Duwamish Waterway (LDW) for the period 2021 to 2026. It is the City's second 5-year plan, presenting information on the City's source control efforts over the past five years and plans for the next five years. The SCIP is developed by Seattle to describe the results and actions focused on source control in the Lower Duwamish Waterway, present information for use in the LDW Superfund sufficiency evaluation, and meet the requirements of Appendix 13 of the 2019-2024 National Pollutant Discharge Elimination System (NPDES) Phase I Municipal Stormwater Permit.

The remedial design phase of the cleanup began in 2016 with the release of the 3rd Administrative Order on Consent (AOC) for the Lower Duwamish Waterway Superfund site, which directed the Lower Duwamish Waterway Group (LDWG) to conduct predesign studies needed to advance the implementation of the Selected Remedy for the LDW (EPA 2016). Seattle has incorporated pertinent data generated as part of these pre-design studies, to assess source control actions and develop priorities for future source control activities. Since then, in 2018, the U.S. Environmental Protection Agency (EPA) issued the 4th AOC (EPA 2018) which initiated the design of the remedy for river mile 3.0 to 5.0 (Upper Reach). Design is expected to occur over the next 4 years, with cleanup currently scheduled to begin in late 2024.

Seattle has taken the waterway cleanup schedule into account in developing this plan and although the City has a relatively small footprint in the Upper Reach compared to other areas in the LDW, Seattle intends to revisit the Upper Reach to ensure that source controls are in place so that cleanup can proceed. The City's source control program over the next five years will also focus on the Middle Reach (mile 2.2 to 4.0) where several City outfalls discharge to the waterway. As in the previous SCIP, Seattle's goal over the next five years is to minimize the potential for waterway sediments to exceed the Remedial Action Levels (RALs) set by EPA (Table 1). While meeting the RALs in the offshore sediment is Seattle's goal, it is important to understand that due to the urban and industrial nature of the Duwamish watershed, low levels of contaminants are ubiquitous and will continue being discharged to the waterway during and after cleanup. No amount of source control efforts would eliminate these low-level discharges.

Table 1: LDW remedial action levels.

Chemical	Units	Remedial Action Level	
		LDW-wide	Intertidal
Arsenic	mg/kg	57	28
PCBs	mg/kg	12	65
	µg/kg dw	130[a]	1,000[a]
cPAH	µg TEQ/kg dw	1,000	900
Dioxins/furans	ng TEQ/kg dw	25	28
Benthic SMS	--	2 x SCO[b]	--

Source: EPA (2014).

a. Approximate dry-weight equivalent of the organic carbon normalized value.

b. 10-year post-construction target to meet SCO.

Preventing recontamination and planning longer term objectives will require collaboration among the agencies with jurisdiction, including the Washington State Department of Ecology (Ecology), EPA, and King County. The City assumes that long-term objectives will be established as part of the Ecology led Source Control Program for implementation of the Record of Decision for the LDW. The City will coordinate with Ecology and the other agencies to establish the long-term objectives and incorporate them into source control plans.

This plan describes work conducted to identify and control sources in the LDW since Seattle's 2015-2020 Source Control Implementation Plan (Seattle 2016) was published (covering the period July 1, 2014 through June 30, 2019) and explains the City's source control program in the LDW for the next five years (2021 – 2026). It also describes what has been done and learned up to now and new strategies and improvements that will be tried and evaluated in the future. Future expansion or changes to the City source control program over the next five years will be predicated on available funding and resources and guided by lessons learned as the program is refined to address future conditions and the upcoming waterway cleanup in the upper reach of the LDW (RM 3.0 to 5.0).

Background information about the City's stormwater and wastewater infrastructure are provided in Section 2. Summary of findings from Seattle's LDW-specific business inspection, source tracing, and line cleaning programs, are provided in Sections 3, 4, and 6, respectively. Section 9 describes the City's planned source control activities for the next five years and Section 11 describes mechanisms for reporting progress to Ecology.

1.1. APPROACH

In developing this plan, the City used a three-pronged approach: (1) document current source control activities in the LDW, (2) prioritize drainage basins/systems in the LDW, and (3) develop plan for next five years and prioritize future program enhancements. The City used multiple lines of evidence to prioritize drainage basins/systems so that future activities could be focused on the most critical areas. Priority basins were selected as follows:

- Locations where elevated levels of contaminants were found in both offshore sediment samples collected in the vicinity of the outfall and storm drain solids samples collected from the downstream end of the drainage system (i.e., near end-of-pipe samples).
- Locations where storm drain solids contaminant concentrations are significantly higher than in other drains in the LDW, which suggests the presence of a unique source(s) in that basin.
- Locations where offshore sediments were predicted to exceed the sediment RAL based on the sediment transport/bed composition model that was developed during the LDW Feasibility Study.

Priority basins were then ranked using the following criteria:

- Evidence of ongoing sources and pollution-generating activities in the basin based on business inspection findings.
- Drainage basin size, which provides an indication of pollutant loading potential.
- Multiple and recurring exceedances of source tracing triggers for chemicals of concern identified in waterway sediment, which indicates need for additional source tracing.
- Land use characteristics such as percentage of industrial use in the basin.

A detailed description of how basins were prioritized is provided in Appendix J.

Future program improvements are included in this plan and are listed in each section as enhancements.

2. BACKGROUND

Seattle Public Utilities (SPU) has implemented an aggressive source control program in the LDW drainage basin since early 2003. At that time, LDWG's municipal partners (e.g., City of Seattle, King County, and Port of Seattle), began to coordinate their efforts to identify and reduce sources of contamination to the LDW. EPA and Ecology were also beginning to develop a comprehensive strategy for controlling sources to the LDW; the final version was published by Ecology in 2004. Ecology's strategy was last updated in 2016.

Since its start in 2003, Seattle's source control program has been successful in identifying and controlling sources of contaminants to the LDW. SPU's source control program includes activities specifically designed to support the cleanup of the waterway, as well as activities that are employed citywide as part of the City's stormwater management program. The LDW-specific activities that Seattle must implement are contained in Appendix 13 Ecology's NPDES Phase I Municipal Stormwater Permit. While the SCIP describes both stormwater and wastewater systems, Appendix 13 requirements are only applicable to the municipal storm sewer system (MS4). The program includes more comprehensive and frequent business inspections than in other parts of the City. The Appendix 13 LDW-specific activities include focused source sampling, an effectiveness monitoring program, targeted line-cleaning, and an annual prioritization process. Citywide activities that support source control efforts in the LDW include the spill response program, water quality complaint response program, illicit discharge detection and elimination program, operations and maintenance of the City-owned drainage and wastewater systems and properties, stormwater code development and implementation, drainage system retrofits and other capital improvements, public education and outreach, and interdepartmental coordination. These programs are described in Appendix F.

2.1. DRAINAGE AND WASTEWATER SYSTEMS IN THE LDW

The City owns and operates most of the municipal systems that collect stormwater and wastewater from homes and businesses throughout Seattle. King County owns the conveyance system that transports the stormwater/wastewater from the City trunk lines to the treatment plants. Both the City and County wastewater collection systems overflow to the Duwamish when there are combined sewer overflows (CSOs). When the system was originally built early in the 1900's, stormwater and wastewater were collected in the same pipes and the combined sewage was discharged to a receiving water body, including the Duwamish. Later some of the combined sewage was routed to a treatment plant, such as the one that Seattle built near Diagonal Ave S and E Marginal Wy S in 1940.

In 1961, following the formation of METRO, the City and METRO agreed that METRO would take over ownership and operation of the combined sewer trunk lines, collection pipes and associated overflow points for large (1,000 acres or more) basins.[1] The City continued operating the local collection system and overflow points for smaller basins, which conveyed combined stormwater and wastewater to METRO's trunk lines. METRO agreed to "accept" the City's sewage and took responsibility for treating it.

In 1985 the Washington Legislature enacted a requirement that combined sewer overflows be reduced at the earliest possible date. The Department of Ecology directed METRO to reduce the volume of overflows from its CSOs by 75 percent by the year 2005. METRO determined that separating stormwater from sanitary sewage would be the fastest and most cost-effective means to reach that goal. METRO and the City worked together to separate stormwater from wastewater in several drainage basins. The consequence of that effort was that more untreated stormwater was discharged to local water bodies. As our understanding of stormwater impacts has evolved and stormwater regulations were promulgated, CSO control projects have more recently focused on using green stormwater infrastructure to mitigate stormwater impacts to the combined sewer system.

Due to this history, the City currently is served by three kinds of drainage systems[2]:

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[1] The Metropolitan Sewerage System shall thus include trunk or interceptor sewer facilities extending to a point within each tributary, and natural drainage area, where not more than one thousand acres remain to be served beyond the upper terminus of such trunk or interceptor sewer. Basic Agreement, p. 2.

[2] The drainage system is termed the Municipal Separate Storm Sewer System (MS4) by Ecology and EPA.

- Separate storm sewer system where stormwater is collected in storm drains, which discharge directly to the receiving water bodies and wastewater is collected in a sanitary sewer system which conveys flow to the King County conveyance system and treatment plants at West Point or Renton.
- Combined sewer system where stormwater and wastewater are collected in a single pipe and flow is routed to the treatment plants via the King County conveyance system. During large storm events, combined flows can exceed the capacity of the conveyance system. When this occurs, excess flows are discharged to the nearest waterway via an overflow structure to keep wastewater/stormwater from backing up into homes, businesses, and on City streets. Seattle and King County both operate combined sewer overflows (CSOs) in Seattle. Seattle currently has only one CSO in the Lower Duwamish. It is located at the Diagonal Ave S CSO/SD.
- Partially separated system where runoff from streets is generally collected in a separate storm drain system, but runoff from private properties (e.g., rooftops, yards, parking lots, and other areas) continues to discharge to the combined sewer system. These areas were once served by the combined sewer system, but the City and METRO later constructed storm drain separation projects that diverted street runoff from the combined system. Most of these separation projects were constructed in the 1960-1990s, typically to reduce the occurrences of combined sewer overflows.

A total of approximately 20,000 acres discharges to the LDW Superfund Site through private and public pipes, including approximately 8,940 acres of land in south Seattle, Georgetown, South Park, the City of Tukwila, and unincorporated King County that are served by separated storm drains (private and public) and approximately 20,000 acres that are served by combined sewers[3] owned by the City of Tukwila, King County and Seattle.

Average annual runoff is estimated at about 4,100 million gallons per year based on average rainfall conditions (1986) with an expected range of approximately 3,100 to 5,300 million gallons per year for typical dry (1993) and wet years (2002), respectively (SPU 2008)[4]. Average annual CSO discharges for the period 2014-2018 from a combination of King County's CSOs (195,877,000 gallons per year) and SPU's single CSO (362,000 gallons per year) in the LDW are estimated at approximately 196 million gallons per year.

Most of the Duwamish waterfront areas discharge stormwater directly to the LDW via privately-owned storm drains or sheet flow. Upland areas are typically served by a variety of private and public (i.e., City of Seattle, Port of Seattle, City of Tukwila, King County, and Washington Department of Transportation [WSDOT]) drainage systems. Seattle owns 18 active stormwater outfalls within the LDW study area. Seattle City Light (SCL) owns three of the City storm drain outfalls, which only serve the Duwamish Substation. Seattle also discharges to 15 other outfalls in the LDW that are owned by King County, WSDOT, City of Tukwila, or private entities.

In addition, Seattle operates three emergency overflows that discharge sewage to outfalls owned by King County and the City of Tukwila. Emergency overflows are located on sanitary sewer force mains to relieve backups due to pump station failure or mechanical clogging. All of the sanitary sewer pump stations in the LDW are equipped with backup generators, so these systems are not affected by power outages.

Outfalls owned or used by the City of Seattle in the LDW are listed in Table 2 and shown on Map 1. The source control activities described in this plan are applicable to the portions of these systems located within the City-owned MS4.

3 Because much of the area in the LDW is partially separated, the separated storm and combined sewer basins overlap.

4 Annual stormwater runoff was estimated from land use, soil type, slope, and rainfall using a simplified Hydrologic Simulation Program-Fortran (HSPF) model.

Table 2: Outfalls in the LDW that are owned or used by City of Seattle.

Outfall	Currently Owned or Built By[m]	River Side	Outfall Number [a]	Map Number [b]	Seattle Use	Area (acres) [c]	Diameter (inches)
Upper Reach							
16th Ave S SD (east)	Tukwila	East	3031 3032	4, 57	SD	3.2	12
KCIA SD#2/ PS 78 EOF	King County	East	2062	--	EOF	0	48
KCIA SD#1	King County	East	2080	5, 31, 58	SD	114	30
S Norfolk CSO/PS 17 EOF/SD	Tukwila	East	2095	6, 32, 59	EOF, SD	431 [d] 1,060 [e]	84
I5 SD at S Ryan St	WSDOT	East	NA	7	SD	407	60
16th Ave S SD (west)	King County	West	2215	8	SD	1.3	12
17th Ave S SD	Seattle	West	NA	9, 34, 60	SD	2.9	18
S 96th St SD	Private	West	2100	10, 35, 61	SD	99	72
Duwamish substation SD#3	Seattle	West	NA	11, 62	SD	1.9	8
Duwamish substation SD#2	Seattle	West	2098	11, 62	SD	1	8
Duwamish substation SD#1	Seattle	West	2099	11, 62	SD	0.6	8
W Marginal Pl S SD	Tukwila	West	2200	11, 62	SD	4.9	30
Middle Reach							
Head of Slip 2 SD	Private	East	2019	12, 36, 63	SD	12[o]	24
1st Ave S SD (east)	WSDOT	East	2503	13, 37, 64	SD	15	36
S River St SD	Seattle	East	NA	14, 38, 65	SD	7.6	8
S Brighton St SD	Seattle	East	NA	15, 39, 66	SD	19	30
S Myrtle St SD	Seattle	East	2026	16, 40, 67	SD	8.6	30
S Garden St SD	Private	East	2035	17, 41	SD	1.5	30
I5 SD at Slip4	WSDOT	East	2046	18, 42, 68	SD	65 [f]	72
Georgetown SD	Seattle	East	2047	19, 43, 69	SD	4.5	24
North Boeing Field SD [g]	Seattle	East	None	--	None	0	24
KCIA SD #3/PS44 EOF	King County	East	2049	--	EOF	0	60
SW Kenny St SD/T115 CSO	Seattle	West	2127	20, 44, 70	SD	154 100 [e]	48
Highland Park Wy SW SD	Seattle	West	2125	21, 45, 71	SD	296 [h]	72
1st Ave S SD (west)	WSDOT	West	NA	22, 46, 72	SD	606	Channel
2nd Ave S SD	Private	West		23, 47, 73	SD	18.4	36 [n]
West Seattle reservoir overflow	Seattle	West	2120	--	Water [i]	None	36
S Webster St SD	Seattle	West	2113		SD	j	6
7th Ave S SD	Seattle	West	2112	24, 48, 74	SD	238	72

Outfall	Currently Owned or Built By[m]	River Side	Outfall Number a	Map Number b	Seattle Use	Area	Outfall
Lower Reach							
S Nevada St SD	Seattle	East	NA	25, 49, 75	SD	26	18
Diagonal Ave S CSO/SD	Seattle	East	2155	26, 27 50, 51 736, 77	CSO, SD	415 [k] 1,500 2,666	144
SW Dakota St SD	Seattle	West	2253	28, 52, 78	SD	47 [l]	30
SW Idaho St SD	Seattle	West	2147	29, 53, 79	SD	423	72
South Ops Center SD [p]	Seattle	West	--	30	SD	6	30

SD = storm drain, CSO = combined sewer overflow, EOF = emergency overflow, (D) = drainage area, (C) = combined sewer area, PS = pump station, Ops = Operations

Note: outfalls are listed in order from downstream end of waterway to upstream end of waterway starting with outfalls located on the east side followed by those on the west side of the waterway
624 / 5,000 / 2,613 = City CSO basin area / King County CSO basin area / separated drainage basin

a. Number from the Herrera (2004) outfall survey used by Ecology to identify outfalls.
b. Refer to Map Atlas for maps. Maps are grouped by 1) drainage basin area, 2) business inspections, spills, and water quality complaints 3) samples collected in each drainage system.
c. Drainage area in City MS4.
d. Includes portion of S Norfolk CSO/PS 17 EOF/SD drainage basin that can discharge to the I-5 SD at S Ryan St during large storm events.
e. King County combined sewer basin
f. An additional 85 acres from I-5 and railroad right-of-way drain to this outfall
g. This storm drain is no longer active.
h. Does not include the approximately 7.3 acre overlap within the 1st Ave S drainage basin.
i. Overflow from drinking water reservoir. No drainage connections.
j. A single catch basin in S Riverside Dr is connected to this outfall.
k. Seattle combined sewer service area, King County combined sewer service area, and drainage basin, respectively.
l. An additional 9 acres drains to the constructed channel that discharges to the LDW downstream (i.e., east) of the City's outfall. See Section 5.3.3.
m. Entity that is currently responsible for the outfall.
n. Upstream end of private pipe.
o. Includes areas served by private storm drains. City MS4 includes 7 catch basins on E Marginal Wy S and one on 1st Ave S.
p. Formerly known as Herrings House outfall.

2.1.1. City Storm Drains

The City-owned MS4 serves an area of about 5,500[5] acres in the LDW. Stormwater runoff from the City-owned MS4 is discharged to the LDW via 32 outfalls, 17 of which are owned by the City. Maps 4-30 show the basin areas for outfalls owned by the City of Seattle and outfalls that the City uses to discharge stormwater and/or wastewater from City-owned systems.

2.1.2. Combined Sewer Overflows

The City and King County both operate and maintain combined sewer overflows (CSOs) in the LDW. This plan does not address actions in CSO basins as SPU and King County are currently developing and implementing Long Term Control Plans to address these discharges and associated potential sources of pollutants. The information

5 Includes portions of the I-5 corridor and railroad right-of-way that have not been separately delineated.

is provided to summarize CSOs that discharge via City-owned outfalls in the LDW. CSO basins are shown on Map 3.

Only one City outfall in the LDW is affected by CSOs, the Diagonal Ave S CSO/SD. Both the City (CSO 111) and King County (Hanford #1) combined sewer systems overflow to the Diagonal Ave S CSO/SD outfall. CSO 111 serves an area of approximately 416 acres of mostly industrial and commercial property. The area is partially separated. CSO 111 had 8 separate overflow locations into the Diagonal Ave S system (111A through 111H), but two were sealed in 2011 (111E and 111F) after records showed that these structures had not overflowed since at least 1998 and modeling indicated that these locations had a low probability of ever overflowing in the future (CH2M Hill et al. 2012). Overflow records are summarized in Table 3.

In 2005, SPU modified the overflow structure on the largest overflow point (111D) to allow more flow to enter the King County system for treatment at its West Point facility. In 2014, SPU raised the overflow weirs at outfalls B and C. SPU has been monitoring the system and updated the basin model in 2018. Modeling indicates that raising the weirs has decreased the frequency of overflows at CSO 111 from 1.9 to 1.2 times per year on average (SPU 2019).

CSO 111 was included in the Long-Term Control Plan (LTCP) that SPU prepared to control CSOs throughout the City (CH2M Hill et al. 2015).[6] It identified the following control measures for CSO 111:

- Offline storage for overflows 111B 111C to be provided by modifying existing control structures and rerouting storm drains to isolate the structures. Two new effluent pump stations will also be installed.
- Offline storage for overflow 111H.

Table 3: CSO 111 overflow records (2007-2018).

Year	No. of Overflows	Duration (hrs)	Total Volume (gallons)	Rainfall Total (inches)
2007	11	134	9,489,000	31.8
2008	0	0	0	29.3
2009	9	7	3,800	37.7
2010	6	41	1,720,740	45.6
2011	2	18	723	35.8
2012	4	28	314,968	47.6
2013	3	4	11,507	27.9
2014	3	17	146,654	46.8
2015	3	6.6	1,056,402	39.9
2016	0	0	0	45.2
2017	2	5.9	317,148	44.5
2018	1	2.8	56,370	33.7
2019	1	8	1,401,251	29.3

The Diagonal outfall also receives overflows from King County's Hanford #1 (Hanford at Rainier) CSO. The Hanford #1 CSO serves an area of about 4,800 acres[7] of industrial and commercial land. Overflows from this system discharge to the Diagonal Ave S CSO/SD via King County's regulator station located at 8th Ave S and S Hanford St. Annual overflows from the King County Hanford #1 CSO to the City's Diagonal Ave S CSO/SD for 2014-2018 ranged from a minimum of 24,557,000 gallons in 2018 to a maximum 78,288,000 gallons in 2014 and averaged 57,414,00 gallons per year (King County 2015 through King County 2019). Control of the Hanford #1

[6] http://www.seattle.gov/util/EnvironmentConservation/Projects/SewageOverflowPrevention/IntegratedPlan/index.htm

[7] Total area served by the combined sewer. Includes about 1,500 acres that drain to the combined sewer in this area (Phillips 2013).

CSO is addressed in King County's CSO control plan. For further information, see King County's website at http://www.kingcounty.gov/environment/wastewater/CSO/Library/PlanUpdates.aspx.

2.1.3. Emergency Overflows

Seattle operates three emergency overflows on sanitary pump stations in the LDW. As explained above, EOFs are relief points on sanitary force mains to prevent sewer backups should the pump fail, or a blockage occur in the line. These discharges are regulated as sanitary sewer overflows (SSO). SPU is required to submit an Environmental Incident Report Form to Ecology's Environmental Report Tracking System (ERTS) for any sanitary sewer overflow immediately after the time the City becomes aware of the discharge, has assessed the situation, taken appropriate steps to control the discharge, and submit a letter report to Ecology within five business days. The report describes 1) the reason for the discharge, 2) date and duration of the discharge, 3) estimated time the discharge is expected to continue if it has not been corrected, 4) estimated discharge volume, and 5) steps taken or planned to reduce, eliminate, or prevent future occurrences. Records from 2009-2019 indicate that EOFs occur infrequently (Table 4).

Table 4: Emergency overflow records.

Pump Station	Outfall	Reported EOFs		
		Date	Duration (hrs)	Volume (gallons)
17	Norfolk CSO/PS17 EOF/SD	12/12/10[a]	6.8	1,300,000[b]
17	Norfolk CSO/PS17 EOF/SD	02/19/17[c]	5.2	47,075
44	KCIA SD#2/PS44 EOF	12/12/10[a]	4.4	72,000
45/78[d]	KCIA SD#2/PS45 EOF	--	--	--
45	KCIA SD#2/PS44 EOF	02/19/17	0.2	100
NA[e]	7966 Perimeter Rd S	09/19/19	68	320,000

a. Seattle rain gauges recorded a 50- to 100-year event on December 11-12, 2010. Under these conditions, inflow and infiltration can overwhelm the capacity of the sewer system, because City systems are not designed to handle this size storm event.
b. Worst case estimate. No evidence that duckbill valve opened to allow flow from the sanitary sewer to discharge to the storm drain. SPU crews did not observe any evidence of sewage in the ditch downstream of the duckbill valve (e.g., toilet paper, rags).
c. Pump station capacity exceeded
d. PS78 overflows to PS45.
e. Overflow occurred at MH 072-037 due to blockage in sanitary sewer line caused by vandals (plywood dumped in maintenance hole). Sewage flowed down ditch and entered KCIA SD #1 drainage system. SPU removed approximately 3,000 gallons of sewage from ditch and surface soil from about 800 feet of ditch.

3. BUSINESS INSPECTION PROGRAM

SPU inspects businesses in the LDW to ensure that they are complying with City Stormwater Code requirements for pollution prevention. Inspections are conducted as a part of the NPDES Municipal Stormwater Permit requirements as well as for targeted source tracing activities when a pollutant is discovered through sediment sampling activities. Businesses are assigned a risk ranking, which is based on the potential for the business to impact the MS4, and this ranking determines the frequency of inspection that the business will be held to. This frequency may be adjusted due to reported spill or water quality incidents and source tracing sampling results in the proximity of these properties. During the current reporting period, SPU conducted nearly 1,300 inspections

at 655 businesses in the LDW[8]. Inspection locations are shown on Maps 31-54. A list of businesses inspected is provided in Appendix G.

A detailed description of SPU's inspection program is provided in Appendix A. Improvements made over the past 5 years are summarized below:

- **New database**. In 2018, SPU converted to a new database based on the Microsoft Dynamics platform, which is now available to inspectors in the field on mobile tablet computers via a secure server connection. The database is also accessible on smartphone via the Resco Cloud platform. It merges records from the previously separate business inspection, spill response, water quality complaint, and stormwater facility inspection databases into a single integrated repository, which improves information sharing and allows inspectors to be better prepared with a full history of business' past performance across multiple disciplines.
- **Messaging**. Inspectors were trained to emphasize the required corrective actions and the enforcement process, which improved the rate and pace of business compliance.
- **Re-inspections**. When possible, inspectors attempt to create a re-inspection appointment during the initial inspection meeting. This practice reinforces the concept of the compliance deadline and improves compliance rate.
- **Shortened enforcement process**. The enforcement process has been modified by removing the "Second and Final" letter. Enforcement now transitions to a Notice of Violation with a suspended penalty immediately following the first re-inspection.
- **Technical assistance**. Inspectors have improved business compliance through increased dissemination of best management practice literature as enclosures or attachments in corrective action letters.
- **Inspection checklist**. To improve inspector efficiency, the checklist was modified to focus on violations of the City of Seattle Stormwater code and related best management practices. Information related to hazardous waste, vehicle use, industrial wastewater, and other elements of the business that did not directly relate to the business inspection process was eliminated from the checklist.

3.1. CORRECTIVE ACTIONS

When inspectors find violations of the stormwater code and/or potential sources of pollutants impacting the stormwater drainage system, they require businesses to implement corrective actions to address these violations or control these sources. All violations found are noted in the corrective action letters issued to businesses, and all issues are required to be addressed in order to close out the inspection cycle. With the 2019 changes to the data base, corrective actions are now tied directly to the BMP requirements in the City Stormwater Manual. Prior to 2019, SPU tracked 26 different corrective actions in the Business Inspection Database. The new database tracks 87 corrective actions. See Appendix L for a list of corrective actions that SPU currently tracks.

To enable comparison between SCIP 1 and SCIP 2, corrective actions have been organized by BMP in Table 5. As of June 30, 2019, inspectors have found problems that required corrective actions at 1,042 of the over 1,700 businesses inspected.[9] Approximately 40 percent of the 7,175 corrective actions required between 2003 and 2019 were associated with spill control and cleanup practices. Twenty-three percent were associated with stormwater practices, such as cleaning and mapping onsite drainage systems or illicit connections/discharges.

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[8] Inspection numbers exceed business numbers because businesses may be inspected more than once during an inspection cycle to achieve compliance with Seattle Stormwater Code.

[9] Includes business located in the combined sewer basin.

Table 5: Summary of corrective actions.

Corrective Action Category	Number of Violations 2003 – 2014	% of Total Violations	Number of Violations 2014 – 2019	% of Total Violations
Spill plan	758	14.7%	281	13.9%
Clean onsite catch basins	543	10.5%	280	13.9%
Spill kit	602	11.7%	202	10.0%
Stormwater and spill response training	582	11.3%	219	10.8%
Referral to partner agency	582	11.3%	199	9.9%
Illicit connection, prohibited discharge	445	8.7%	121	6.0%
Spill cleanup	143	2.8%	58	2.9%
Container storage	352	6.8%	143	7.1%
Perform routine site maintenance	326	6.3%	148	7.3%
Solid waste storage	295	5.7%	12	0.6%
Repair, map, or install drainage infrastructure	139	2.7%	145	7.2%
Cleaning and washing	160	3.1%	58	2.9%
Storage of leachable or erodible materials	112	2.2%	100	5.0%
Equipment and vehicle repair	53	1.0%	24	1.2%
Material transfer / loading/ unloading	39	0.8%	11	0.5%
Vehicle and equipment fueling	23	0.5%	20	1.0%
Total	5154	71.8%	2021	28.6%

3.1.1. Notices of Violation

From 2014 to 2019, SPU issued 49 Notices of Violation (NOV) letters to businesses in the LDW (see Appendix H). Most NOVs were associated with illicit connections and/or discharges (25) followed by failure to implement appropriate BMPs (15), broken or clogged side sewer (8), and failure to report spill (3). On some occasions, businesses were issued NOV letters citing more than one code violation. SPU started issuing monetary penalties in 2009. Penalties are often suspended if the business corrects the problem within the specified time period. During this reporting period, penalties were suspended for 34 of the NOVs. Penalties ranged from $500 to $4,500.

3.1.2. Referrals

From 2014 to 2019, SPU referred 85 sites to other agencies or other City Departments for follow-up. If there are hazardous waste handling, labelling, or disposal issues, the site is referred to King County Hazardous Waste program (small quantity generators) or Ecology (large quantity generators). If there are industrial waste issues (e.g., process waste being discharged to the sanitary or combined sewer), the site is referred to King County Industrial Waste program. Businesses found to be contributing pollutants to the MS4 that cannot be appropriately controlled through the Corrective Action or NOV processes may be referred to the Ecology Water Quality program as a potential significant contributor.

A list of referrals in provided in Appendix I. Referrals are summarized by agency below:

King County Hazardous Waste 8

King County Industrial Waste 20

Ecology Hazardous Waste Program 5

It is difficult to track status once a site has been referred to another agency. SPU typically only tracks progress of those sites referred to another City department or another division within SPU.

4. SOURCE TRACING/SAMPLING PROGRAM

This section describes the City's sampling efforts to identify and characterize sources of contaminants discharged to and from the City-owned drainage system. SPU conducts source tracing to determine the extent and location of contaminants within the drainage system. Sampling is designed to identify sources by sampling at key locations within these systems. Sampling generally starts at the downstream end of the system or at key junctions within the system and systematically moves upstream to identify sources. In addition, inspectors also collect samples from catch basins on private property during business inspections if problems or unusual conditions are encountered during the inspection. SPU refers to these as "private onsite catch basin" samples.

Data generated by the sampling program are used to:

- Identify sources of contaminants to the City-owned MS4
- Characterize the quality of storm drain solids discharged to the LDW for use in recontamination analyses
- Identify and prioritize City-owned MS4 sections for cleaning.

Source tracing is an iterative process and although fairly straightforward, in practice it can be difficult to locate individual sources. Tracing works best when contaminants associated with a site are significantly elevated and the site discharges into a relatively flat section of pipe where material can accumulate.

A detailed description of SPU's source tracing program is provided in Appendix A.

4.1. 2014-2019 PROGRESS

4.1.1. Source Tracing

Between July 1, 2014 and June 30, 2019, SPU collected 370 source tracing samples from 22 storm drains in the LDW drainage basin. Samples were collected in 14 of the 17 city-owned outfalls and 8 of the other 15 outfalls used by Seattle plus four other outfalls in the LDW (Table 6). Sample locations are shown on Maps 55-79. Box plots of the sample results for select chemicals are provided in Appendix B. A detailed description of the source tracing results for each major drainage basin discharging to outfalls either owned by or used to discharge stormwater and/or wastewater from City-owned systems is provided in Appendix C and a summary of the specific sources identified to date is provided in Appendix D.

Table 6: Summary of source tracing samples collected in the LDW (July 2014 through June 2019).

City-owned outfalls	Sample Type	Other outfalls[b]	Sample Type
Upper Reach			
17th Ave S SD	Trap, inline, ODS, CB	16th Ave S SD (east)	Inline
Duwamish substation SDs[a]	Inline, CB	KCIA SD #1	Inline
		S Norfolk St CSO/PS17 EOF/SD	Trap, inline, CB, ODS
		I5 SD at S Ryan St	None[c]

City-owned outfalls	Sample Type	Other outfalls[b]	Sample Type
Upper Reach			
		16th Ave S SD (west)	None
		S 96th St SD	Inline
		W Marginal Pl S SD[a]	Inline
City-owned outfalls	**Sample Type**	**Other outfalls[b]**	**Sample Type**
Middle Reach			
1st Ave S SD (east)	Inline	Head of Slip 2 SD	Inline
S River St SD	Inline, CB, ODS	S Garden St SD	None
S Brighton St SD	Inline, CB, ODS	I5 SD at Slip 4	Trap, inline
S Myrtle St SD	Trap, inline, CB	KCIA SD#2/PS78 EOF	None
Georgetown SD	Inline	KCIA SD #1	None
SW Kenny St SD/T115 CSO	Trap	1st Ave S SD (west)	Trap, inline, CB, ODS
Highland Park Wy SW SD	Trap, inline, CB	2nd Ave S SD	CB
S Webster St SD	CB		
7th Ave S SD	Trap, inline, CB, ODS		
City-owned outfalls	**Sample Type**	**Other outfalls[b]**	**Sample Type**
Lower Reach			
S Nevada St SD	Inline, CB	Diagonal Ave S SD	None
Diagonal Ave S CSO/SD	Trap, inline, CB	South Ops Center SD	None
SW Dakota St SD	Inline		
SW Idaho St SD	Trap, CB		

Note: Outfalls are listed in order from upstream end of the waterway to downstream end of the waterway starting with outfalls located on the east side followed by those on the west side of the waterway
Trap = inline sediment trap, CB = catch basin grab sample, inline = inline grab sample
ODS = outside drainage system (e.g.., soil or street dirt, and other materials such as paint or caulk)

a. Samples collected by Ecology (Leidos 2015) in Duwamish Substation SD#2 and #3 plus W Marginal Pl SD
b. Receives discharges from City-owned stormwater and/or wastewater collection systems.
c. Sampling attempted, but not enough sediment present for chemical analysis.

Sample counts by sample type are summarized in Table 7.

Table 7: Source tracing sample counts by sample type (July 2014 through June 2019).

Sample Type	Count
Sediment trap	124
Inline grab	91
Private onsite catch basin grab	104
Right-of-way catch basin grab	51
Soil/street dirt	40
Total	410

In 2014-2019, SPU installed new traps at 6 locations (Table 8). Traps were installed to provide near end-of-pipe data for future sufficiency analyses or to support source tracing efforts.

Table 8: New traps installed 2014-2019.

Reach	Year	Number	Storm Drain	Purpose		
				Long term monitoring[a]	Sediment trap pilot	Source tracing
Upper	2017	1	17th Ave S SD	X		
Middle	2016	1	S Myrtle St SD[b]	X	X	
Middle	2016	1	Diagonal Ave S CSO/SD[b]		X	
Middle	2018	3	Diagonal Ave S CSO/SD			X

a. Traps installed near the downstream end of the system to support long term monitoring/source control sufficiency evaluation.

b. Modified-Norton (SPU's old trap), Portland's SIFT, Hamlin, and 2 versions of SPU's lower profile bowl-style traps installed at two field test locations in 2016. Traps were retrieved in 2017, 2018, and 2019. The 2017 samples were analyzed for grain size. The 2018 and 2019 samples were analyzed for chemistry and grain size when there was enough material. SPU plans to retrieve these test sediment traps in 2020 to compare trap style performance. After 2020, the field test traps in Diagonal Ave S CSO/SD will be replaced with modified Norton traps for source tracing purposes and the traps in S Myrtle St SD will be replaced by the low profile bowl-style trap to evaluate near end of pipe contributions to the LDW over the long term.

SPU currently maintains sediment traps at 28 locations in 10 of the major storm drains discharging to the LDW to monitor the quality of solids discharged to the LDW and in larger basins where multiple traps are installed, to isolate contributions from major sub-basins contributing to the outfall. Trap installations are summarized in Table 9 and shown on Map 87.

Table 9: Sediment traps maintained by SPU in the LDW.

Storm drain	Trap Type	No. of traps	Year Installed	Last sampled by SPU
Upper Reach				
17th Ave S SD	Modified-Norton	1	2017	May 2019
S Norfolk St CSO/PS17 EOF/SD	Modified-Norton	5	2007	April 2019
Middle Reach				
S Myrtle St SD	a	1	2016	May 2019
I5 SD at Slip 4	Modified-Norton	1	2005	April 2019
SW Kenny St SD/T115 CSO	Modified-Norton	1	2008	April 2019
Highland Park Wy SW SD	Modified-Norton	2	2008	April 2019
1st Ave S SD (west)	Modified-Norton	5	2008	April 2019
7th Ave S SD	Modified-Norton	3	2008	April 2019
Lower Reach				
Diagonal Ave S CSO/SD	a	6	2003-2016	April 2019
SW Idaho St SD	Modified-Norton	3	2008	April 2019
Total		28		

a. Sediment trap pilot test location. Modified-Norton, SIFT, Hamlin, and SPU's new bowl style traps are installed in the two most downstream maintenance holes in the S Myrtle St SD and at Airport Wy S and S Spokane St in the Diagonal Ave S CSO/SD.

4.2. Overview by Chemicals Found in Storm Drain Solids Samples (2003 – 2019)

This section summarizes results of SPU source tracing efforts in the City MS4 for the entire period of record (2003-2019). Data analysis focuses on results for the following chemicals of concern in waterway sediment and chemicals commonly found in storm drain solids samples collected from the City MS4 and from catch basins on private property that drain to the MS4.

- Arsenic
- Copper
- Lead
- Mercury
- Zinc
- Bis(2-ethylhexyl) phthalate (BEHP)
- Low molecular weight polycyclic aromatic hydrocarbons (LPAH)
- High molecular weight polycyclic aromatic hydrocarbons (HPAH)
- Polychlorinated biphenyls (PCBs)
- Carcinogenic polycyclic aromatic hydrocarbons (cPAH).

LPAH = Sum of acenaphthene, acenaphthylene, anthracene, anthracene, fluorene, naphthalene, and phenanthrene.

HPAH = Sum of benzo(a)anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, total benzofluoranthenes, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, and pyrene.

cPAH = Total toxic equivalent concentration calculated as the sum of benzo(a)pyrene, benzo(a)anthracene, total benzofluoranthenes, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene adjusted using the toxicity equivalency factors specified in WAC 173-340-900.

Overall results, which combine data from nearly 700 samples (inline grabs, inline sediment traps, and grab samples collected from private catch basins and catch basins in the right-of-way), are summarized in Table 10 and discussed in the following sections. Chemicals of concern in the LDW sediment are frequently detected in City storm drains, but for most contaminants (i.e., arsenic, copper, lead, mercury, LPAH, HPAH, and cPAH), concentrations are relatively low with only occasional exceedances of the SMS screening levels. The major exceptions are zinc, PCBs, and bis(2-ethylhexyl)phthalate (BEHP), butyl benzyl phthalate, and dimethyl phthalate where SCO exceedances occur in 55, 46, 76, 77, and 49 percent of the samples, respectively. However, CSL/2LAET exceedances of zinc (13 percent) and PCBs (4 percent) are uncommon. Only BEHP frequently exceeds both the LAET and 2LAET screening (73 and 65 percent of the samples, respectively).

Detailed discussions of sampling results for the period of record are presented in the following locations in this report:

- Results for the entire period of record for inline samples collected near the downstream end of each MS4 drainage system are summarized in Section 4.3. SPU considers these near end-of-pipe inline samples to be most representative of storm drain solids discharged to the waterway.
- Box plots for each chemical by outfall are provided in Appendix B.
- Discussion of results by outfall are provided in Appendix C.
- Discussion of major sources identified to date and status of source control activities are provided in Appendix D.
- Discussion of the process used to prioritize the City's source sampling activities over the next five years is provided in Appendix J.

Table 10: Summary statistics for select contaminants in drain solids collected from the City MS4.

	Count	% Detect	SCO/ LAET	CSL/ 2LAET	Min	Max	Mean	Median	% of samples greater than SCO/ LAET	% of samples greater than CSL/ 2LAET
Arsenic	705	53	57	93	<4.6	452	12	10	1	1
Copper	700	100	390	--	<19.2	10,900	230	110	8	--
Lead	703	99	450	530	<6	40,500 [f]	220	80	5	4
Mercury	701	74	0.41	0.59	<0.02	48	0.28	0.084	7	5
Zinc	700	100	410	960	41	10,100	700	460	55	19
LPAH	688	94	5,200	--	<15	95,700	1,800	530	6	--
HPAH	688	98	12,000	17,000	<19	585,400	9,000	2,975	11	8
cPAH	688	98	1,000[a]	--	<18	84,000	1,100	360	17	--
PCBs	688	81	130	1,000	<9.3	46,060[e]	540	110	46	7
BEHP	688	99	1,300	1,900	<22	1,400,000	13,000	5,350	76	71
BBP	688	72	63	900	<19	160,000	1,700	280	77	17
DMP	688	25	71	160	<18	36,000	210	116	49	22
TPH-Oil No cleanup[c]	512	99	2,000[b]	--	<32	250,000	4,600	5,100	55	--
TPH-Oil Silica gel clean[d]	176	100	2,000[b]		17.8	24,000	3,000	3,000	58	--

BEHP = bis(2-ethylhexyl)phthalate, BBP = butyl benzyl phthalate, DMP = dimethyl phthalate, TPH = total petroleum hydrocarbons, PCBs = polychlorinated biphenyls, PAH = polycyclic aromatic hydrocarbons, cPAH = carcinogenic PAH
All units in dry weight. Metals and TPH-oil: mg/kg Organics, except cPAH: ug/kg cPAH: ug TEQ/kg

Includes all samples collected in the MS4 between 2003 and June 30, 2019 (i.e., inline grabs, inline traps, private catch basins, and catch basins in the right-of-way), except for samples collected prior to line cleaning. If lines were cleaned prior to 2019, only the most recent, post-cleaning samples are included, as line cleaning activities would have removed pre-cleaning contamination. See the description of line cleaning activities in section 6 for additional information.

a. Remedial Action Level (RAL) for the LDW.
b. MTCA Method A soil cleanup level for industrial and unrestricted use.
c. No cleanup prior to analysis. Results may include naturally occurring (i.e., polar) hydrocarbons.
d. Silica gel and acid cleaned prior to analysis. Cleanup step used for all samples collected after 2016 to remove polar hydrocarbons.
e. Does not include samples collected in the storm drain on Denver Ave S where a PCB spill was discovered in 2019. See Section 7.1.1.
f. Inline grab sample collected in 2019 in Diagonal Ave S CSO/SD from discrete deposit beneath a lateral entering at ST2 from the adjacent property. Lead in the three sediment trap samples collected at this location were below the SCO.

When a sample exceedance of any chemical of concern is received, source tracing activities are conducted to attempt to find and eliminate the source of these materials. The SPU Source Control business inspectors are notified of the exceedance and tasked with trying to find the source and remove the contamination. This process often involves additional sampling, localized focused business inspections, and follow up line cleaning activities by either SPU or a private business to remove residual contamination.

Chemical concentrations are typically higher in samples collected from private onsite catch basins compared to right-of-way catch basins. This is expected given that onsite samples are usually collected either 1) during a business inspection when inspectors observe high-risk pollution generating activities and/or problems with the business' pollution prevention practices or 2) as the last step in source tracing to confirm that a particular site is a source of contaminants to the City storm drain system. When these sources are discovered, corrective actions are issued to eliminate the discharge through modifications to storage or operations. Catch basins or drainage lines are cleaned to remove the accumulated materials.

4.2.1. Arsenic

Arsenic continues to be found infrequently and at low concentrations in the City MS4. As a result, SPU does not consider arsenic a chemical of concern for municipal storm drain discharges. It has been detected in only 53 percent of the 705 samples collected in the MS4 since 2003 (sample count does not include samples that were collected before lines were cleaned as part of SPU's source control program in the LDW)[10] and exceeded the SCO and CSL screening levels in 1 percent (9 samples) and 1 percent (7 samples) of the samples collected, respectively.

The highest concentration (452 mg/kg) was found in an inline grab sample collected in 2019 at the sediment trap pilot test station in the Diagonal Ave S CSO/SD. None of the three sediment trap samples collected at this location in 2019 (7.42-15.4 mg/kg) exceeded the SCO. Other samples that exceeded the SCO screening level (57 mg/kg) include:

- Private onsite catch basins (3 samples)
- Diagonal Ave S CSO/SD (5 inline grab samples collected at various locations in the drainage system). None of the 35 inline samples collected near the downstream end of the Diagonal Ave S CSO/SD system have exceeded the SCO, which indicates that this outfall is not a significant contributor of arsenic to the waterway.
- SW Kenny CSO/SD (1 inline grab sample collected at the downstream end of the system in 2013). However, none of the sediment trap samples and none of the inline samples collected after 2013 exceeded SQS for arsenic.

Arsenic exceeded the SCO in less than two percent of the surface sediment samples collected from the waterway and none of these sampling locations is near an outfall that is owned by the City or that receives stormwater and/or wastewater from a City-owned system (AECOM 2012a). See Appendix J for detailed description of SMS exceedances in waterway samples collected near outfalls.

4.2.2. Copper

Copper was detected in all 700 samples collected in the MS4 after cleaning or in pipes that have not been cleaned, but exceeded the SCO/CSL screening level in only eight percent of the samples. Over half (32) of the 53 samples that exceeded SCO/CSL were collected from private onsite catch basins. Nearly half (9) of the remaining 21 samples that exceeded SCO/CSL were collected in drains (S Myrtle St SD and S Brighton St SD) that are near a large metal recycling facility where fugitive dust emissions have been an ongoing problem. SPU anticipates that actions required as part of a recent lawsuit with be effective in reducing fugitive dust emissions from this site.

[10] Post cleaning samples and samples collected from pipes that have not been cleaned are considered representative of current conditions in the City MS4. SPU started cleaning storm drains in the LDW in about 2008. See Section 6 for a description of line cleaning activities.

In addition, copper has exceeded the SCO/CSL in near end-of-pipe samples collected from only three outfalls S Myrtle St SD, S Garden St SD, Highland Park Wy SW SD, and the 1st Ave S SD [east]). Seven of the 10 exceedances occurred in the S Myrtle St SD and one occurred in the Highland Park Wy SW SD before, but not after it was cleaned.

Copper exceeded the SCO in only about one percent of the 1,994 surface sediment samples collected from the waterway (Windward 2019) and with the exception of one sample collected 100 feet upstream of the 2nd Ave S SD, none of these sampling locations is located within 200 feet of an outfall that is owned by the City or that receives stormwater and/or wastewater from a City-owned system (Windward 2010). See Appendix J for a detailed description of SMS exceedances in waterway samples collected near outfalls.

4.2.3. Lead

Lead was detected in all 703 samples collected in the MS4 after lines were cleaned as part of SPU's LDW source control program or in locations where no cleaning has occurred. Five percent of these samples exceeded the SCO screening level and four percent exceeded the CSL screening level. Like copper, lead exceeded the CSL in near end-of-pipe samples collected from only the S Myrtle St and S Garden St storm drains.

Lead exceeded the SCO in only about two percent of the 2,124 surface sediment samples collected from the waterway (Windward 2019). The 2nd Ave S SD (Trotsky Inlet), which is a private outfall, is the only outfall that receives stormwater and/or wastewater from a City-owned system where lead exceeded SCO within 200 feet of the outfall (AECOM 2012a). See Appendix J for a detailed description of SMS exceedances in waterway samples collected near outfalls. Based on these data, it does not appear that the City MS4 is a significant contributor of lead to waterway sediment.

4.2.4. Mercury

Mercury was detected in 74 percent of the 701 samples collected in the MS4 after lines were cleaned or in locations where no cleaning has occurred but exceeded the SCO and CSL screening levels in only 7 and 5 percent of the samples, respectively. Elevated concentrations are generally associated with industrial activities. CB116, a private onsite catch basin at a former small scrap/waste recycling facility[11] contained the highest concentrations of mercury (10.5 – 48 mg/kg). Elevated mercury levels were also found at recycling (0.8 – 1.55 mg/kg), battery (2.05 mg/kg), machine shop (2.2 – 4.3 mg/kg), and equipment design/testing (0.66 0.86 mg/kg) businesses. Only one of these businesses (Seattle Iron and Metals Company) has an NPDES Industrial Stormwater Permit from Ecology.

Mercury concentrations were also elevated (3.3-7.6 mg/kg) in inline samples collected from a small sub-basin of the Diagonal Ave CSO/SD drainage basin, located near Airport Wy S and 7th Ave S. SPU has cleaned the storm drain lines and conducted extensive source tracing efforts in this area but has not yet identified a source. However, as shown in Figure 1, mercury concentrations in the near end-of-pipe samples collected from the Diagonal Ave S CSO/SD have been below SCO in 28 out of 32 samples. King County has found that mercury concentrations can be quite variable in field replicate samples, due to matrix effects. SPU intends to continue tracking mercury in the Diagonal Ave S CSO/SD system.

[11] This property at 7620 2nd Ave S has been vacated and the yard area swept. The site is currently occupied by a theatre company and Cam Grinders, Inc., a machine shop specializing in reconditioning gas and diesel engine blocks, crankshafts, camshafts, connecting rods, and cylinder heads. SPU inspected site in 2017 and required owner to clean onsite catch basins.

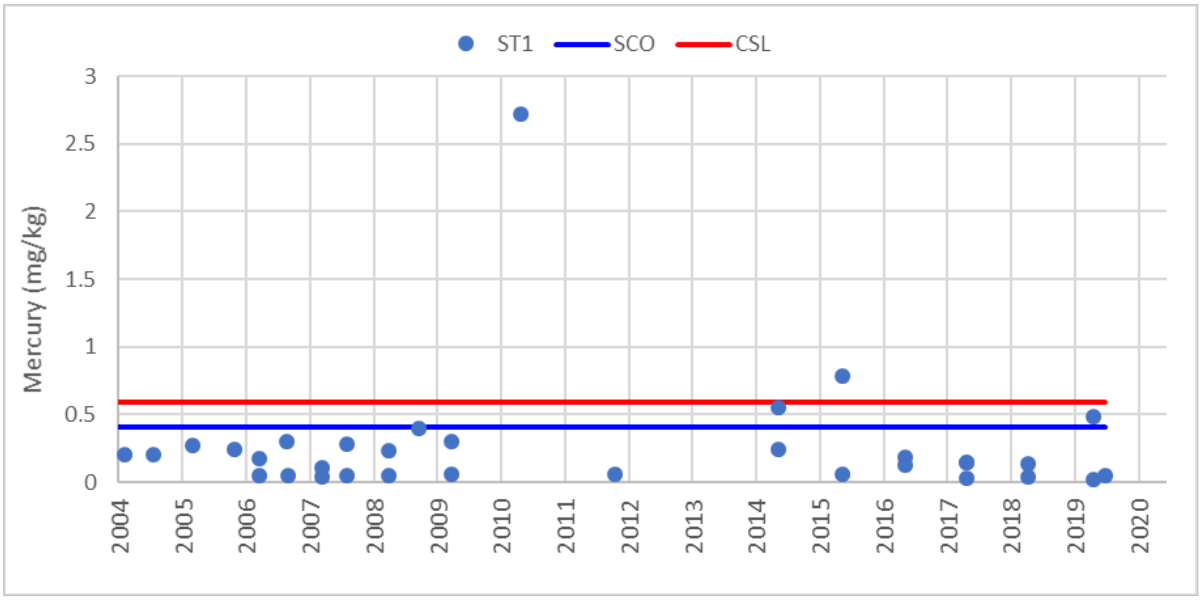


Figure 1: Mercury in Diagonal Ave S CSO/SD near end-of-pipe samples.

Only 4 percent of the 1,958 surface sediment samples collected in the LDW were greater than the SCO and less than the CSL, while 3 percent of the samples were greater than the CSL (Windward 2019). Slip 4, Trotsky inlet, S Myrtle St SD, and 7th Ave SD are the only sampling locations where SMS exceedances occurred near an outfall that either is owned by the City or that receives stormwater and/or wastewater from a City-owned system. One sample collected 165 feet offshore of the Diagonal Ave S CSO/SD outfall exceeded the SCO for mercury, but none of the samples collected within 100 feet of the outfall exceeded the SCO. In addition, none of the samples collected since the 2004-2005 Diagonal Duwamish Early Action Area cleanup have exceeded the SCO for mercury. See Appendix J for a detailed description of SMS exceedances in waterway samples collected near outfalls.

4.2.5. Zinc

Zinc was detected in all 703 samples collected in the MS4 after lines were cleaned as part of SPU's LDW source control program or in locations where no cleaning has occurred. Fifty-five (55) percent of the samples exceeded the SCO screening level and 19 percent exceeded the CSL screening level. Zinc is a common component of galvanized materials (e.g., fences, roofs, flashing, pipe, and heating and ventilation equipment), automobile tires, motor and hydraulic oils, and chemical treatments for moss control, so it is not unusual to find elevated levels of zinc in storm drain solids samples. However, zinc was not often found above SCO in waterway sediment. Only 3.1 percent of the surface sediment samples collected in the LDW were greater than the SCO and less than the CSL, while 1.9 percent of the samples were greater than the CSL (AECOM 2012a). One of these samples is located within 200 feet of an outfall owned by the City (Diagonal Ave S CSO/SD)[12]. Two are located near an outfall that receives stormwater and/or wastewater from a City-owned system (16th Ave S SD and 2nd Ave S SD). See Appendix J for a detailed description of SMS exceedances in waterway samples collected near outfalls. Because of the widespread use of zinc and the low frequency of zinc in waterway sediment, SPU has not focused source tracing efforts on zinc.

12 Sample DUD005 collected in 1994 prior to King County's 2004-2005 Duwamish/Diagonal Early Action Area cleanup. Zinc did not exceed SCO in surface sediment samples collected post-cleanup.

4.2.6. LPAH

LPAH was detected in 95 percent of the 688 samples collected in the MS4 after lines were cleaned as part of SPU's LDW source control program or in locations where no cleaning has occurred but exceeded the LAET/2LAET screening level (5,200 ug/kg dw) in only 6 percent of the samples. Nearly half (20) of the 41 samples that exceed the screening levels were in private onsite catch basins. Of the remaining 21 samples that exceeded LAET/2LAET, 14 were collected in the Diagonal Ave S CSO/SD system, 3 in the S Nevada St SD, 23 in the S Norfolk CSO/EOF/SD, and one each in the S Webster St SD and the Georgetown SD.

During the previous SCIP, the highest LPAH concentrations were found in two catch basins in the parking lot at the King County Sheriff's storage facility where coal tar sealant had been used on the pavement (140,100 ug/kg dw at CB222 and 173,200 ug/kg dw at CB221) at some time in the past. King County removed the sealant material and resurfaced most of the parking area in 2016. LPAH concentrations in samples after the sealant was removed were below the LAET (483-514 ug/kg dw in CB221 and 4,519 ug/kg dw in CB222).

Other samples collected in the past five years that contained elevated levels of LPAH are listed in Table 11.

Table 11: Samples containing elevated levels of LPAH (2014-2019).

Sample	Date	Sample Type	Outfall	LPAH (ug/kg dw)
RCB86	06/19/19	Right-of-way catch basin	S Nevada St SD	95,672
NST4	04/25/17	Sediment trap	Norfolk CSO/EOF/SD	79,127
CB324	02/15/18	Onsite catch basin	Diagonal Ave S CSO/SD	40,680
CB344	06/12/19	Onsite catch basin	Diagonal Ave S CSO/SD	30,047
CB315	09/01/16	Onsite catch basin	Diagonal Ave S CSO/SD	23,987
CB343	06/12/19	Onsite catch basin	Diagonal Ave S CSO/SD	12,287
CB306	10/11/17	Onsite catch basin	Diagonal Ave S CSO/SD	10,630
RCB89	06/19/19	Right-of-way catch basin	S Nevada St SD	9,833
RCB298	04/06/16	Right-of-way catch basin	S Webster St SD	8,390
MH18	04/06/16	Inline grab	Diagonal Ave S CSO/SD	6,560
RCB88	06/19/19	Right-of-way catch basin	S Nevada St SD	6,187
TUL-CB3	09/21/17	Onsite catch basin	Diagonal Ave S CSO/SD	5,511

LPAH exceeded the SCO in less than 1 percent of the surface sediment samples collected from the waterway and only one of these sampling locations is near an outfall (7th Ave S SD) that is owned by the City or that receives stormwater and/or wastewater from a City-owned system (AECOM 2012a)[13]. See Appendix J for a detailed description of SMS exceedances in waterway samples collected near outfalls.

4.2.7. HPAH

HPAH was detected in 98 percent of the 688 samples collected in the MS4 after lines were cleaned as part of SPU's LDW source control program or in locations where no cleaning has occurred. Eleven (11) percent (76 samples) and 8 percent (56 samples) of the samples exceeded the LAET and 2LAET screening levels, respectively. Forty eight (48) of the samples exceeding the LAET were collected from private onsite catch basins (12,150 – 1,082,300 ug/kg dw), 31 were collected from inline grab/trap samples (12,150 – 360,160 ug/kg dw),

13 LPAH exceeded the SCO offshore of the outfalls in Slip 4 prior to the 2012 cleanup but did not exceed the SCO in the 2013 post-cleanup samples.

and 13 were collected from right-of-way catch basins (14,300 – 425,890 ug/kg dw). Unlike LPAH, HPAH remained above the 2LAET in one of the catch basins (34,310 ug/kg dw at CB222) sampled at the King County Sheriff's storage facility following removal of the coal tar sealant but was significantly lower than the sample collected prior to removal (1,555,000 ug/kg dw). Other samples collected in the past five years that contained elevated levels of HPAH are listed in Table 12.

Table 12: Samples containing elevated levels of HPAH (2014 - 2019).

Sample	Date	Sample Type	Outfall	HPAH (ug/kg dw)
RCB86	6/19/19	Right-of-way catch basin	S Nevada St SD	425,890
NST4	4/25/17	Sediment trap	Norfolk CSO/EOF/SD	360,160
CB324	2/15/18	Onsite catch basin	Diagonal Ave S CSO/SD	134,780
CB344	6/12/19	Onsite catch basin	Diagonal Ave S CSO/SD	111,230
CB343	6/12/19	Onsite catch basin	Diagonal Ave S CSO/SD	62,755
RCB298	4/06/16	Right-of-way catch basin	S Webster St SD	62,100
CB306	10/11/17	Onsite catch basin	Diagonal Ave S CSO/SD	55,920
RCB89	9/26/19	Right-of-way catch basin	S Nevada St SD	47,054
CB297	9/21/17	Onsite catch basin	Diagonal Ave S CSO/SD	34,844
CB222	9/26/19	Onsite catch basin	Diagonal Ave S CSO/SD	34,310
TUL-CB3	9/21/17	Onsite catch basin	Diagonal Ave S CSO/SD	32,657
MH18	2/15/18	Inline grab	Diagonal Ave S CSO/SD	30,887
MH18	4/06/16	Inline grab	Diagonal Ave S CSO/SD	30,410
MH23	6/05/19	Inline grab	Diagonal Ave S CSO/SD	30,343
RCB60	3/12/18	Right-of-way catch basin	Diagonal Ave S CSO/SD	25,718
MH18	2/15/18	Inline grab	Diagonal Ave S CSO/SD	24,376
RCB88	6/19/19	Right-of-way catch basin	S Nevada St SD	24,253
MH23	6/12/18	Inline grab	Georgetown SD	22,913
CB296	4/27/16	Onsite catch basin	Norfolk CSO/EOF/SD	19,150
CB270	2/23/16	Onsite catch basin	S River St SD	18,900
CB278	3/31/16	Onsite catch basin	Diagonal Ave S CSO/SD	18,760

HPAH exceeded the SCO in 2.9 percent and the CSL in 0.48 percent of the surface sediment samples collected from the waterway (AECOM 2012a). SCO exceedances occurred in samples located within 200 feet of outfalls owned by the City or that receive stormwater and/or wastewater from a City-owned system in Slip 4 (prior to the 2012 Early Action Area cleanup) and offshore of the Diagonal Ave S CSO/SD (prior to the 2004-2005 Early Action Area cleanup), 16th Ave S SD (east), KCIA SD #2/PS78 EOF, SW Dakota St SD, 2nd Ave S SD, and 7th Ave S SD, outfalls. See Appendix J for a detailed description of SMS exceedances in waterway samples collected near outfalls.

4.2.8. cPAH

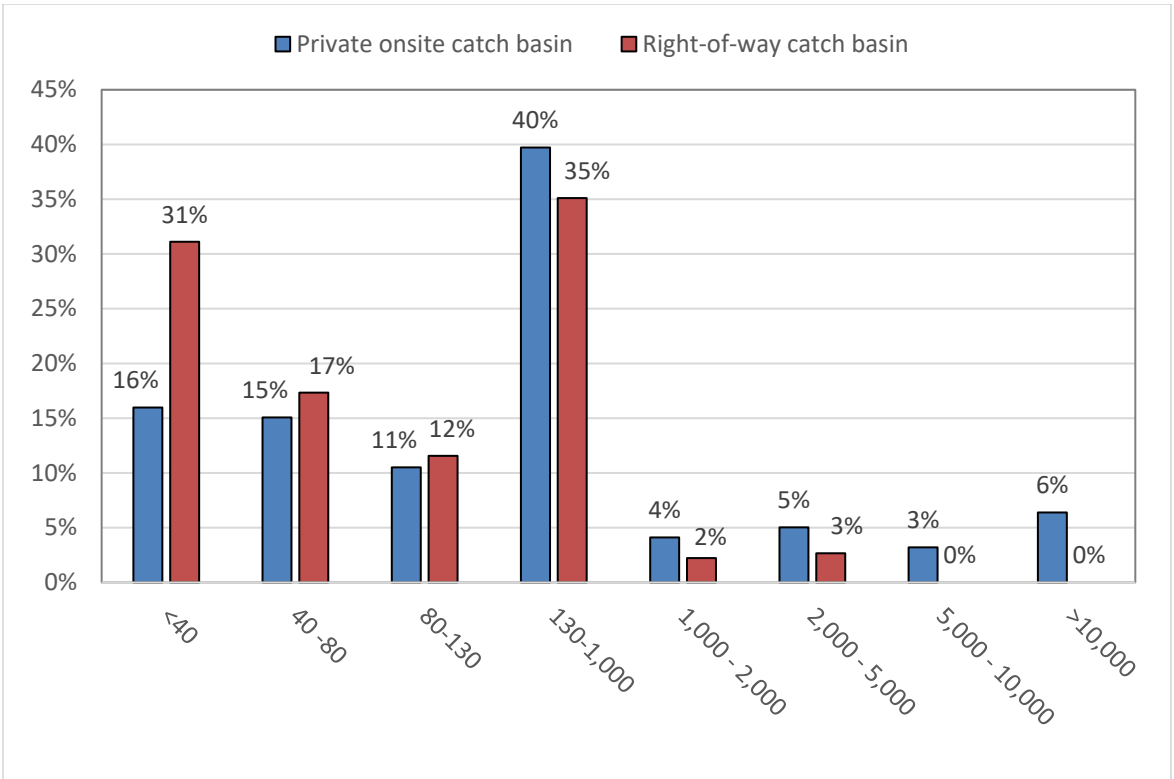
cPAH were detected in 99 percent of the 688 samples collected since 2003. There are no SMS for cPAH. For this analysis, the remedial action level (RAL = 1,000 mg/kg TEQ) was used to assess storm drain solids results[14]. Nineteen percent of the samples exceeded the RAL. Because cPAHs are a subset of the HPAH, elevated levels of cPAH were found at the same locations as described above for HPAH.

4.2.9. PCBs

PCBs were detected in 81 percent of the 719 samples collected since 2003 in the MS4 after lines were cleaned as part of SPU's LDW source control program or in locations where no cleaning has occurred. Approximately 46 percent of the samples exceeded the LAET screening level and 7 percent exceeded the 2LAET screening level. Relatively low levels of PCBs (100 – 300 ug/kg dw) are commonly found in the City MS4, but hot spots are limited to a few locations where significant sources of PCBs have been found. Ecology's 2016 Source Control Strategy established a near-term goal "to control ongoing sources of contaminants to LDW sediments with the potential to exceed the remedial action level established in Record of Decision", which for PCBs is 130 ug/kg dw. Source tracing data collected to date indicate that it will be difficult to achieve this level of PCBs throughout the drainage system. A detailed discussion of the City's process for prioritizing storm drains for source control work and outfall by outfall discussion of sampling results is provided in Appendices D and J.

As shown in Figure 2, PCB concentrations are often higher in private onsite catch basin samples than right-of-way catch basin samples. Approximately 58 percent of the private onsite catch basin samples exceed the LAET compared to only 40 percent of the right-of-way (ROW) catch basins. Similarly, the private onsite catch basins more often exceed the 2LAET (19 percent of the samples) compared to the right-of-way catch basins (5 percent of the samples).

[14] The RAL = MTCA Method A cleanup level for unrestricted land use for cPAHs.



Note: Removed right-of-way catch basins samples that were clearly affected by inputs from adjacent properties:

RCB37 = 2,300 – 17,500 ug/kg dw
RCB146 = 2,560 ug/kg dw
RCB189 = 2,950 – 8,320 ug/kg dw
RCB13 = 2,360 ug/kg dw
RCB148 = 3,700 ug/kg dw
RCBSTEV1-3 = 201-17,000 ug/kg dw
RCBSTEV4 = 12,400 ug/kg dw)
Denver Ave S = 69,400 – 6,970,000 ug/kg dw

See Appendix D.

Figure 2: Frequency histogram of PCBs in private onsite versus right-of-way catch basins (2003-2019)

To date, nine significant sources of PCBs have been identified (see Appendix D for a detailed discussion of these sources):

- Terminal 117. Terminal 117 (T117) is one of seven early action sites in the LDW. Upland areas on T117, as well as adjacent streets and residential yards were contaminated with PCBs from historic operations at a manufacturer of asphalt roofing materials. PCBs were found in the drainage system (1,200 – 16,000 ug/kg dw), as well as soil in the adjacent right-of-way (1,300 – 9,200 ug/kg dw) and yards (170 – 46,000 ug/kg) [Windward 2010, KCHD 2004]. Seattle completed cleanup of adjacent yards in 2013 and the right-of-way in 2016.
- Rainier Commons property at 3100 Airport Wy S where PCB concentrations as high as 213,000,000 ug/kg were found in exterior building paint (NVL 2012). The paint is in poor condition. The EPA Toxics Substances Control Act (TSCA) Program took over enforcement for this site following a 2009 inspection when up to 10,000,000 ug/kg PCBs was found in exterior paint samples. The first phase of the cleanup, involving paint removal from two of the 24 buildings to be cleaned, was completed in 2014. The second phase (IIa), which involved cleaning the south wall of Building 15 was completed in 2016. EPA is currently reviewing the abatement plan for cleanup of Buildings 6 west, 7 west and south, 8/9 elevator shaft and parapet walls, 10 south and catwalk, and 9 catwalk wall.

- Seattle Iron and Metals Company at 601 S Myrtle St, a metal recycling facility, where PCB concentrations as high as 25,000 ug/kg dw were detected in storm drain solids collected from the onsite drainage system. Site runoff passes through an onsite treatment system before discharging to the S Garden St storm drain. Fugitive dust emissions and track out of contaminated material are affecting the adjacent roadways, properties, and the City storm drain systems at S Myrtle St, S Garden St, and S Brighton St.
- Independent Metals Plant 1/Green Day Trading and Recycling at 747 S Monroe St, a metal recycling facility where PCBs in soil adjacent to the south gate were 46,910 and 63,810 ug/kg dw at the fence line and in a nearby planter area, respectively. PCBs were found by University of Washington's Conservation Canine Program detection dog and confirmed by sampling. SPU reported this site to Ecology. Independent Metals vacated this site in 2014. When in operation, onsite stormwater was treated and discharged to the sanitary sewer under an industrial waste permit with King County. Soil contamination found on the south side of the property is presumably related to track out and/or fugitive dust emissions. This area drains to the City's 7th Ave S SD system.
- Independent Metals Plant 1/Green Day Trading and Recycling storage yard on vacant lot at southeast corner of S Monroe St and 7th Ave S where in 2012, SPU and Ecology found 7 ug/L PCBs runoff entering the City MS4 on 7th Ave S from this site which was used to temporarily store struck chassis and enclosed shipping containers, empty truck trailers, and empty roll off containers. In 2016, SPU sampled soil that had been left on site after Independent Metals scraped the yard area as part of work conducted to reduce the offsite discharge of PCBs. PCBs in the remaining soil were low (<18.4 – 77 ug/kg dw).
- Independent Metals Plant 2, a metal recycling facility, where elevated levels of PCBs were found in catch basins immediately adjacent to the metal shredding facility on 816 S Kenyon St that drains to the combined sewer system (5,300 ug/kg dw). Independent Metals vacated this site in 2014. A portion of the property is currently leased by a gypsum recycling facility.
- Former Western Waterproofing Company facility at 4429 Airport Wy S where elevated levels of PCBs (16,100 - 145,000 ug/kg dw) were found in an onsite catch basin, as well as surface dirt on the pavement (28,900 – 39,000 ug/kg dw). SPU had the company clean its onsite drainage system as well as the affected public system. The company also paved over a portion of the yard area where PCBs were thought to exist. This property is currently leased to a welding and engine repair facility.
- Sun Food Trading Company property at 4715 6th Ave S, where elevated levels of PCBs were found in paint chips collected from pavement (45,000 ug/kg) and in onsite catch basins (6,200 – 32,000 ug/kg dw). SPU required the property owner to clean the onsite drainage system and continues to monitor the system downstream to determine whether PCBs migrate offsite.
- Denver Ave S between 1st Ave S and 2nd Ave S where PCB concentrations as high as 40,300 mg/kg dw were found in an initial sample collected from surface soil along the roadway shoulder in June 2019. The affected soil was determined to encompass an area of about 38 feet by 530 feet with PCB concentrations ranging from 100 to 14,000 ug/kg dw in the top 0 to 6 inches of soil. SDOT removed the contaminated soil and SPU cleaned the storm drain system on Denver Ave S in July-August.

To continually refine our tools and source tracing activities to address elevated PCB contamination, SPU will conduct a pilot study of PCB source tracing using a screening level between 750 – 1000 ug/kg dw. Two storm drain basins with no known PCB sources and with PCB sample results just below the 2LAET level (the current screening level) have been identified for the pilot. SPU Source Control staff will conduct targeted inspections and area sample screening in an attempt to determine if the sources of the PCBs can be identified using the lower screening levels. If the targeted screening and inspections show that lower levels of PCB contamination can be identified, the City will evaluate how to refine the current screening level. Drainage basins being targeted during this 5-year SCIP are:

- S Nevada St SD (933 ug/kg dw)

- Highland Pkwy S SD (800 ug/kg dw)

4.2.10. Phthalates

Phthalates, particularly BEHP exceed the LAET/2LAET screening levels in storm drain solids collected throughout the Lower Duwamish Waterway. Overall, BEHP was detected in 99 percent of the 686 samples collected since 2003 in the MS4 after lines were cleaned as part of SPU's LDW source control program or in locations where no cleaning has occurred and exceeded the LAET/2LAET screening levels in 76 and 71 percent of the samples, respectively.

Phthalates are a class of industrial compounds commonly used as softeners in plastics, as solvents, as oil in vacuum pumps and electric capacitors and transformers, and as carriers for fragrances and pesticides. Because they are a regional concern extending beyond the Duwamish Waterway, King County and SPU joined with the City of Tacoma in 2003 to test various commonly used products and materials to help identify the source of these chemicals. The intent of that testing was to use information about the phthalate content of common consumer products in conjunction with the source tracing efforts to identify specific sources of phthalates to the storm drains and the sanitary sewer. In addition, project staff hoped to identify specific products low in phthalates that they could recommend as replacement products to businesses and residents. The testing identified phthalates (BEHP, diethyl phthalate, and butyl benzyl phthalate) in a wide variety of products, including used motor oil from a commercial lube shop, used synthetic oil, various tire dressing and automotive care products, serpentine auto belts, used cigarette butts, packing peanuts, brake pads, brake pad dust, and tires (SPU and KCIW 2004, 2005).

Subsequently, the cities of Tacoma and Seattle, King County, Ecology, and EPA conducted an investigation to understand how phthalates reach Puget Sound sediments and to evaluate the relative risk of phthalates found in sediment compared to other contaminants and within the broader context of phthalate risks from all exposure pathways (Floyd|Snider 2007). The group, known as the Sediment Phthalates Work Group or SPWG, concluded that phthalates are widespread in urban and other developed areas and that they are ubiquitous in water, soil, sediment, and air. They developed the basic working model shown in Figure 3 of how phthalates may reach the LDW sediments. The basic concept is that phthalates initially enter the environment primarily through off-gassing from manufactured products. Once in the atmosphere, they attach to particulates and deposit on land and water surfaces. These particles are then transported to water bodies like the LDW through stormwater runoff (Floyd|Snider 2007).

The Work Group published the following recommendations:

- Manage phthalate re-accumulation at cleanup sites using site-specific O&M plans. Suggestions included developing appropriate triggers for action based on size of impacted area, level of exceedances, and co-occurrence with other target pollutants, as well as continued monitoring, thin layer capping or removal, and outfall engineering.
- Conduct studies/research to further validate the work completed by the group and to define other pollutants transported via an air-stormwater-sediment pathway.
- Coordinate with Puget Sound Partnership and air agencies regarding the air-stormwater-sediment pathway and jointly evaluate effective solutions.
- Educate agency and community stakeholders regarding phthalates.
- Develop recommendations regarding plasticized PVC including environmentally sustainable alternatives to phthalates, adjusting Leadership in Energy and Environmental Design (LEED) standards to address plasticized PVC, considering building code modifications and tax or incentive mechanisms regarding product use.

- Coordinate with other phthalate risk initiatives from other exposure pathways (e.g., cosmetics, toys, medical devices).
- Evaluate stormwater source control and treatment options including costs/benefits for treatment versus repeated cleanup in impacted areas.
- Consider amending the Sediment Management Standards to include considerations for pervasive pollutants such as protocols for making decisions regarding the cleanup trigger for phthalates and similar pollutants.

Most of these recommendations have not been implemented.

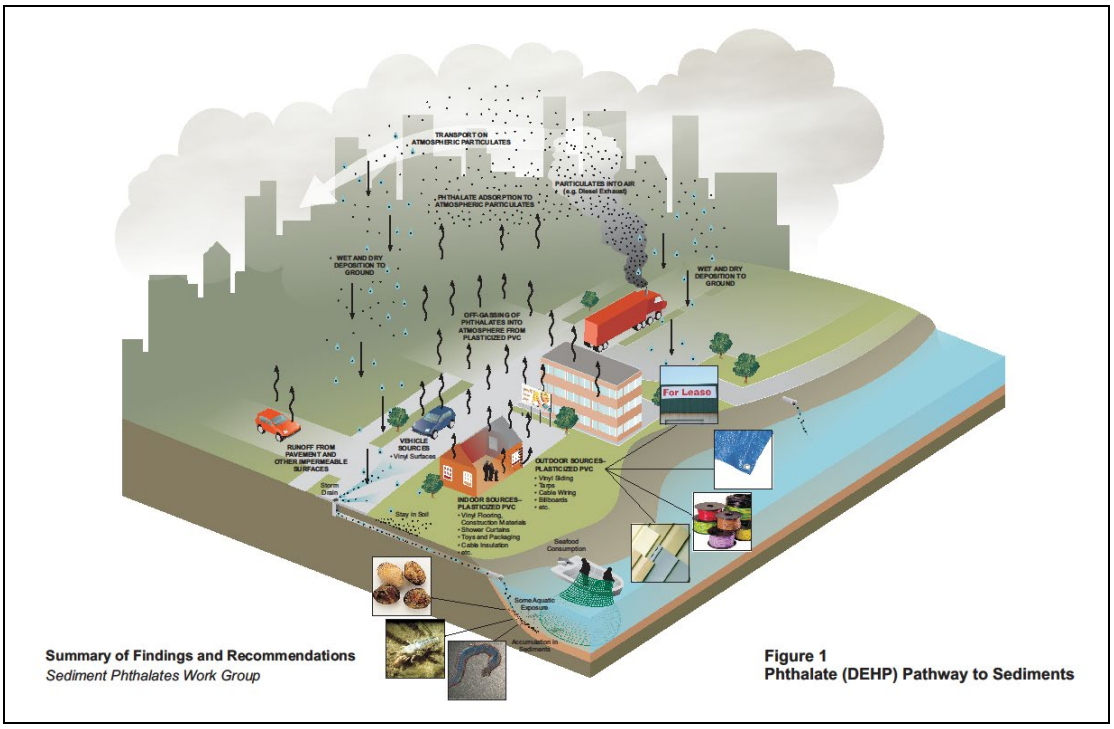


Figure 3: BEHP pathways.

4.2.11. Dioxins/Furans

SPU has analyzed dioxins/furans in 30 source samples collected in 2011 from City storm drains in the LDW. Concentrations ranged from 0.51 to 143 ng/kg TEQ, with an average of 29.5 ng/kg TEQ. The highest concentration (143 ng/kg TEQ) was found in a sample of sediment that had accumulated in the temporary stormwater storage tanks at the Terminal 117 Adjacent Streets site. The tanks receive runoff from the streets adjacent to Terminal 117. The remaining samples contained less than 90 ng/kg TEQ. As shown in Figure 4, dioxin/furan concentrations in samples collected from City-owned storm drains in the LDW are generally lower than most other samples collected from storm drains in the LDW and East Waterway, but are comparable to the concentrations found in samples collected from combined sewers.

The data from the samples indicated widespread, but low concentrations of dioxins/furans throughout the storm drains within the LDW. There was no discernable pattern to concentrations found in the sample results and their proximity to possible sources. Source tracing efforts for dioxins/furans was not effective, as concentrations were generally low and sources of these chemicals are not fully understood. Additionally, the costs associated with analyzing sediment data for Dioxins/Furans is prohibitively expensive, making the source tracing process very difficult and ineffective.

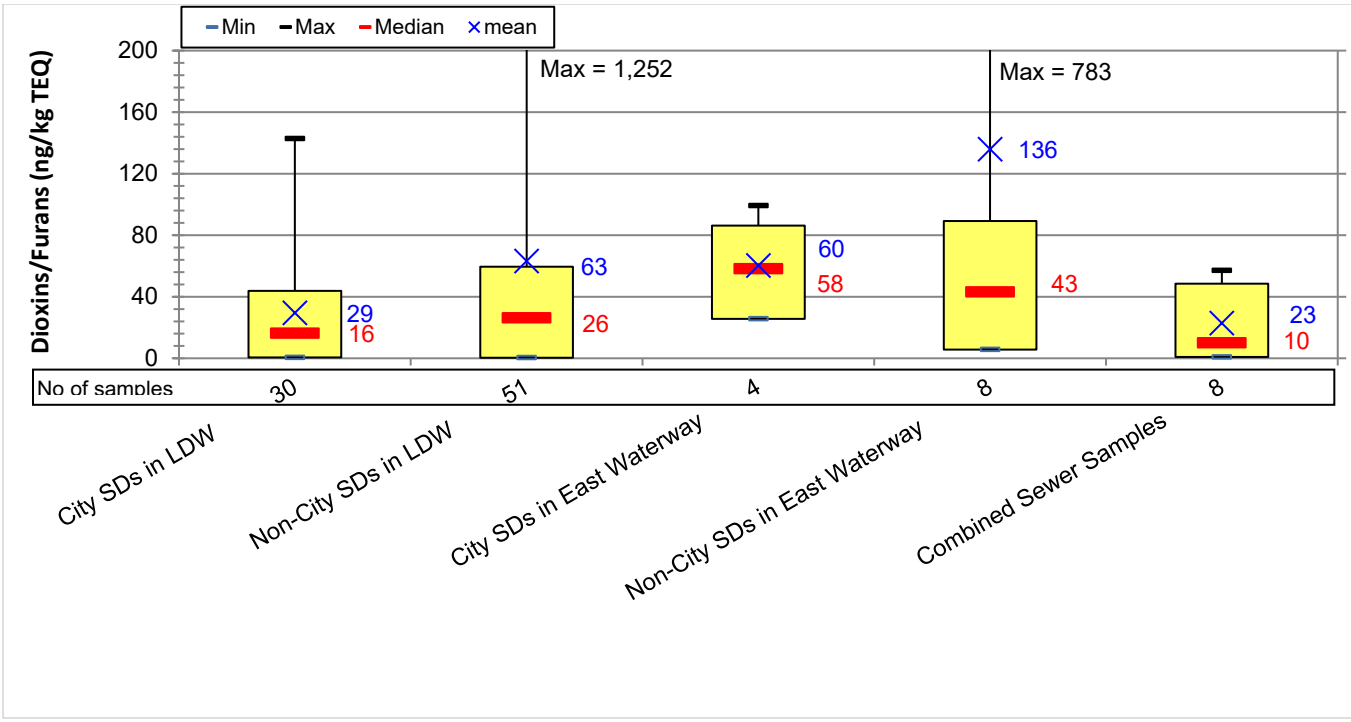


Figure 4: Comparison of dioxins/furans in City and non-City storm drains and combined sewers in the LDW and East Waterway.

4.3. NEAR END-OF-PIPE SAMPLES

SPU collects inline samples (grabs and or sediment traps) from maintenance holes located near the downstream end of the system in many of the storm drains owned or used by the City that discharge to the LDW. Samples are collected as close as possible to the downstream end of the City MS4. These so-called near end-of-pipe (NEP) samples are used to roughly characterize the quality of solids discharged from the City MS4 to the LDW. Ideally, a single NEP location would be sampled in each drainage system. However, due to the configuration of the City's MS4, multiple locations are often needed to capture representative solids samples. Lack of sediment accumulation in the system can also be problematic. In these situations, SPU sometimes collects grab samples from catch basins to represent portions of the drainage system where inline sampling was not feasible. SPU intends to monitor these sites long term to assist in evaluating trends, prioritizing source control activities, and assessing the effectiveness of its source control program. NEP sampling locations are shown on Map 88.

Time series for select chemicals in each of the storm drains where NEP stations are located are provided in Appendix B in the form of heat tables where the lowest concentrations are shown in green with colors progressively increasing in intensity (i.e., orange to red) as concentrations increase. Heat tables are based on the median concentration of all samples collected each year. Key findings are summarized below:

- Arsenic exceeded the CSL screening level in the S River St SD and S Brighton St SD in 2009 but has not exceeded the CSL screening level in any outfall in the past 10 years.
- Copper, lead, and mercury exceeded the CSL/2LAET screening levels in the most recent samples collected from the S Myrtle St SD and S Garden St SD (2019 and 2008, respectively), but have not exceeded the CSL screening levels in any other outfall in the past 10 years.
- Zinc exceeded the CSL screening level in three outfalls: S Myrtle St SD, 1st Ave S SD (west), and 16th Ave S SD (west) and exceeded the SCO screening level in 11 outfalls in 2019.

- PCBs exceeded the CSL/2LAET screening levels in only two outfalls (all samples collected from the S Myrtle St SD before and after cleaning and the only sample collected from the S Garden St SD in 2008).
- PCBs exceeded the SCO/LAET screening level in all but four of the outfalls that have been sampled (Head of Slip 2 SD, Highland Park Wy SW SD, 1st Ave S SD[west], and S Webster St SD)
- cPAHs exceeded the RAL screening level in samples collected from only four outfalls over the past five years (S River St SD, Georgetown SD, S Webster St SD, and the S Norfolk St CSO/PS17 EOF/SD).
- Bis(2-ethylhexyl) phthalate exceeded the CSL/2LAET screening level in samples collected over the past five years from all but the following outfalls: SW Idaho St SD, Head of Slip 2 SD, and the S 96thSt SD.
- Butyl benzyl phthalate exceeded the CSL/2LAET screening level in samples collected over the past five years in all but the following outfalls: Head of Slip 2 SD, 16th Ave S SD.
- Dimethyl phthalate exceeded the CSL/2LAET screening level in samples collected over the past five years in all but the following outfalls: Head of Slip 2 SD, 1st Ave S SD (east), S Brighton St SD, 2nd Ave S SD, 7th Ave S SD, and the S 96th St SD.

4.4. OUTFALL TO OUTFALL COMPARISONS

Another way to evaluate the storm drain solids data is to compare results between outfalls to assess whether contaminant concentrations are different between outfalls. Differences could indicate the presence of different sources in the drainage basins. SPU evaluated potential differences by comparing distributions for each chemical of concern by outfall, looking at the median concentrations and outlying values. By comparing contaminant levels obtained through sampling, we may prioritize source control efforts to target those basins with the highest concentrations of pollutants of concern.

SPU uses box plots to illustrate the statistical distributions of contaminants amongst drainage basins. Box plots are a simple visual tool that display summary statistics (25th/75th percentiles, median concentrations, and outliers) from all samples (e.g., inline grabs, catch basins grabs, and sediment traps) by outfall over different time periods. Box plots from the previous reporting period, 2003 – June 30, 2014 (SCIP 1) and the current reporting period, July 1, 2014 through June 30, 2019 (SCIP2) for the following chemicals that were commonly detected in storm drains solids samples, are presented in Appendix B:

- Metals (arsenic, copper, lead, mercury, and zinc)
- PCBs
- Polycyclic aromatic hydrocarbons (LPAH, HPAH, and cPAH)
- Phthalates (bis[2-ethylhexyl]phthalate, butyl benzyl phthalate, and di methyl phthalate)
- Total petroleum hydrocarbons (TPH-oil).

Box plot distributions amongst basins are similar to the NEP results described above in Section 4.3. For example, the S Myrtle St and S Garden St storm drains contained higher concentrations, and thus percentiles and median concentrations, of metals (copper, lead, mercury, and zinc) than other drains sampled in the LDW. Elevated concentrations are associated with operations of a metals recycling facility located in these basins. Other basins that exhibited unique chemical signatures include:

- Georgetown, S Webster St, and S Nevada St storm drains: LPAH, HPAH, and cPAH.
- S Garden St and S Myrtle St storm drains: PCBs and phthalates
- Georgetown SD: dimethyl phthalate
- S Nevada St SD: butyl benzyl phthalate.

4.5. New Sediment Trap Design

In 2013-2017, Ecology funded SPU to develop a new sediment trap that could be easily installed and serviced in a wide range of pipe sizes, particularly in small diameter pipes where the trap that SPU currently uses (modified-Norton) cannot be used due to its high (approximately 9 inches tall) profile. Work involved designing and testing the sediment capture ability of a new trap, followed by side by side testing of the new trap with others (i.e., modified-Norton, SIFT, Fuller, and Hamlin traps) to compare both capture efficiency and chemical quality of the material captured. SPU completed bench testing of several designs in 2015 (SPU 2016). Based on the flume test results, a bowl-style design was selected for field testing. Two versions of the design were fabricated (Figure 5 and Figure 6) and installed at two test locations in early 2016, a 72-inch diameter pipe (Diagonal Ave CSO/SD) and a 24-inch diameter pipe (S Myrtle St SD).

Figure 5: Field prototype #1.

Figure 6: Field prototype #2.

Test results for the 2016 and 2017 seasons were provided to Ecology (SPU 2019). Although not all the traps were able to capture enough sample quantity for both grain size and chemistry testing, the results indicated that the new trap design performed similarly to the other styles currently in use for source tracing.

Prototype #2, which was fabricated from two stainless steel bowls, experienced rust problems within one year of installation. SPU eliminated this model and in 2019, developed a third model fabricated from a stainless-steel 3¾-inch pipe cap (Figure 7). SPU intends to install Prototypes 1 and 3 in new locations where a lower profile trap is needed. Because these new traps will be installed in small diameter pipes which serve small drainage basins (5-25 acres), the primary concern will be the ability to capture enough material for chemical analyses. SPU routinely installs two traps at each location but may need to install additional traps to ensure enough material is collected.

Figure 7: Field prototype #3.

5. STATUS OF DATA GAPS IDENTIFIED IN PREVIOUS SCIP

All data gaps that were identified during the previous SCIP (Seattle 2015), summarized below, have been filled:

- Head of Slip 2 SD. This 24-inch outfall is privately owned. It serves an approximately 12-acre basin located east of E Marginal Wy S between S Michigan St and S Fidalgo St. The basin consists almost entirely of large warehouse buildings that are occupied by several small businesses. With the exception of a container storage yard located at 6050 E Marginal Wy S, business activities are housed indoors. The only outdoor activities appear to be employee parking. A small portion of E Marginal Wy S and 4th Ave S also drains to this outfall. SPU collected an inline grab sample (MH38) at the last maintenance hole on the system in 2018. No chemicals exceeded the SMS screening levels. This drain is not considered a high priority.
- North Boeing Field SD. This storm drain used to serve approximately 90 acres at the north end of the King County Airport (North Boeing Field) and served as an emergency overflow for SPU's sanitary pump station 44. However, in about 1985, the majority of the runoff and EOF were re-plumbed to the King County Airport drainage system (KCIA SD#3/PS44 EOF). Since then the North Boeing Field SD outfall has served only about 3 acres adjacent to building 7-027-1 on North Boeing Field. Boeing has re-plumbed the remaining catch basins in this area to the KCIA SD#3/PS44 EOF drainage system (Bach 2014). As a result, there no longer appears to be any runoff from North Boeing Field entering this system. SPU video-inspected this system in 2015 and confirmed that the line on North Boeing Field had been plugged. In addition, the 18-inch pipe that connects to this outfall at maintenance hole D071-052 in the middle of E Marginal Wy S appears to be filled and no longer appears to be active. SPU confirmed that catch basins on North Boeing Field have been disconnected from this system during a site inspection conducted on February 18, 2015.
- S Webster St SD. A single catch basin on S Riverside Dr is connected to this outfall. SPU sampled the catch basin in 2016. LPAH, HPAH, and cPAHs exceeded the 2LAET screening levels. However, benzyl alcohol is the only chemical that exceeded SCO, and only in one of five sediment samples collected within 200 feet of the outfall (sample located 100 feet upstream of the outfall). This drain is not considered a high priority. SPU will clean this catch basin in 2020 and resample following cleaning.
- 17th Ave S SD. SPU constructed the 17th Ave S SD stormwater collection and treatment system in 2016 as part of the City's Terminal 117 Adjacent Streets Early Action Area cleanup, which removed PCB-contaminated soil present in the right-of-way adjacent to Terminal 117. SPU has collected four samples from right-of-way catch basins in the system, one dirt sample from an area where runoff had been observed to pond, and one sediment trap sample (17th-ST1) at the last maintenance hole before the

outfall[15]. Zinc and phthalates exceeded the CSO/2LAET screening level in 20 percent of the samples. In addition, PCBs in the 2019 sediment trap (685 ug/kg dw) were higher than observed in most other near end-of-pipe samples collected in the LDW. PCBs in four of the other five samples collected were below the LAET screening level, and one catch basin sample (456 ug/kg dw at RCB85 in 2018) exceeded the LAET screening level. Given that PCB-contaminated soils were removed in 2016, it is not clear why PCBs were elevated in the sediment trap sample. SPU will collect additional catch basin samples[16] in 2020 to assist in determining whether there are ongoing sources of PCBs in this 2.9-acre drainage basin.

6. LINE CLEANING PROGRAM

SPU initiated a storm drain line cleaning effort in 2008 to remove contaminated material that has accumulated in the system and prevent it from reaching the LDW. Storm drainage lines are selected for cleaning based on NEP contamination. Lines are selected for cleaning based on known loading of contaminants of concern, with additional priority given to basins where there has been difficulty in finding active contaminant sources. Line cleaning removes accumulated, potentially historic contamination from the system, allowing for post cleaning samples to gauge any active sources of these pollutants. When a pollutant is found in pre-cleaning sampling, but not found after several years of post-cleaning sampling, it is likely that the pollutant was a legacy contamination trapped in the drainage system. When pre-cleaning sampling and post cleaning sampling both show the same contaminants, it is probable that there is an active source of pollutants in the basin, which may be traced through source tracing sampling.

Prior to 2018, SPU allocated approximately $250,000 per year to fund both the source tracing and line cleaning programs. This was increased to about $500,000 in 2018. Funding for line cleaning has also come from savings in source tracing efforts, which have been partially funded by Ecology grants (WQC-2016-SeaPUD-00196 and WQC-2018-SeaPUD-00233). Between 2015 and 2019, Ecology provided nearly $300,000 in funding which covered SPU's non-labor costs (laboratory analysis and data validation) for source tracing. Grant funding currently runs through 2021.

Between 2015 and 2017, SPU line cleaning work was also supported by an Ecology's Toxics Cleanup Remedial Action Grant (RAG) grant (TCPRA-2014-SeaPUD-00025).

6.1. PROGRAM EXAMPLE

Line cleaning is used in concert with targeted business inspections and source trace sampling to find, trace, and remove contamination. Line cleaning allows SPU to remove solids and associated pollutants from storm drain lines so they are no longer a potential source of pollution. Following line cleaning, SPU has a clean pipe that can be resampled overtime to determine if there are still sources of pollutants discharging into the pipe. To better describe how line cleaning fits into the overall source control program, Seattle has selected a small sub-basin, South Snoqualmie, within the Diagonal Ave S storm drain basin as an example.

The South Snoqualmie Sub Basin drains an area of industrial businesses and distribution warehouses just north of the Georgetown neighborhood. In 2012, Source Control inspectors collected a sediment sample from a maintenance hole (MH18) within this basin and found high levels of PCBs and Mercury. Maintenance holes are access points along a storm drain line. MH18 was cleaned to remove the settled contaminated solids to prevent them from traveling further downstream. Following the cleaning, targeted sampling was conducted in the upstream area to try to find the potential source. Twenty-eight samples were taken upstream from both private and public property, and two PCB sources were found on private property and eliminated through the City's

[15] Trap was installed in 2017. It took 2 years for enough sediment to accumulate in the trap to permit sampling.
[16] Samples from the inlet cells on the bioretention cells.

progressive enforcement process. One of the property owners was required to clean the drainage system from their property to MH18 to remove contamination found leaving their property. Unfortunately, the PCB sources controlled did not match the PCB Aroclor that was found in MH18, so they were not considered the primary contamination source. Additional upstream businesses were inspected to determine if any operational or storage conditions may be the sources of the pollutants, but none were found.

With no matching upstream contamination found, additional investigation was required. A second round of upstream sampling was conducted in 2016, and ongoing targeted business inspections continue within the sub-basin. MH18 and associated lines have been cleaned five times in seven years to remove any trapped contamination so that it does not accumulate and reach downstream (see Table 13 below). MH18 was placed on a frequent sampling schedule, to track contamination level fluctuations associated with the cleaning activity. Contamination decreased after an initial round of targeted line cleaning and inspections in 2013, but spiked a second time in 2018. As of 2020, PCB and Mercury levels have fallen to levels commonly seen in the industrial areas of the city, but ongoing monitoring and cleaning will continue until sampling shows that these contaminants have not returned, or a source is found and controlled. The entirety of the upstream drainage area was cleaned in Fall of 2020 in an effort to remove any remaining residual contamination that may impact the MH18 structure, and to allow for another round of source trace sampling and screening.

Table 13: S Snoqualmie Sub-Basin MH18 PCB and Mercury Sample Results

	2004	2008	2012	2013*	2014*	2016	2018*	2019*	2020*
PCBs (ug/kg dw)	253	460	45900	6560	3060	4350	46060	3075	297.3
Mercury (mg/kg dw)	1.02	0.48	7.6	3.48	0.44	1.14	4.72	0.888	0.14

* Years where MH18 was cleaned

6.2. PROGRESS TO DATE

As of 2019, SPU has cleaned over 132,400 feet of city-owned storm drain lines in the LDW, as well as associated catch basins, maintenance holes and other structures (e.g., vaults, gates). SPU also required adjacent property owners who had discharged contaminants to the City system to clean an additional 2,000 feet of pipe. Line cleaning activities are summarized in Table 14 and shown on Map 80.

Table 14: Summary of SPU line cleaning in the LDW.

Date	Outfall	Linear feet	Cost	Tons removed[m]	Description	Pollutants
2002-2003	Diagonal Ave S CSO/SD[a]	6,000	$846,000	669	Storm drain mainline and laterals (Denver Ave S, 1st Ave S, and S Dakota St) at downstream end of system	PCBs, PAH, mercury
2005	S Norfolk CSO/PS 17 EOF/SD	2,200	NA[l]	NA[l]	Cleaned MLK Jr Wy S south of S Norfolk St in advance of replacing damaged pipe btw MLK Jr WY S and I5 ditch	Sediment, PAH
2007-2008	Diagonal Ave S CSO/SD	NA	$30,900	960	Cleaned all CBs in ROW (approximately 3,500)	Metals and organic compounds
2008	Diagonal Ave S CSO/SD	890	$3,600	5	Airport Wy S line below Rainier Commons	Metals and organic compounds
2009-2010	S Myrtle St SD	1,500	$29,800	24	Entire city owned MS4 system	PCBs, metals
2009-2010	Brighton Ave S CSO/SD	2,870	$56,800	47	Entire drainage system, tidally influenced	PCBs, metals
2009-2010	S Garden St SD	530	$10,400	9	Entire city owned MS4 system	Metals
2010	T117 Adjacent Streets	1,580	$8,100	0.2	Portions of separated storm and combined sewer adjacent to T117	PCBs
2010	S River St SD	1,640	$15,700	18	Entire city owned MS4 system	Metals
2010	2nd Ave S SD	4,370	$41,800	47	Entire MS4 piped system, but not the 2nd Ave S ditch	PCBs
2010	Diagonal Ave S CSO/SD	8,290	$79,400	89	S Snoqualmie St, 7th Ave S, 6th Ave S, S Alaska St, Airport Wy S	Mercury
2012-2013	SW Idaho St SD	13,200	$323,900	212	Entire city owned MS4 system	HPAH and heavy sediment accumulation
2013	16th Ave S SD (east)	1,900	b	b	Entire city owned MS4 system	Benzyl alcohol and benzoic acid
2013	7th Ave S SD[g]	13,100	$934,000[c]	744[c]	Entire city owned MS4 system	Metals, PCBs
2015	Highland Park Wy SW SD[h]	21,000	$491,100	282	All but the last 1,100 feet at the downstream end of the system	PAH
2015	S Nevada St SD	1,120	f	f	Entire city owned MS4 system	Lead and mercury
2016	SW Dakota St SD	2,530	$400,000	199	Entire city owned MS4 system	Sediment

Date	Outfall	Linear feet	Cost	Tons removed[m]	Description	Pollutants
2016	S 96th St SD	3,030	i	i	Entire city owned MS4 system	Chromium
2017	1st Ave S SD (west)	13,400	$523,000	220	All city owned MS4 pipes. Could not clean culverts due to condition of adjoining ditches	Sediment
2017	SW Kenny St SD	4,300	i	i	Entire city owned MS4 system	Arsenic
2018	Norfolk CSO/PS 17 EOF/SD	7,700	$318,000	173	MLK Wy Jr sub-basin, only one pipe downstream of MLK Wy S and the oil water separator at downstream end not completed	HPAH
2018	Diagonal Ave S CSO/SD	500	j	j	Downstream of flush tank at Denver Ave S and S Bennett St	PCBs
2019	Diagonal Ave S CSO/SD	19,200	$293,400	104	SW Dakota St and 6th Ave S sub-basins	PCBs
2019	Diagonal Ave S CSO/SD	1,540	$277,000	k	Denver Ave S pipes affected by spill	PCBs
Totals		**132,390**	**$4,682,800**	**3,802**		

PCBs = polychlorinated biphenyls, PAH = polycyclic aromatic hydrocarbons

a. SPU source control project to support King County's Diagonal/Duwamish early action cleanup project.
b. 16th Ave S SD and SW Idaho St SD were cleaned at the same time. Costs and sediment removal quantities for 16th Ave S SD are included under the SW Idaho St SD entry.
c. Cost and sediment removed includes cleaning in the lower section of SW Idaho St SD that was conducted concurrently with the 7th Ave S SD cleaning.
d. SPU required the owner to clean the private onsite drainage system and the portion of the City-owned MS4 system that was affected by discharges from the facility.
e. Line cleaned by private property owner as directed by SPU.
f. Included with Highland Park Wy SW SD values.
g. Ecology provided $555,989 to support line cleaning
h. Ecology provided approximately $245,000 to support line cleaning.
i. Included with 1st Ave S SD (west) values
j. Included with Norfolk CSO/EOF/SD values
k. Approximately 1,021 tons from line cleaning and contaminated soil excavated from site were combined for offsite disposal. Cannot estimate quantity from line cleaning alone
l. Line cleaned under capital program; data not compiled
m. Wet tons. Solids dewatered to pass paint filter test.

7. CITYWIDE PROGRAMS

Citywide programs that support source control work in the LDW are described in Appendix F. This section summarizes key work completed during this reporting period (2014 - 2019).

7.1. Spill Response and Water Quality Investigations

Between July 1, 2014 and June 30, 2019, SPU responded to 330 spills in the LDW. The most common spill involved automobile-related fluids such as gasoline, diesel, oil, and antifreeze (49 percent). The remaining spills involved a variety of materials including hydraulic oil, concrete/cement, paint, chemicals (e.g., solvents, acids, hazardous materials), and garbage. Spill locations that occurred in the LDW are displayed on Maps 31-54 and a list of spills is provided in Appendix E.

During that same time period, SPU responded to 296 water quality complaints in the LDW. The most common complaints involved (1) sewage and wastewater-related problems (20 percent), (2) garbage/trash/illegal dumping (15 percent), (3) discharges of domestic water to the MS4 due to line breaks (13 percent), and (4) automotive-related fluids (11 percent). In 10 percent of the calls, the inspector did not see any problems when visiting the site. Locations of water quality complaints occurring in the LDW are displayed on Maps 31-54 and a list of complaints is provided in Appendix E.

SPU staff responding to these water quality investigations and spill incidents are the same as those conducting business inspections within the LDW. Staff participate in biweekly meetings to discuss challenging incidents or trends in reported cases, and to share lessons learned from these responses. Trends and lessons learned through the responses to the spills and complaints are applied during the business inspection process to assist in preventing future spills and complaints.

7.1.1. Denver Ave S PCB Spill

In June 2019, an SPU inspector discovered PCBs in the right-of-way along Denver Ave S between 1st Ave S and 2nd Ave S (Map 91). Sampling confirmed that surface soil along the north/west shoulder of Denver Ave S contained up to 40,300,000 ug/kg dw PCBs and solids in a storm drain inlet on Denver Ave S contained 6,970,000 ug/kg dw PCBs. The affected soil was determined to encompass an area of about 38 feet by 530 feet with PCB concentrations ranging from 100 to 14,000 ug/kg in the top 0 to 6 inches of soil. PCBs in the storm drain downstream of the inlet where soil initially entered the drainage system ranged from about 4,000 to 69,400 ug/kg dw PCBs. Both Ecology and EPA were notified. In July and August, SPU and SDOT conducted a cleanup under the Toxics Substance Control Act (Seattle 2019). Approximately 981 tons of non-regulated PCB-contaminated soil and 40 tons of regulated PCB-contaminated soil/storm drain solids were removed from the site and approximately 1,500 feet of pipe and associated structures (e.g., inlets, catch basins, maintenance holes, and vaults) on Denver Ave S were jetted and cleaned. Non-regulated waste was disposed at the Columbia Ridge Landfill and regulated waste was disposed at the Chemical Waste Management Landfill, both located in Arlington, Oregon. SDOT backfilled and paved the road shoulder after contaminated soil was removed. Soil samples collected at the bottom of the excavation prior to backfill contained <50 to 86 ug/kg dw PCBs.

7.2. Illicit Discharge Detection and Elimination

The goal of the Illicit Discharge Detection and Elimination (IDDE) Program is aimed at preventing, identifying, and eliminating non-stormwater discharges to the City-owned MS4. SPU uses the term IDDE to mean its Dry Weather Screening Program. The City employs a systematic approach to finding illicit discharges and illicit connections using dry weather field screening and source tracing at key locations in the City-owned MS4. Field screening is designed to identify and characterize dry-weather flows and attempt to identify pollutants which

may indicate illicit discharges or connections. During the current reporting period, SPU conducted IDDE screening in the Diagonal Ave S CSO/SD drainage basin. Problems found and corrected during this 2018 screening are summarized in Table 15. Detailed information about the IDDE program and 2018 findings are provided in Appendix F.

Table 15: Summary of 2018 IDDE findings in Diagonal Ave S CSO/SD drainage basin.

IDDE Problem	Number of Problems
Illicit connection	2
Illicit discharge	2
Broken side sewer	2
Damaged sewer mainline	1

7.3. STREET SWEEPING

Street sweeping in Seattle is conducted jointly by SPU and the Seattle Department of Transportation (SDOT). SPU establishes program direction, provides water quality expertise, and funds routes located in areas that discharge to city receiving water bodies. SDOT provides operational expertise, sweeping services, and funds routes in areas that discharge to the combined sewer system.

During 2004-2019, SDOT swept 176 miles of roadway in the LDW (57 miles in areas served by the MS4 drainage system and 119 miles in areas served by the combined sewer system). Streets, with the exception of S. Myrtle St., were swept approximately every other week (29 sweeping events per year). S. Myrtle St. is on a weekly sweeping schedule per the requirements of NPDES MS4 Permit Appendix 13. Sweeping routes are shown on Map 81. SPU estimates that street sweeping removed approximately 25 tons of solids from the streets in the LDW each year.

7.4. SITE INVESTIGATIONS

7.4.1. Seattle Department of Transportation

SDOT encountered contaminated soil when excavating for a capital project to improve the street and public access on the east side of the Duwamish Waterway at 1st Ave S and S River St. Composite samples were collected at three locations at depths of 0 to 3 feet. Samples were analyzed for BTEX, TPH, metals, and PCBs. Results for two of the three samples were well below MTCA Method A cleanup levels and SMS screening levels for all chemicals. Arsenic (70 mg/kg), lead (484 mg/kg) and cPAH (870 ug TEQ/kg) exceeded the MTCA Method A cleanup levels for unrestricted use at one location. This site is listed on Ecology's Confirmed and Suspected Contaminated Site List as 101 S River St.

7.4.2. Seattle Parks and Recreation Department

Seattle Parks and Recreation Department (Parks) investigated soil contamination at the Duwamish Waterway Park located at 10th Ave S and S Elmgrove St in 2014-2019 (Eco Compliance Corporation, 2019). Soil samples were collected from depths of 1-6 inches and 7-12 inches at approximately 61 locations on the site and were analyzed for arsenic and lead. Arsenic ranged from 4.1 to 104 mg/kg. The highest concentrations (41.7 – 104 mg/kg) were found in six samples located in the northeast corner of the site (Figure 8). Parks is undertaking the following steps to address contamination on this site:

1. Ecology has placed Duwamish Waterway Park on the Confirmed and Suspected Contaminated Sites List due to concentrations of arsenic and lead exceeding the LDW Preliminary Cleanup Levels (based on

the protection of surface water). Concentrations of arsenic and lead throughout the park (except for the northeast portion of the park) are below MTCA Method A values for unrestricted land use.

Parks is managing the renovation and cleanup of the site as part of Ecology's Voluntary Cleanup Program (VCP).

2. Parks prepared and submitted a Remedial Investigation (RI) report to Ecology's VCP in July 2020, and requested a VCP opinion from Ecology on the RI. Ecology provided feedback on the RI and cleanup in July and August. As of October 2020, Parks continues to revise and clarify the RI based on Ecology's feedback.

3. In the RI, Parks proposed soil remediation actions concurrent with park renovations:

a. Prior to renovations: Excavation of material on the northeast portion of the park. Excavation will minimize impact to existing trees by utilizing an air knife to loosen soils from tree roots. Excavation will avoid shoreline armoring. No soil will be removed from adjacent Port of Seattle or Seattle Department of Transportation-owned properties.

b. During renovations: Planned excavations in other areas of the park for utility trenches (irrigation, water, storm, sewer, etc.) and for removal of trees and other existing site features as part of park renovations will remove many areas of impacted soil.

c. During renovations/park construction: Planned concrete pads for picnic areas and play structure will cap some impacted soils.

d. Mixing proposed in the RI will not be conducted.

4. Soil remediation activities began in Fall 2020, and continue to be conducted concurrently with park renovations at the time of this report. COVID-19 and recent unhealthy air quality have caused scheduling delays.

5. Additional analyses requested by Ecology will be conducted on confirmation samples.

6. Remaining areas not addressed during the interim remedial action are planned to be addressed in future phases of park renovations.

7. Interim remedial action activities will be provided in a report to Ecology after park renovations are complete, separate from the revised RI.

8. Park project managers are working on public stakeholder communications.

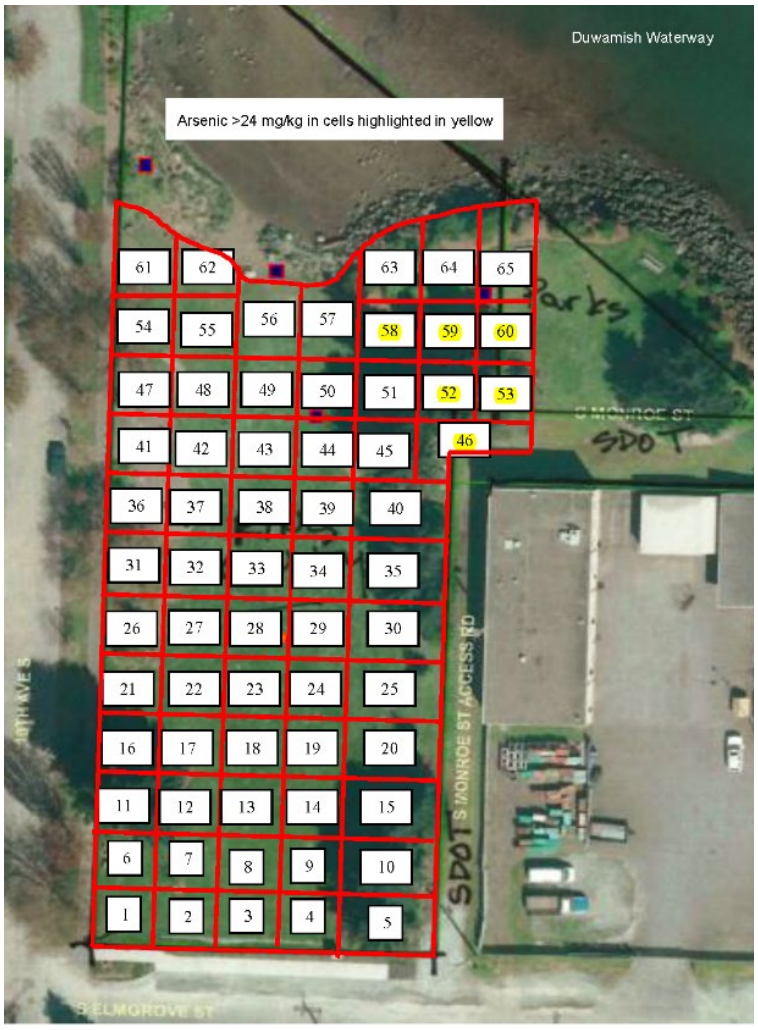


Figure 8: Soil sample locations at Duwamish Waterfront Park.

7.5. TRANSPORTATION PROGRAMS

In 2015 Seattle voters passed Move Seattle, a nine-year, $930 million property tax levy which is a significant source of funding for the transportation budget. This levy replaces funds previously obtained from the Bridging the Gap levy that helped fund SDOT between 2006 and 2015. The Move Seattle funds support on-going pavement maintenance and corridor improvement projects. The Move Seattle 10-year Strategic Vision for Transportation set forth methods for identifying streets as priority corridors for investment and ranking projects proposed for these corridors. The Move Seattle methodology used several factors including leveraging opportunities, funding availability, community support, SDOT's existing commitments, geographic equity, and avoidance of major maintenance to prioritize capital projects. SDOT has identified the Move Seattle priority projects and programs, listed below, that are located within the Lower Duwamish drainage basins and can reduce pollutants in the roadway runoff and/or improve the effectiveness of operational BMPs.

Improvements to street conditions reduces the generation of solids and enhances the ability of street sweeping to remove solids and associated pollutants before they can enter the drainage system. These maintenance projects typically do not trigger stormwater code-required infrastructure upgrades. However, in some instances SPU may partner with SDOT to upgrade infrastructure.

7.5.1. Arterial Asphalt Concrete (AAC) Program

SDOT's Arterial Asphalt and Concrete Program resurfaces several major arterial streets each year with the larger goal of enhancing both mobility and safety citywide. The projects are prioritized and selected by SDOT's Pavement Engineering and Management Section based on pavement condition, volume and type of traffic, identified needs of residents and businesses, opportunities for coordination with other capital projects, and identified maintenance and liability concerns. These paving projects include enhancements such as improved curb ramps and sidewalks, providing a safer and more convenient pedestrian environment, as well as road markings and signal detectors to help bicycles and vehicles share the road more safely.

Improvements to street conditions reduces the generation of solids and enhances the ability of street sweeping to remove solids and associated pollutants before they can enter the drainage system. These maintenance projects typically do not trigger stormwater code-required infrastructure upgrades. However, in some instances SPU may partner with SDOT to upgrade infrastructure. Coordination on these projects is conducted using the mechanisms described in Section 7.14 of this SCIP.

Between 2015 and 2019, SDOT paved approximately 29 miles of roadway in the LDW drainage basin as part of the AAC Program. These paving projects are shown on Map 85.

7.5.2. Arterial Major Maintenance

This is a program implemented by SDOT in-house Maintenance Operations crews. The program typically has funds to repair approximately 8 lane miles per year at about 65 targeted locations. The jobs typically consist of one to three blocks of mill and overlay or replacement of eight to ten concrete panels. No project exceeding $120,000 in value can be constructed by crews, so only projects that do not trigger drainage improvements per Seattle Stormwater Code are undertaken. About 65 percent of work is planned about a year in advance, the remainder is complaint-driven. For the planned portion of AMM projects there are several areas that are repaired annually because they fail repeatedly but have not been upgraded by an AAC project. AMM priority locations are near schools, hospitals, or bike routes or in an area where the work can be combined with other City departments. As much as 35 percent of the AMM budget is spent constructing ramps for ADA compliance.

Between 2015 and 2019, approximately 14.5 lane miles of roadway in the LDW drainage basin were paved as part of the AMM paving program. These paving projects are shown on Map 85.

7.5.3. Non-Arterial Street Resurfacing and Restoration (NASRR)

This is a program operated in the same manner as the AMM program except that the streets repaired are non-arterials. This is the only SDOT maintenance program that addresses pavement conditions on non-arterials, and its budget covers about 2 lane-miles per year. As for the AMM program, improvements to street conditions through the NASRR program reduce the generation of solids and enhances the ability of street sweeping to remove solids and other pollutants before they can enter the drainage system.

Between 2015 and 2019, approximately 7.4 lane miles of roadway in the LDW drainage basin were paved as part of the NASRR program. These paving projects are shown on Map 85.

7.5.4. Slurry Sealing

Slurry seal is a type of protective seal coat which extends pavement life. It is a thin layer of asphalt emulsion blended with finely crushed stone for traction. The streets chosen for this process are selected based on pavement age, pavement maintenance history and inspection results from Maintenance Operations Division. They are mostly low-volume, non-arterial streets.

During 2019, approximately 3,900 feet of roadway in the LDW drainage basin was treated using slurry seal.

7.6. CAPITAL PROJECTS

7.6.1. SPU

South Park Pump Station

The South Park Pump Station is designed to reduce chronic flooding problems in the lower 7th Ave S drainage system. The drainage system cannot currently drain at high tide. The pump station will allow the main trunk line to function properly during a wide range of tidal conditions. It will also support future local drainage and roadway improvements needed to improve drainage service in the lower basin. The pump station will be located on city-owned property at 636/640 S Riverside Dr (Map 89). Design was completed in 2019, the project will be advertised for construction in early 2020, and construction is anticipated to begin in summer 2020. Completion of the pump station will allow for the South Park Water Quality Project to begin, as the pump station is required for this project to be completed.

South Park Drainage and Roadway Partnership Project

The South Park Drainage and Roadway Partnership Project is a cooperative effort between SPU and SDOT to improve the stormwater collection and conveyance system, reduce flooding, and improve roadway conditions in the lower 7th Ave S drainage basin. Phase 1 of the project includes improvements on nine city blocks in the South Park neighborhood (Map 90). Design will be completed in 2020 and the project advertised for construction in late 2020. Construction is scheduled to start in 2021.

South Park Water Quality Project

The South Park Water Quality Facility is one of the projects included in SPU's Integrated Plan approved by Ecology and EPA in 2015 as part of the City's Long-Term CSO Control Plan. It will treat runoff from the 230-acre 7th Ave S drainage system. SPU originally intended to build the water quality facility in conjunction with the South Park Pump Station on the 636/640 S Riverside Dr site shown on Map 89. Unfortunately, SPU was unable to acquire the needed adjacent street end vacation to allow both the pump station and the water quality facility to be constructed at this location. In 2018, SPU decided to construct the pump station on the two properties on S Riverside Dr and began searching for alternate locations for the water quality facility. At the same time, SPU also started to consider additional treatment options, including bioretention. SPU had previously been considering mechanical treatment technologies and in 2017 completed pilot testing of chemically-enhanced filtration and ballasted flocculation systems (HDR 2017). In 2018, SPU conducted a preliminary feasibility analysis of bioretention treatment and determined that bioretention could be used to treat runoff from this 230-acre drainage basin but would require more space for construction than a mechanical treatment system. In 2020, SPU expects to begin Options Analysis (i.e., preliminary engineering) to identify the preferred treatment technology for design and continue to search for available property for the facility.

7.6.2. SDOT

East Marginal Way Corridor Project

The East Marginal Way Corridor Improvement project shown on Map 85, is a 3-phase project which will improve the safety, efficiency, and reliability in the movement of people and goods. Improvements include a protected bike lane along the east side of the street, new roadway surface between S Holgate and Duwamish Ave S, drainage collection and conveyance systems, water quality treatment facilities, and flow control facilities. Phase

1 bike lane construction is scheduled to start in 2021. The schedule for Phase 2 and 3[17] will depend on identifying funding sources. SPU is currently evaluating the need for sewer improvements and water main upgrades, which would be coordinated with Phase 2 and 3 work.

23rd Avenue Corridor Project

In 2017, SDOT completed Phase 1 of the 23rd Avenue Corridor Project located in the LDW basin (see Map 85). Corridor projects install a suite of improvements within a specific geographic area. These improvements can focus on bike facilities, safety improvements, utility upgrades, providing greenways, traffic revisions, transit lanes, and freight corridors, but they also include significant pavement improvements. Repaving will reduce the amount of sediment generated and will increase the effectiveness of street sweeping.

This project repaved 5.4 lane miles of roadway between East John Street and South Jackson Street. To comply with City Stormwater Code basic treatment requirements, SDOT installed 5 storm drain filter systems and 13 Filterra™ bioretention systems as part of the project.

Phase 2 of the 23rd Avenue Corridor Project was completed in 2019. It repaved 2.3 lane miles of roadway between South Jackson Street and Rainier Avenue South. The repaving included mill and overlay of approximately 0.9 linear miles of asphalt roadway, and approximately 1.4 lane miles of concrete panels, and repair of the roadway base where it was broken. Treatment was not required for Phase 2 because the project did not meet the threshold requirements (i.e., existing basin surface coverage is >35 percent impervious and new pollution generating hard surface is <5,000 ft2) in addition to being partially located in the combined sewer basin.

15th Ave S / S Spokane St / S Columbian Way

This project will replace 5.5 miles of pavement on 15th Ave S from S Angeline St to S Spokane St, S Spokane St from S Columbian Way to 18th Ave S, and S Columbian Way from 15th Ave S to the I-5 West Seattle Bridge ramps (see Map 85). The project will also construct curb ramps and crossing improvements, and repair or replace damaged sidewalks. As part of this project, SPU will also replace multiple inlet pipes and upgrade inlets, and repair multiple main lines and catch basins where roots have intruded.

Construction is scheduled to be completed in 2021.

Swift Ave S / S Myrtle St

This project will replace existing asphalt overlay (mill and overlay), construct code required curb ramps triggered by the paving limits, and replace all impacted pavement markings along Swift Ave S, S Myrtle St, S Myrtle Pl, and S Othello St, from S Albro Pl to MLK Jr Way S (see Map 85). This project will also upgrade the bike lanes in both directions. As part of this project, SPU will also replace catch basin castings, as well as inlet and catch basin lateral pipes.

8. CITY-OWNED PROPERTY AND RIGHT-OF-WAY

Excluding the rights-of-way (ROW), the City owns approximately 2,470 acres of land in the LDW, most of which is managed by the Department of Finance and Administrative Services (FAS), although various City Departments (e.g., Seattle Public Utilities, Seattle Department of Transportation, Seattle City Light, Seattle Fire Department, and Seattle Parks Department) utilize these properties. City-owned parcels and rights-of-way within the LDW separated storm and combined sewer overflow basins are shown on Map 82.

[17] Planned Phase 3 work is located outside the LDW basin.

All City departments implement pollution prevention/source control practices in accordance with Seattle's Source Control Manual[18]. City owned properties are ranked using the same process established for other businesses. City properties are then scheduled for a business inspection using this ranking system rotation (i.e., every 2 years for high, every 4 years for medium, and every 6 years for low) and are inspected using the same form as private businesses. An internal compliance process is available for City owned facilities with compliance issues. See Appendix F for a description of ranking and inspection processes and citywide source control requirements. Facilities that are required to maintain a stormwater pollution prevention plan are listed in Table 16.

Table 16: City-owned facilities with SWPPPs in LDW.

Facility	Department	Address	Drainage Basin
Operation Control Center	SPU	2700 Airport Wy S	Diagonal Ave S CSO/SD drainage basin, combined sewer
South Operations Center	SPU	4500 W Marginal Wy S	South Operations Center SD
South Service Center	SCL	3613 4th Ave S	Diagonal Ave S CSO/SD drainage basin, combined sewer
Sunny Jim Sign Shops	SDOT	4200 Airport Wy S	Diagonal Ave S CSO/SD drainage basin
Jefferson Park Horticulture	Parks	3801 Beacon Ave S	Diagonal Ave S CSO/SD drainage basin

8.1. Discovering and Reporting Contamination

Environmental issues affecting City-owned property or the ROW are typically discovered as part of a capital project when site conditions are assessed and options for disposing excavated material are evaluated, or when contaminants are encountered unexpectedly during construction. When the City discovers contamination, either on City-owned property or on projects located within the public right-of-way, Ecology is notified as required under the Model Toxics Control Act. Notifications are submitted to Ecology by the individual City department conducting the work. The City will also notify Ecology's designated source control manager (as identified by Ecology).

Map 83 shows the 409 sites in the LDW that are included on Ecology's list of confirmed and suspected contaminated sites (CSCSL, Ecology 2020). Sites are listed when available data indicate that hazardous substances are present in groundwater, surface water, soil, sediment, and/or air associated with the site. Sites are generally reported to Ecology by residents or by business owners and operators. Once listed, a site undergoes a site hazard assessment (SHA) to confirm the presence of hazardous substances and to determine the relative risk the site poses to human health and the environment. Information from the SHA is then used to develop a Washington Ranking Method (WARM) score. Sites are given a score of 1 to 5 that represents the level of risk (1 being the highest). Sites are cleaned up as required by Ecology, or during any redevelopment activities occurring on these properties, as required by regulations. These City owned sites are include in the SPU Source Control programs list of sites for business inspection and compliance. The goal of business inspections are to reduce and eliminate stormwater impacts to the MS4. See Section 3 of this document for more information on the business inspection program.

[18] Seattle Source Control Manual available at: http://www.seattle.gov/dpd/codesrules/codes/stormwater/default.htm

Twenty of the 409 listed sites are on City-owned property. Current WARM ranking and status of these sites are summarized in Table 17. Eleven of the City properties have been ranked and six received the lowest ranking (5). The South Park Landfill has a 2 ranking.

Table 17: City-owned properties on Ecology's confirmed and suspected site list.

Site Name	Site Address	City Department	State WARM[19] Ranking	Status
Seattle City Hillman Shops	5952 Rainier Ave S	Finance and Administration	3	Cleanup started
Seattle Fire Station #14	3224 4th Ave S	Finance and Administration	5	Cleanup started
Seattle Fire Station #6	405 Martin Luther King Jr. Wy S	Finance and Administration	Not ranked	Cleanup started
Seattle SDOT Sunny Jim site	4200 Airport Wy S	Finance and Administration	4	No action to date
Seattle West Maintenance Headquarters	9200 8th Ave SW	Finance and Administration	4	Cleanup started
Seattle Public Utilities spoils yard	5821 1st Ave S	Georgetown LLC[a]	5	Awaiting cleanup
Seattle City Light 4th Ave S site	3814 4th Ave S	Seattle City Light	5	Awaiting cleanup
Seattle City Light Georgetown Steam Plant	7370 E Marginal Wy S	Seattle City Light	5	Interim cleanup completed
Seattle City Light South Service Center	3613 4th Ave S	Seattle City Light	5	No Further Action Letter from Ecology
Seattle City Light Duwamish Substation	10000 W Marginal Pl S	Seattle City Light	Not ranked	Awaiting cleanup
Denver Ave S PCB spill	Denver Ave S between 1st Ave S and 2nd Ave S	Seattle Department of Transportation	Not ranked	Cleanup completed 2019
Puget Park	16th Ave SW and SW Edmunds St	Seattle Parks and Recreation	4	Cleanup started
Seattle Parks Colman School	1515 24th Ave S	Seattle Parks and Recreation	Not ranked	No action to date
Duwamish Waterway Park	7900 10th Ave S	Seattle Parks and Recreation, Seattle Department of Transportation	Not ranked	2020, Cleanup started

[19] Sites "not ranked" did not have sufficient information to complete the SHA, during the last ranking process

Site Name	Site Address	City Department	State WARM[19] Ranking	Status
640 S Riverside Drive property	640 S Riverside Dr	Seattle Public Utilities	Not ranked	Interim cleanup completed
Seattle Public Utilities Operations and Control Center	2700 Airport Wy S	Seattle Public Utilities	5	Cleanup started
S Kenyon St Bus Yard	110, 130, 150, 200 S Kenyon St	Seattle Public Utilities	Not ranked	Cleanup started
South Operations Center[d]	4500 W Marginal Wy SW	Seattle Public Utilities	Not ranked	Cleanup started
South Park Landfill	8200 2nd Ave S	Seattle Public Utilities	2	Cleanup started[c]
South Seattle Transfer Station (South Park Landfill)[b]	8100 2nd Ave S	Seattle Public Utilities	Not ranked	Cleanup started[c]

Source: Downloaded from Ecology website March 2, 2020: https://apps.ecology.wa.gov/tcpwebreporting/reports/cleanup/contaminated

a. SPU has leased this property to Georgetown LLC since 2006 for temporary storage of materials used in or excavated from SPU construction sites.
b. Transfer station is part of the South Park landfill cleanup.
c. Interim action has started on the landfill site. Remedial investigation/feasibility study is underway for the transfer station parcel.
d. Former Evergreen Trails property.

In addition to the properties listed in Table 17, there are 10 listed sites where sampling has confirmed that soil in the ROW has been found to contain hazardous materials (Table 18).

Table 18: Public right-of-way locations on Ecology's confirmed and suspected site list as of December 2019.

Street Location	Adjacent Property	Address	State WARM Ranking[20]
8th Ave S west of E Marginal Wy	Sternoff Metals	7201 E Marginal Wy S	5
Dallas Ave S, 17th Ave S, S Donovan St[a]	Terminal 117	8700 Dallas Ave	Superfund site
Delridge ROW[b]	Seattle City Light	5601 23rd Ave SW	Not ranked
Rainier Court	Rainier Court	3700 Rainier Ave S	4
S Fontanelle St[c]	None identified	S Fontanelle St and 5th Ave S	Not ranked
S Monroe St east of 5th Ave S	Marine Lumber	Northeast corner of 5th Ave S and S Monroe St	Not ranked
S Myrtle St west of E Marginal Wy S	Seattle Iron and Metals, Whitehead Tyee Property, Fox Ave Building	601 S Myrtle St 730 S Myrtle St 6900 Fox Ave S	Not listed Not ranked 1

[20] Sites "not ranked" did not have sufficient information to complete the SHA, during the last ranking process

Street Location	Adjacent Property	Address	State WARM Ranking[20]
Duwamish Trail Project[d]	None identified	S Portland St between 5th Ave S and 7th Ave S	4
S River St[e]	1st Ave S Bridge	101 S River St	Not ranked
Upper Hudson St[f]	McFarland	4815 15th Ave SW	2

a. City completed removal of PCB-contaminated soil from streets adjacent to Terminal 117 in 2016.
b. City Light discovered lead in soil under road pavement while completing cleanup on adjacent property (Ecology 2016c).
c. SDOT reported toluene, ethylbenzene, and xylenes contamination in soil (Ecology 2016a).
d. SDOT cPAH and lead in soil beneath the roadway (Ecology 2015a).
e. SDOT reported PAH contamination in soil between roadway and shoreline (Ecology 2016b).
f. Cement kiln dust (Ecology 2015b).

The sites listed above are highlighted on Map 83. Information from the CSCSL is provided in Appendix K.

9. 2021 – 2026 PLAN

9.1. BUSINESS INSPECTIONS

Over the past 5 years, SPU has inspected about 100-125 businesses per year with the total number of inspections ranging from 250 to 300 per year.[21] It is anticipated that this level of effort will continue in 2021-2026.

9.1.1. Upper Reach

Under the current schedule for cleanup of the upper reach, design is expected to be completed in 2023 with construction scheduled to start in late 2024. To ensure that source control actions are in place in advance of cleanup, SPU will re-inspect every business in the Upper Reach during the next three years (by end of 2022). There are currently 51 businesses in the Upper Reach identified in SPU's database,[22] most of which (36) are in the S Norfolk St CSO/PS 17 EOF/SD basin. Eighteen (18) of the businesses have been ranked high priority[23] and are inspected every 2 years. The remaining 33 businesses are ranked medium or low or have not been ranked and as such would have been inspected approximately every 4 to 6 years.

9.1.2. Middle Reach

SPU will continue to inspect businesses in the middle reach based on assigned priority with high ranked businesses inspected every 2 years, medium ranked every 4 years and low ranked every 6 years. There are currently 213 businesses in the Middle Reach identified in SPU's database (40 high ranked, 90 medium ranked, 81 low ranked, and 52 unranked).

9.1.3. Lower Reach

SPU will continue to inspect businesses in the lower reach based on assigned priority with high ranked businesses inspected every 2 years, medium ranked every 4 years and low ranked every 6 years. There are

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21 Often more than one inspection conducted at each business during each inspection cycle. Consequently, inspection counts are different from the number of businesses inspected.

22 Does not include businesses on King County Airport since King County currently inspects these businesses.

23 As described in Section 3, SPU ranks businesses based on the potential to contribute pollutants to the waterway. Rankings are updated each time a business is inspected.

currently 471 businesses in the Lower Reach identified in SPU's database (138 high ranked, 97 medium ranked, and 183 low ranked).

9.1.4. Direct Dischargers

SPU inspects direct dischargers (sites that discharge directly to the waterway without entering the City MS4) only after all NPDES permit inspection counts have been met. These inspections usually occur towards the end of the year and focus on high priority sites. There are currently 19 direct dischargers listed in SPU's business database. Over the past five years, SPU has inspected 2 to 7 direct dischargers each year. It is anticipated that a similar level of effort will be accomplished in 2021-2026.

9.2. STORM DRAIN SOLIDS SAMPLING

The City intends to continue collecting storm drain solids samples to support its source control program and to inform future cleanup decisions. Data will be used to characterize the quality of storm drain solids discharged to the waterway, as well as to identify new sources that may occur in the future as businesses relocate, industrial and other pollution-generating activities change, and properties redevelop.

City sampling efforts will include the following:

- Monitoring of existing sediment traps and installation of new sediment traps at near end-of-pipe locations to characterize the quality of storm drain solids discharged to the LDW.
- Sampling of private onsite catch basins when businesses are inspected.
- Sampling of right-of-way catch basins and inline grabs with follow up source tracing where triggers are exceeded.
- Resampling storm drains following line cleaning to evaluate whether ongoing sources or new sources that may crop up in the future.
- Installation of new sediment traps at near end-of-pipe locations to characterize the quality of solids discharged to the waterway and support sufficiency analyses.

The data generated from source tracing efforts will be evaluated using box plots or other tools as they develop to assess potential changes in storm drain solids chemistry as source control progresses. While it is hoped that concentration levels will decline over time, the box plots will also continue to be used to support source tracing efforts by identifying differences in chemical signatures between drainage systems that could indicate that these systems are being affected by specific sources.

9.2.1. Basin Prioritization

SPU updated the ranking/prioritization of outfalls using results from the storm drain solids samples collected over the past 5 years along with new waterway sediment data compiled from studies conducted after the RI was completed and new samples collected as part of the LDW pre-design activities under AOC#3 (EPA 2016). The ranking process used the following lines of evidence:

- Comparison of storm drain solids data to offshore sediment data to identify where elevated levels of contaminants were found in both offshore sediment in the vicinity of the outfall (within 200 feet) and storm drain solids samples collected from near the end of pipe or point of discharge to the waterway. Near end-of-pipe sampling locations are shown on Map 88.

- Storm drain to storm drain comparisons to assess whether one storm drain exhibited a different contaminant signature than other drains in the LDW. [24]
- Results of the sediment transport/bed composition model (ST/BCM) that was developed during the Feasibility Study to assess recontamination potential (see Appendix J of the Feasibility Study, AECOM 2012b).

These data were used in conjunction with the following secondary criteria to select priority basins:

- Knowledge of ongoing sources and pollution-generating activities in each drainage basin that has been gained through the business inspection program.
- Drainage basin size, which provides an indication of pollutant loading potential.
- Multiple and recurring exceedances of the primary screen source tracing triggers for COCs identified in waterway sediment, which indicates the need for additional source tracing.
- Land use characteristics such as percentage of industrial use in the basin.

Details of the ranking process are provided in Appendix J. Results are summarized in Table 19. The areas where SPU intends to focus its source tracing efforts over the next five years include:

Upper Reach

- 16th Ave S SD (east)

Middle Reach

- S Myrtle St SD
- S Garden St Sd
- Georgetown SD

Lower Reach

- S Nevada St SD
- Diagonal Ave S CSO/SD

[24] If the median value for a chemical at one outfall exceeds two times the median of the median values for all outfalls, SPU believes that there may be a unique source of this chemical in that drainage basin.

Table 19: Summary of outfall prioritization.

Outfall	Area[a] acres	Owner	No. of SD samples[b]	No. of NEP samples	No. of offshore samples	Inline NEP to Offshore Exceedance Matches[c]	>SCO in Offshore Samples[d]	Median > 2x Median in All Outfalls sampled[e]	Source Identified [n]
Upper Reach									
16th Ave S SD (east)	3.2	Tukwila	1	1	4	Zn, BEHP, BA	Zn, HPAH, cPAH, PCBs, BA, SVOC[g]	Cu, Hg, Pb, Zn, PCBs, LPAH, HPAH, cPAH, BEHP, TPH-oil	No
KCIA SD#2/PS 78 EOF	0[k]	King County	0	0	16	EOF has not discharged in past 10 years	As, Zn, LPAH, HPAH, cPAH, PCBs, BEHP, BBP, BAl, BA, SVOC[h]	EOF has not discharged in past 10 years	--
KCIA SD#1	86	King County	3	1	10-12	BAl	cPAH, BEHP, DMP, BAl, BA, SVOC[i]	BBP	No
Norfolk CSO/PS17 EOF/SD	676	Tukwila	55	23	36	BEHP	PCBs, BEHP, BBP, SVOCs[o]	--	No
I-5 SD at S Ryan St	55	WSDOT	3	1	3	--	PCBs[q]	Pb	Highway runoff
16th Ave S SD (west)	1.3	King County	0	0	3-16	No NEP samples	--	No samples in MS4	No
17th Ave S SD	2.9	SPU	4	1	4-16	--[e]	None post-cleanup	As, BEHP	No
S 96th St SD	42	Unknown	5	1	2	--	BBP, dioxins/furans [r]	BBP	No
Duwamish substation SD #3	1.9	SCL	1	1	3-5	--	--	DMP	No
Duwamish substation SD #2	1.3	SCL	1	1	11	--	BAl	LPAH, HPAH, cPAH, DMP	No
Duwamish substation SD #1	<1	SCL	0	0	7	--	--	No data	No
W Marginal Pl S SD	4.8	Tukwila	1	0	6	--	BAl	Cu, Pb, Zn, LPAH, HPAH, cPAH, BBP	No
Middle Reach									
Head of Slip 2 SD	12	Private	1	1	2-3	--	BAl, PCBs[s]	--	No
1st Ave S SD, east	15	SPU	3	3	2	--	PCBs[p]	--	No
S River St SD	6	SPU	18	4	5-6	BAl	PCBs, BAl	DMP	Yes
S Brighton St SD	17	SPU	6	2	4-6	--	cPAH, fluoranthene, hexachlorobenzene, benzyl alcohol	--	No
S Myrtle St SD	6	SPU	9-14	4	6	Hg, Zn, PCBs, BEHP, BBP	Hg, Zn, PCBs, BEHP, BBP, BAl, BA, hexachlorobenzene	Cu, Pb, Hg, Zn, PCBs, LPAH, BEHP, BBP, DMP	Yes

Outfall	Area[a] acres	Owner	No. of SD samples[b]	No. of NEP samples	No. of offshore samples	Inline NEP to Offshore Exceedance Matches[c]	>SCO in Offshore Samples[d]	Median > 2x Median in All Outfalls sampled[e]	Source Identified [n]
S Garden St SD	1.5	Private	3	0	7-26	No NEP samples	PCBs, BAl, acenaphthene, dibenzofuran	As, Cu, Pb, Hg, Zn, PCBs, BEHP, BBP, DMP	Yes
I-5 SD at Slip 4	150	WSDOT	30	25	5-10	Zn, PCBs[j], BEHP, BBP, DMP, BAl	Zn, PCBs, BEHP, BBP, BAl	--	No
Georgetown SD	6	SPU	4	3	5-10	BEHP, BBP, BAl	Zn, PCBs, BEHP, BBP, BAl	LPAH, HPAH, cPAH, PCBs, BBP	No
KCIA SD#3/PS 44 EOF	0	King County	0	0	5-10	--	Zn, PCBs, BEHP, BBP, BAl	--	
SW Kenny St SD/T115 CSO	154	SPU	2	2	8	BAl	cPAH, BBP, BAl, hexachlorobenzene	As, Hg	No
Highland Park Wy SW SD	289	SPU	15	11	6-11	BEHP	PCBs, BEHP, BBP, DMP	PCBs	No
1st Ave S SD, west	603	WSDOT	41	32	10	BBP	PCBs, BBP	--	No
2nd Ave S SD	18.4	Private	24	2	24-27	Zn, BEHP, BAl	Cd, Cu, Cr, Pb, Hg, Ag, Zn, LPAH, HPAH, cPAH, PCBs, BEHP, BBP, DMP, BAl, SVOC[k]	--	No
S Webster St SD	<1	SPU	1	1	5-7	LPAH, HPAH, cPAH, BEHP	BAl	LPAH, HPAH, cPAH	No
7th Ave S SD	238	SPU	35	10	5-6	BEHP, BAl	Hg, LPAH, HPAH, cPAH, PCBs, BEHP, BBP, BAl, SVOC[l],	--	No
Lower Reach									
S Nevada St SD	23	Port	5	1	1	--	--	PCBs, LPAH, HPAH, cPAH, BBP, BEHP, TPH-oil	No
Diagonal Ave S CSO/SD	2,664	SPU	429	35	21	PCBs[f], BEHP, BBP, DMP	PCBs, LPAH, HPAH, BEHP, BBP, DMP, SVOC[m]	--	No
SW Dakota St SD	47	SPU	4	2	1	BEHP, BAl	Zn, PCBs, BEHP, BBP, BAl	PCBs, BEHP, BBP, DMP	No
SW Idaho St SD	423	SPU	22	8	7	BAl	BAl, phenol, 2,4-dimethylphenol	--	No
South Operations Center SD	6	SPU	0	0	0	--	--	--	No

Note: Highlighted rows are considered priorities

SD = storm drain CSO = combined sewer overflow EOF = emergency overflow PS = pump station NEP = near end-of-pipe

BEHP = bis(2-ethylhexyl)phthalate BBP = butyl benzyl phthalate DMP = dimethyl phthalate Bal = benzyl alcohol BA = benzoic acid
Cu = copper Hg = mercury Zn = zinc

a. City MS4 drainage area
b. Catch basin grabs, inline grabs, and sediment traps collected from 2003-2019. Does not include samples collected in drains before line cleaning.
c. CSL exceedance in near end-of-pipe inline sample and SCO exceedance in waterway sediment sample located within 200 feet of outfall
d. Median concentration in all MS4 samples not affected by line cleaning exceeds 2x the median of the median concentrations measured in all outfalls
e. Near end-of-pipe sample analyzed only for PCBs due to limited sample volume
f. 3 of 24 post cleanup samples exceeded SCO for PCBs within 200 ft of the outfall. 1 each in 2005 and 2006 and one in 2011 at DUD_1A. The 2012 sample at DUD-1A did not exceed SCO
g. Benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene. Zn exceeded SCO in one sample located 170 feet upstream of outfall. Zn did not exceed SCO in any samples located within 40-120 ft of outfall
h. Acenaphthene, benzo(a)anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, total benzofluoranthenes, chrysene, dibenz(a,h)anthracene, dibenzofuran, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, phenanthrene
i. Benzo(g,h,i)perylene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, phenol
j. 1 of 25 samples exceeded 2LAET (7,800 ug/kg dw in 2005). None of the samples collected in 2006-2019 exceeded 2LAET.
k. 1,4-dichlorobenzene, 1,2-dichlorobenzene, 1,2,4-trichlorobenzene, 2-methylphenol, 4-methyl phenol, 2,4-dimethylphenol, 2-methyl naphthalene, acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, fluorene, fluoranthene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, pyrene, total benzofluoranthenes, dibenzofuran, di-n-butylphthalate, pentachlorophenol, phenol, n-nitrosodiphenylamine
l. 2-methylnaphthalene, acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, dibenzofuran, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, phenanthrene, total benzofluoranthenes, 2,4-dimethylphenol, hexachlorobenzene
m. Chrysene, fluoranthene, phenanthrene, pyrene, 2,4-dimethylphenol, 1,4-dichlorobenzene, phenol
n. Source(s) of problem has been identified. Further source tracing not necessary.
o. 1,4-dichlorobenzene, fluoranthene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, phenanthrene. Note, PCB exceedances all occurred in sampled collected 90-120 feet downstream of the outfall or directly offshore in area that was not dredged in 1999.
p. Exceedance at station 170 feet downstream of outfall opposite the Michigan CSO.
q. One of 11 samples collected 40 feet upstream of outfall
r. Composite sample collected 100-200 feet offshore of the outfall by Corps of Engineers in 2013. No exceedances in 2 other samples collected 40-80 feet from the outfall.
s. Exceeded SCO in 1997 sample 30 feet offshore of outfall but not in 2011 sample collected nearby.

9.2.2. Planned Sampling Activities

Source sampling activities planned for 2021-2026 are summarized in Table 20. Sampling activities are divided into the following categories:

- Maintain existing traps, particularly those used for long-term monitoring. Other traps used to assist in source tracing may be removed following completion of source tracing activities. SPU will notify Ecology before removing any traps.
- Resample inline and/or catch basin locations following cleaning to determine whether additional source tracing is needed.
- Sample to fill data gaps. Remaining data gaps are largely in smaller areas (1-5 acres) within the MS4 that discharge to other larger drainage systems (e.g., 16th Ave S SD-west, W Marginal Pl S SD) or areas that have been difficult to sample due to lack of solids in the system (e.g., I5 SD at S Ryan St). The remaining data gap, the South Operations Center SD is a newly owned system for SPU, encompassing a 6-acre area that has not yet been sampled.
- Sampling to identify sources, particularly in areas where 1) previous samples have exceeded SMS screening levels or 2) existing data indicate concentrations of specific chemicals are higher than observed in other storm drains in the LDW.
- Install sediment traps or establish routine inline grab sampling near the downstream end of the MS4 (near end-of-pipe or NEP). Outfalls that do not already have NEP traps typically serve small basins (e.g., <10 acres) and are small diameter pipes where the modified-Norton style trap that SPU has used in the past will not work. SPU's new lower profile trap will be installed in these locations. Given the small contributing area, it may be difficult to obtain enough material for analysis in these locations.
- Continue to track combined sewer overflow and emergency overflow frequency and volume.

Each outfall has been evaluated to determine whether it has a high potential to contribute to recontamination of waterway sediment following cleanup. Priority rankings (4th column on Table 20) are based on an analysis of stormwater solids chemistry, exceedances of source tracing screening levels in inline samples collected near the downstream end of the drainage system, and comparisons with chemistry in surface sediment samples collected within 200 feet of the outfalls. Detailed chemical by chemical analyses of priority rankings are provided in Appendix J and a detailed discussion of source tracing activities by outfall is provided in Appendix C.

Table 20: Summary of Planned Source Tracing Activities by Outfall (2021 – 2026).

Outfall	Drainage Area [a] (acres)	Owned by or installed by	Priority	Maintain existing traps	Resample following cleaning	Sample to fill data gap	Source tracing	Install NEP trap	Maintain overflow records [d]	IDDE screening
Upper Reach										
16th Ave S SD (east)	11.5	Tukwila	Y				✓	✓		✓
KCIA SD#2/PS78 EOF	0	King County	N						✓	
KCIA SD #1	86	King County	N					✓		✓
Norfolk CSO/PS17 EOF/SD	676	Tukwila	N	✓[e]	✓		✓		✓	✓
I-5 SD at S Ryan St	54.9	WSDOT	N			✓				
16th Ave S SD (west)	3.5	King County	N			✓				✓
17th Ave S SD	2.9	SPU	N				✓			✓
S 96th St SD	12	Private	N	✓			✓	✓		✓
Duwamish substation SDs	3.8	SCL	N		✓					
W Marginal Pl S SD	5	Tukwila	N		✓	✓				
Middle Reach										
Head of Slip 2 SD	12	Private	N					✓		
1st Ave S SD, east	16	SPU	N				✓	✓		✓
S River St SD	7.6	SPU	N				✓	✓		✓
S Brighton St SD	18	SPU	N					✓		✓
S Myrtle St SD	5.9	SPU	Y	✓						✓
S Garden St SD	12	Private	Y					✓		✓
I-5 SD at Slip 4	150	WSDOT	N	✓						✓
Georgetown SD	5.8	SPU	Y		✓		✓	✓		✓
KCIA SD#3/PS 44 EOF	296	King County	N						✓	
North Boeing Field SD [b]	--	SPU	N							
SW Kenny St SD/T115 CSO	155	SPU	N	✓			✓			✓
Highland Park Wy SW SD	289	SPU	N	✓						✓
1st Ave S SD, west	603	WSDOT	N	✓						
2nd Ave S SD	38	Private	N				✓			✓
S Webster St SD [c]	<1	SPU	N		✓					
7th Ave S SD	238	SPU	N	✓			✓			
Lower Reach										
S Nevada St SD	22	SPU	Y				✓	✓		✓
Diagonal Ave S CSO/SD	2,664	SPU	Y	✓			✓		✓	
SW Dakota St SD	44.8	SPU	N					✓		✓

Outfall	Drainage Area [a] (acres)	Owned by or installed by	Priority	Maintain existing traps	Resample following cleaning	Sample to fill data gap	Source tracing	Install NEP trap	Maintain overflow records [d]	IDDE screening
SW Idaho St SD	412	SPU	N	✓						
South Operations Center SD	6	SPU	N			✓				

ND = No data Y = Yes N = No SD = storm drain CSO = combined sewer overflow EOF = emergency overflow
PS = pump station NEP = near end-of-pipe IDDE =illicit discharge detection and elimination

a. City MS4 drainage area
b. Given findings from video inspection, SPU will investigate whether this outfall can be taken out of service, since there are no longer any active connections to this system.
c. Outfall serves one catch basin on S Riverside Dr.
d. Maintain CSO and SSO records to support source evaluations
e. Relocate NST-2 pending redevelopment at 3303 S Norfolk St property (Prologis)

Table 20 summarizes results for all lines of evidence (e.g., outfall to outfall comparisons, inline near-end-of-pipe storm drain solids to waterway sediment comparisons, and FS recontamination predictions) and lists the source control/tracing activities planned for each outfall over the next 5 years. Outfalls are also assigned a priority ranking. The highest priority outfalls include 16th Ave S SD (east), S Myrtle St SD, S Garden St SD, Georgetown SD, S Nevada St SD, and Diagonal Ave S CSO/SD. A brief discussion of each of these high priority outfalls is provided in the following sections. Detailed descriptions of planned activities in other storm drains owned by or used by the City of Seattle are provided in Appendix C.

16th Ave S SD (east)

The 16th Ave S SD (east) serves a 3.2-acre basin west of E Marginal Wy S. This system mostly collects roadway runoff from short sections of 16th Ave S and E Marginal Wy S plus runoff from a portion of an industrial parcel located at the southwest corner of 16th Ave S and E Marginal Wy S within the City of Seattle (Map 4).

Multiple chemicals in a near end-of-pipe inline grab sample collected in 2019, after the line was cleaned in 2013 exhibited higher concentrations than observed in other storm drains in the LDW (mercury, PCBs, LPAH, HPAH, and cPAH). Although likely a minor contributor to sediment recontamination due its relatively small drainage area, this outfall was selected because it is in the upper basin, which is scheduled to begin cleanup during the timeframe covered by this SCIP. SPU intends to complete the following activities in this basin:

- Establish a long-term monitoring station near the downstream end of the City-owned portion of this system to monitor the quality of storm drain solids discharged to the LDW.
- Inspect business at corner of E Marginal Wy S and 16th Ave S and if possible, collect sample from private onsite catch basin.
- Clean entire system after completing source tracing.

S Myrtle St SD

The S Myrtle St SD, which serves an 8.6-acre industrial basin located between Slip 3 and Slip 4 (Map 16), is heavily impacted by activities at an adjacent metal recycling facility located on the south side of S Myrtle St and its storage yard located on the north side of S Myrtle St. See the discussion of Seattle Iron and Metals Company (SIMC) in Appendix D for more details.

Chemicals that exceeded both the CSL/2LAET in near end-of-pipe inline samples and SCO in offshore sediment included mercury, zinc, PCBs, bis(2-ethylhexyl)phthalate, and butyl benzyl phthalate. SPU is hopeful that source control actions required of SIMC by the 2019 Consent Decree (U.S. District Court 2019) will significantly reduce the amount of pollutants released to the neighboring area served by the S Myrtle St SD. Actions that the City will take in this basin over the next five years include:

- Continue to annually sample the sediment trap located near the downstream end of the system.[25]
- SPU will continue working with SIMC to control track out issues from their site and will continue to inspect the two Filterra™ stormwater treatment units that SIMC installed to the driveway on S Myrtle St to ensure that SIMC maintains these units.
- Continue to monitor sediment levels in the catch basins on S Myrtle St each quarter and clean when sediment depths reach 60 percent of the sump depth.
- SDOT will continue to sweep S Myrtle St on a weekly basis as part of the City's ongoing Street Sweeping for Water Quality Program.
- After SIMC completes the source control actions required under the 2019 Consent Decree, SPU will jet and clean the S Myrtle St drainage system to remove residual contaminants

[25] SPU intends to leave the new style sediment trap for long term monitoring and remove all the others used in the recent pilot test.

S Garden St SD

The S Garden St SD serves a 12-acre industrial basin located between Slip 3 and Slip 4 (Map 17), but only 1.5 acres is within the City MS4 drainage system. The remaining area is part of the Seattle Iron and Metals Corporation's private drainage system and outfall. Like the S Myrtle St SD, the City's portion of this drainage system is also heavily impacted by metal recycling operations. See the discussion of Seattle Iron and Metals Company (SIMC) in Appendix D for more details.

Although SPU did not collect any samples from this drainage system in the 2014-2019 reporting period, SPU anticipates that this system experiences similar problems as the S Myrtle St drainage system described above. SCO exceedances have been observed in eight of the 11 samples collected offshore of this outfall (PCBs, dibenzofuran, acenaphthene, and benzyl alcohol). Actions that the City will take in this basin over the next five years include:

- Establish a routine monitoring station in the maintenance hole located near the west end of the City right-of-way on S Garden St. Inline solids samples will be collected each year using either an inline sediment trap or by collecting inline grabs if sufficient sediment accumulates in the system.
- Monitor track out of auto shredding residuals on S Garden St and require controls, as necessary
- Coordinate with Ecology inspectors on SIMC inspections and conduct joint inspections, as necessary.
- Continue to inspect the other active business in this drainage basin, which has a high priority ranking.
- Inspect the Filterra™ unit to make sure it is maintained appropriately.
- S. Garden St. was included with S. Myrtle St. sweeping schedule. The street sweeping on S. Garden St. is not part of the Street Sweeping Expansion Arterials Project described in Appendix 13 but was added due to source control concerns around the Seattle Iron and Metals facilities Unfortunately the roadway condition has deteriorated around the Union Pacific Railroad Tracks the cross S. Garden St. at 8th Ave. S. to the point that the street sweepers are unable to access and sweep the street. SPU is in conversations with SDOT about potential improvements to the surface. However, these improvements must be conducted in coordination with Union Pacific.
- After SIMC completes the source control actions required under the 2019 Consent Decree, SPU will jet and clean the S Garden St MS4 drainage system to remove residual contaminants.

Georgetown SD

The Georgetown SD, constructed in 2009 to replace the old flume from the Georgetown Steam Plant, serves an area of about 4.5 acres, which includes the roof of the Georgetown Steam Plant, a short section of S Myrtle St and adjacent parcels, and areas immediately adjacent to the storm drain (catch basin in parking lot at Washington National Guard property and service drains from the motel at the downstream end of the system.

Inline samples collected from the new drainage system between 2014 and 2019 exhibited elevated concentrations of LPAH (2,829 – 24,500 ug/kg dw), HPAH (22,913-146,000 ug/kg dw), and cPAH (2,965 – 21,520 ug TEQ/kg). Seattle City Light suspects that PAHS may be associated with roofing material at the old steam plant and plans to replace the roof in 2020. Over the next five years, SPU intends to conduct the following activities in the Georgetown SD basin:

- Install a sediment trap in MH23 near the downstream end of the system.
- SPU and SCL will jet and clean the Georgetown SD after roof replacement is completed.

S Nevada St SD

The Nevada St SD serves an area of approximately 26 acres, most of which is occupied by a large warehouse and associated parking on the Port of Seattle's Terminal 106 (Map 25). The west end of S Nevada St was vacated to the Port in 1970.

SPU has observed illegal dumping of concrete waste on several occasions in catch basins on S Nevada St and has taken measures to track the illegal dumping problem but has not yet determined the source. In addition, elevated levels of LPAH (6,187 – 96,672 ug/kg dw), HPAH (24,253 – 425,890 ug/kg dw), and cPAH (2,700 – 47,000 ug TEQ/kg) have been found in three right-of-way catch basin samples collected in 2018-2019. Although no chemicals exceeded the SCO in the one sediment sample collected offshore of this outfall, the sample was collected in 2005, before SPU observed these problems.

Over the next 5 years, SPU intends to conduct the following activities in the S Nevada St SD basin:

- Evaluate the potential to install a sediment trap near the downstream end of the system to improve long term monitoring
- Continue to investigate illegal discharges of concrete slurry in this system.
- Track sources of PAHs found in the 2019 samples
- Continue to inspect businesses.

Diagonal Ave S CSO/SD

The Diagonal Ave S CSO/SD drainage basin, which covers an area of about 2,666 acres, is the largest drainage basin in the City (Maps 26 and 27). Land use in the basin is a mixture of residential (23 percent), commercial (9 percent), industrial (19 percent), vacant/park (10 percent), and right-of-way (39 percent). The upper portion of the basin east of I-5 is mostly residential with commercial businesses clustered along the major transportation corridors (Rainier Ave S, Beacon Ave S, and S Jackson St). The lower portion of the basin west of I-5 is mostly industrial.

SPU has conducted extensive source tracing in this basin over the past 17 years, and although overall concentrations in the Diagonal Ave S CSO/SD drainage system have been comparable to other storm drains in the LDW, given the large area served, this outfall likely contributes a significant load of chemical pollutants to the waterway. Most of the spills and water quality complaints that SPU receives occur in this basin. SPU also continues to look for sources of PCBs and mercury in the S Snoqualmie St sub-basin.

Over the next five years, SPU intends to conduct the following activities in the Diagonal Ave S CSO/SD drainage basin:

- Continue to monitor the sediment traps currently installed in this system (ST1, ST2, ST09, ST10).
- Continue inspecting businesses in the basin.
- Resample City mainline in Airport Wy S downstream of the Rainier Commons property at 3100 Airport Wy S and if necessary, require Rainier Commons to jet and clean onsite and affected MS4 to remove PCBs discharged from the site.
- Coordinate sampling and cleaning activities at the Seattle City Light South Service Center and Yard to address any PCB contamination at the site.
- Continue to sample the 144-inch diameter trunkline downstream of Denver Ave S and the Denver Ave S sub-basin to monitor PCB levels following the cleanup of the spill that occurred in 2019. The first follow up sampling occurred in June 2020 and found very low levels of PCBs in the system.
- Monitor mercury and PCBs in the S Snoqualmie St sub-basin to assess whether source control actions have been effective. Clean impacted structures and source trace exceedances.
- Conduct source tracing in the Bush Pl sub-basin to locate source(s) of HPAHs.
- Clean maintenance hole at ST2 (EQNUM 597066) where elevated lead levels were found in 2019 inline grab samples and inspect adjacent property.
- Conduct source tracing along Beacon Ave where elevated levels of lead were recently found in an inline sample.

- Work with businesses where elevated levels of mercury, LPAH, and HPAH have been found in private onsite catch basins to identify and control the source of these chemicals.

COVID-19 Impacts

While every effort will be made to remain on the schedule contained within this document, the COVID-19 pandemic has impacted the 2020 schedule. An adjustment to methodologies and staffing availability may result in some of the tasks targeted for 2020 slipping into the 2021 and 2022 seasons. Priority for task completion will be made based on available data and effectiveness assessments, as well as time available to complete these items.

9.2.3. Other Source Tracing Activities

Detection Dog

During the previous reporting period, SPU and the University of Washington Center for Biological Diversity successfully pilot tested the use of a specially trained detection dog to identify PCBs in the field. Work was funded under Ecology's Stormwater Financial Assistance Program (WQC-2016-SeaPUD-00196).

Ecology is funding additional work in 2020-2021 under Grant No. WQC-2018-SeaPUD-00233). Work involves developing policy and procedures on how to incorporate the detection dog into SPU's ongoing source tracing program. SPU intends to fund detection dog use in the future as part of its routine source control program in the LDW.

To date, detection dogs and inspectors have identified 13 buildings in the LDW that may contain PCBs in either the caulk or paint used on the building exterior. , Eight of these have been confirmed by sampling dirt or storm drain solids in catch basins adjacent to or downgradient of the building. Unless a building is owned by the City, SPU does not sample building materials.

10. LONG-TERM MONITORING AND EFFECTIVENESS EVALUATION

As described earlier, SPU routinely collects inline samples (grabs or sediment traps) at maintenance holes located near the downstream end of each drainage system. These near end-of-pipe samples are used for two purposes. First is to support source tracing activities by identifying where elevated levels of contaminants are present in the mainlines of the MS4 drainage system. Near end-of-pipe samples are also used to characterize the quality of storm drain solids discharged to the waterway. Long term monitoring at these locations will assist in assessing source control sufficiency. For the past 8-10 years, SPU has collected these near end-of-pipe samples each year.

Over the next five years, the City will continue to monitor these locations to help identify where discharges from City-owned outfalls could contribute to an exceedance of the LDW sediment RALs following cleanup. Sediment traps are currently installed in 10 of the approximately 32 outfalls that are either owned by the City or used by the City to discharge stormwater and/or wastewater to the LDW (see Map 87). In addition, SPU has collected inline grab samples from near the downstream end of the City MS4 in an additional 10 drainage systems[26]. SPU will continue to retrieve and redeploy the existing traps every year. Outfalls where traps are installed and will be maintained over the next five years are listed in Table 21.

[26] 16th Ave S SD (east), 1st Ave S SD (east), 2nd Ave S SD, Georgetown SD, Head of Slip 2 SD, S 96th St SD, KCIA SD#1, S River St SD, S Brighton St SD, and S Nevada St SD.

Table 21: Existing sediment traps that SPU will operate/maintain over the next five years.

Drainage System	No. of Traps
Upper Reach	
Norfolk CSO/PS17 EOF/SD	5
17th Ave S SD	1
Middle Reach	
S Myrtle St SD[a]	1
I-5 SD at Slip 4	1
SW Kenny St SD/T115 CSO	1
Highland Park Wy SW	2
1st Ave S SD (west)	5
7th Ave S SD	3
Lower Reach	
Diagonal Ave S CSO/SD	2
SW Idaho St SD	3
Total	22

a. Following 2020 trap retrieval, the multiple devices installed as part of the sediment trap pilot test will be removed and replaced with the new bowl-style trap at the downstream most maintenance hole (EQNUM 599350).

During the previous reporting period, SPU also began collecting inline grab samples at near end-of-pipe locations in most of the other storm drains that it owns or uses in the LDW. During the next five years, SPU plans to install sediment traps at many of these locations, using the new trap that SPU recently developed as this new, lower profile trap is more suited to these small diameter pipe systems. Locations where SPU intends to install sediment traps over the next five years are listed in Table 22.

Table 22: Locations where new sediment traps will be installed over the next 5 years.

Drainage System	Proposed Location		Proposed Install Date
	Primary Location[a]	Other Potential Location[b]	
Upper Reach			
16th Ave S SD (east)	MH201		2020
S 96th St SD	MH244 / 600535	999806	2020
Middle Reach			
S River St SD	MH211 / 599043	599026	2021[c]
S Brighton St SD	MH222 / 599155	NH223 / 599156	2021[c]
S Garden St SD	966152		2022[c]
Georgetown SD	MH23		2022[c]
Lower Reach			
Diagonal Ave S CSO/SD	ST6 / 595461[d]		2023
SW Dakota St SD	RCB200A / 597264		2023[c]

a. Existing inline grab location / SPU equipment number (EQNUM)
b. Potential alternate location if primary location is unsuitable for trap installation.
c. Inline grab samples will be collected if possible, in the years prior to trap installation.
d. Re-install trap at this location to assist in tracking potential sources of PAH.

10.1. LINE CLEANING

Over the next 5 years, SPU will allocate approximately $250,000 per year for line cleaning activities. Given the variability in costs, it is difficult to estimate the length of line cleaning this will support. In the past 3 years, line cleaning costs have varied from $20 to over $30 per foot of pipe cleaned. Cleaning costs are affected by a number of factors, including 1) the amount of sediment that has accumulated in the system, 2) the ease of dewatering the sediment removed from the system prior to disposal (finer sediment is harder and requires more time to dewater than coarse sediment), 3) the amount of base flow in the system, which requires more extensive set to bypass base flow around the work area, 4) the degree of tidal influence from the waterway, which limits access to the pipe for cleaning, 5) the number of arterial streets involved, which increases the cost for traffic control, and 6) the level and type of contaminants presence in the storm drain solids, which necessitates additional treatment to dispose decant water to the sanitary sewer system. Without continued grant funding, SPU expects to be able to clean at least 4,000 feet of pipe each year over the next 5-year period.

In 2020, SPU intends to focus on completing work in the following areas that was started, but not finished during the previous reporting period:

- ***S Norfolk St CSO/PS17 EOF/SD***. Remove material from the sediment trap at the downstream end of MLK Wy Jr sub-basin and re-establish flow channel, clean oil/water separator, 64-inch pipe (EQNUM 614010) west of MLK Wy Jr and 36-inch pipe (EQNUM 614009) pipe on MLK Wy Jr that were not cleaned in 2018. Schedule annual preventative maintenance cleaning in Maximo for the sediment trap and oil/water separator. Due to the impacts of Covid-19, this may be completed in 2021.
- ***1st Ave S SD (west)***. Clean 30- to 36-inch pipes on S Kenyon St between Occidental Ave S and 2nd Ave S. These pipes are continuously backwatered due to a reverse grade in a downstream pipe and must be dewatered prior to cleaning. Work will be coordinated with SPU Solid Waste Division so drainage structures at the South Transfer Station can be cleaned at the same time.
- ***Diagonal Ave S SD, Denver Ave S sub-basin***. Clean pipes on Ohio Ave S, Denver Ave S, 1st Ave S, 2nd Ave S, 3rd Ave S, and 4th Ave S outside the area cleaned in 2019 as part of Seattle's response to a PCB release on Denver Ave S between 1st Ave S and 2nd Ave S.
- ***Diagonal Ave S SD, S Dakota St sub-basin***. Clean about 9,000 feet of pipe that were not completed in 2019.

Other cleaning work to be completed in 2020 includes:

- ***Catch basin RCB298*** (EQNUM 879610) in S Webster St SD.
- Work with SPU line of business to establish decant/dewatering site at the South Operations Center. The site in South Park neighborhood that SPU has been utilizing will not be available after 2019 due to construction of storm drain pump station.

Drainage systems or sections of drainage systems that SPU intends to clean in the next five years are described below:

- ***Diagonal Ave S CSO/SD, S Snoqualmie St sub-basin***. This sub-basin continues to exhibit elevated levels of mercury and PCBs in inline samples collected near S Snoqualmie St and 7th Ave S. It is an area where SPU will conduct additional source tracing. Lines will be cleaned after pollutant source(s) are found and controlled.
- ***16th Ave S SD (east)***. Re-clean following inspections/source tracing work.
- ***Diagonal Ave S SD, Bush Pl sub-basin***. Nine (9) of the 10 inline samples collected from the downstream end of this sub-basin contain elevated levels of HPAH (16,400 – 127,580 ug/kg dw). SPU attempted to collect inline storm drain solids samples from this system in 2019 but was not successful due to lack of

sediment accumulation in maintenance holes. Lines will be cleaned after pollutant source(s) are found and controlled.

- ***Georgetown SD.*** After Georgetown Stream Plant roof replaced.
- ***7th Ave S SD***. Re-clean the entire drainage system.

10.2. TRANSPORTATION

SDOT has identified one capital project and several paving program projects that will be conducted in the LDW during 2021-2026. Schedule and actual completion of projects depend upon funding, project scopes, and competing work priorities. Because of this uncertainty, projects in these programs are typically planned up to two years in advance. Projects are listed in Table 23 and locations are shown on Map 85.

Table 23: SDOT activities in the LDW (2021-2026).

Project / Program	Location	Length (miles)	Timeframe
Arterial Asphalt Concrete (AAC)	15th Ave S between S Columbian Way and S Spokane St[a]	5.4	2020 - 2024
Non-Arterial Street Resurfacing and Restoration (NASRR)	--	1	2020 - 2021
Arterial Major Maintenance (AAM)	--	2.2	2020-2021
East Marginal Way Corridor[b]	E Marginal Wy S between S Holgate St and Duwamish Ave S		2021

a. Scheduled to start in November 2020 and be completed in June 2021. The project will repave approximately 5.4 lane miles of roadway located on 15th Avenue S between S Spokane Street and S Angeline St; S Columbian Way between 14th Ave S and 15th Avenue S; and S Spokane St between S Columbian Way and Beacon Ave S.

b. Improvements include a protected bike lane along the east side of the street, new roadway surface between S Holgate and Duwamish Ave S, drainage collection and conveyance systems, water quality treatment facilities, and flow control facilities. Phase 1 construction is scheduled to start in 2021. The schedule for Phase 2 and 3 will depend on identifying funding sources.

11.REPORTING

The City will submit a report to Ecology in conjunction with the City's MS4 permit annual report by March 31 each year describing the status of source control activities. Source Control staff conducting the sampling and inspections discussed within this SCIP are the same staff working to ensure compliance with the City's MS4 permit. Information and tasks conducted for this SCIP are included in the MS4 permit annual report as well, and the two reporting sets guide the work of one another. The annual SCIP status report will 1) document actions taken by the City to minimize the potential for contaminant concentrations to exceed the RALs established for the LDW, 2) identify ongoing efforts and plans to integrate LDW source control priorities into ongoing citywide activities, 3) describe results of source tracing and characterization monitoring efforts in the LDW, and 4) describe the source control actions that the City will be taking during the next reporting period.

It is anticipated that the annual source control report can be tailored after the format of previous NPDES annual reports. The City will work with Ecology over the next year to develop a workable format to streamline reporting efforts so that limited staff resources can focus on implementing the source control plan. At a minimum, a series of summary charts and tables will be submitted to document City actions:

- Numbers of source tracing samples with maps and box plots for contaminants of concern

- Feet of line cleaned, and amount of sediment removed
- Miles of street swept and sweeping frequency
- Summaries of source control effectiveness evaluations and if necessary, descriptions of any changes in priorities for City's source control program
- Status of planned capital projects (e.g., stormwater retrofits)/

Source tracing and characterization data will also be uploaded to Ecology's EIM database by May 31 each year.

As remedial design and cleanup approaches, and cleanup schedules are developed, progress reports will focus on documenting the status of source controls in specific basins that discharge at or near proposed cleanup sites to support Ecology's sufficiency determinations.

SPU will also continue to submit summaries of inspection and source tracing efforts at the Duwamish Inspector Group meetings.

The City will use the data and information collected during the SCIP 2 period (2021-2026), along with the goals and objectives that Ecology has established over the course of the period, to identify and prioritize actions for the 2026-2030. The City will provide Ecology with the next SCIP for approval in 2025.

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