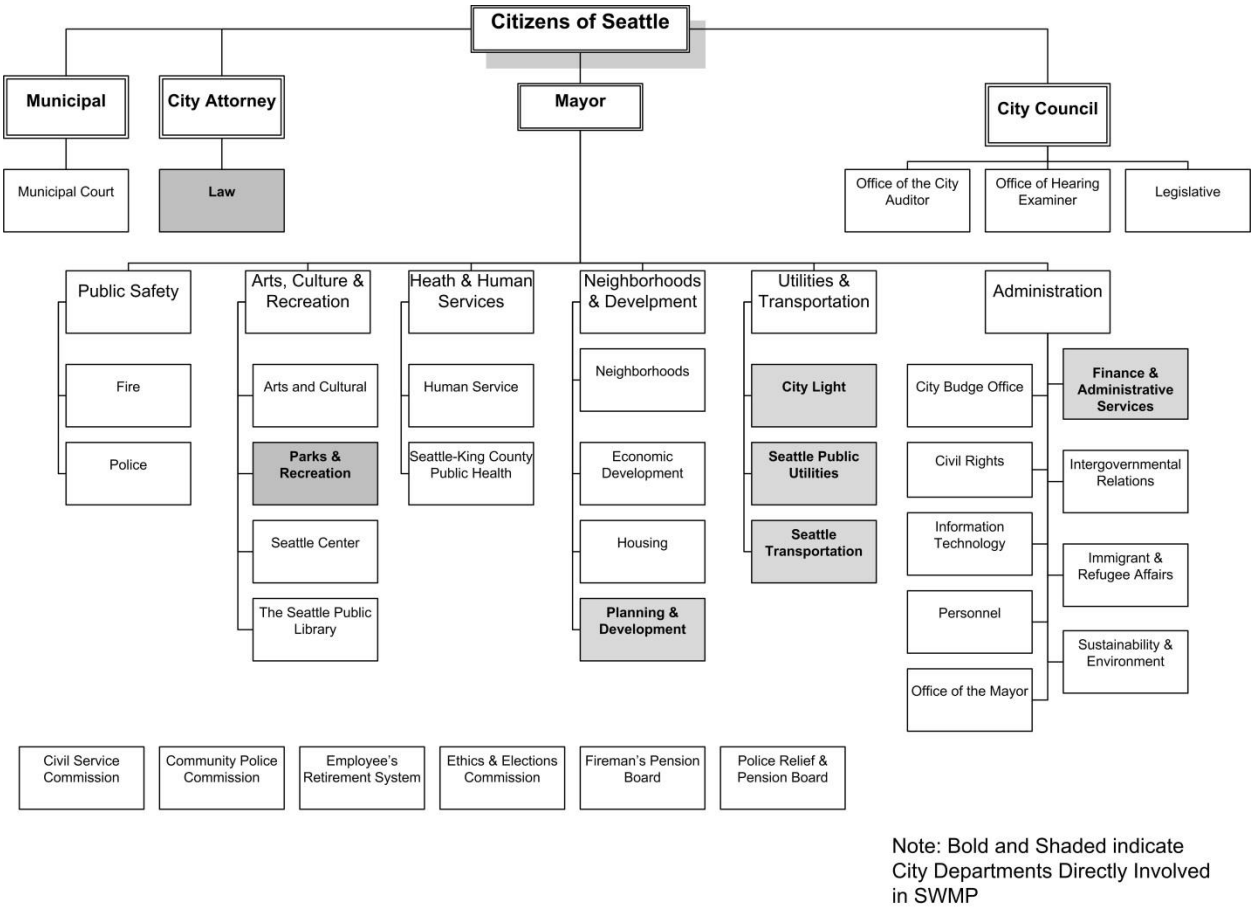
10 – Internal Coordination

SPU is the lead City department for implementing Permit coordination requirements in the Stormwater Management Program (SWMP). Among the many City departments serving the residents of Seattle, there are six departments (highlighted on Figure 1) primarily responsible for implementation of programs and projects for stormwater management within the City's MS4. Departments with major Permit-related responsibilities include the Department of Planning and Development (DPD), Seattle Parks and Recreation (Parks), Seattle Department of Finance and Administrative Services (FAS), Seattle City Light (SCL), and Seattle Department of Transportation (SDOT). These departments and SPU have been implementing many of the Permit-required programs for many years and in some cases well before the first NPDES municipal separate storm sewer system (MS4) permit was issued in 1995. SPU coordinates with the various departments to facilitate the stormwater management program for the City.

Figure 1 City Organizational Chart



Seattle Public Utilities

SPU is the City-designated lead department for managing municipal stormwater, including meeting Phase I Permit requirements, conducting water quality programs, and managing drainage-related capital projects. SPU conducts inspections, maintenance and repair of stormwater facilities in the right-of-way.

Department of Planning and Development

DPD is the City department responsible for developing, administering, and enforcing development standards. DPD issues development permits as required under the Stormwater Code and other ordinances and inspects sites prior to and during construction. SPU and DPD share complaint response and enforcement (i.e., inspection and response) responsibilities. Both SPU and DPD have authority to issue notices of violation and initiate enforcement for drainage related issues. DPD manages customer complaints and inquiries related to current construction activities. SPU manages customer complaints and inquiries unrelated to development permits.

Seattle Parks and Recreation

Parks is responsible for several hundred parks and park facilities and plays a key role in environmental stewardship. Parks trains its staff in comprehensive BMPs for various maintenance activities, works in partnership with SPU on creek improvement projects, and is involved in programs designed to reduce pesticide use, remove invasive plants, and replant native species on property managed by Parks.

Seattle Department of Finance and Administrative Services

FAS manages most of the City's non-utility real estate portfolio, oversees the design, construction and occupancy of City facilities, maintains City buildings, and purchases, maintains and repairs the City's fleet of vehicles. FAS trains its staff in BMPs related to its business activities and works to reduce impacts on stormwater. FAS is responsible for implementation of the Stormwater Code at facilities under its management.

Seattle City Light

Created by the citizens of Seattle in 1902, SCL provides customers with electricity and related services. SCL is dedicated to managing all of its activities in an environmentally responsible manner. SCL trains its staff in BMPs related to its business activities and works to reduce adverse impacts on stormwater. SCL is responsible for implementation of the Stormwater Code at facilities under its management.

Seattle Department of Transportation

SDOT is responsible for the City's streets, bridges, sidewalks, bike paths, street trees, and traffic operations. SDOT performs such roadway maintenance activities as street sweeping and snow and ice control. The Capital Projects Division of SDOT oversees all aspects of Transportation Capital Improvement Programs (CIPs) and coordinates development and implementation of large-scale City projects. SPU works with SDOT during implementation of projects to design stormwater facilities in the right-of-way. At project completion, SPU takes over operation and maintenance of all stormwater facilities in the right-of-way.

Internal Coordination Meetings

SPU leads inter-departmental meetings to coordinate the City's stormwater management and Permit reporting efforts. These meetings are typically held quarterly and have enabled the different departments to better coordinate stormwater-related policies, programs and projects. Departments with major Permit-related responsibilities (SPU, SDOT, DPD, FAS, SCL. And Parks) have a designated stormwater coordinator who coordinates stormwater permit requirements within their Department. The inter-departmental team includes coordinators from SPU, SDOT, DPD, FAS, SCL, and Parks, and any other interested parties

Executive Order

The Permit requires SPU to "establish, in writing…intra-governmental (internal) coordination agreement(s) or Executive Directive(s) to facilitate compliance with the terms of the permit." Executive Order # 01-08 (attached) was issued on January 29, 2008, by the Mayor of Seattle to meet this Permit requirement. The Executive Order prescribes the following responsibilities and orders all departments to coordinate all stormwater-related policies, programs, and projects:

- Each department director will be responsible for meeting the Permit requirements that apply to his or her respective department.
- SPU will serve as the lead department for overseeing City compliance with the Permit.
- SPU will provide each department with information, technical support, and a forum for inter-departmental coordination.
- All City departments must provide SPU with all necessary reporting elements and supporting material necessary to comply with the reporting requirements and associated deadlines of the Permit.

Office of the Mayor
City of Seattle
Gregory J. Nickels, Mayor

Executive Order: 01-08
NPDES Municipal Stormwater Permit

An Executive Order directing all City Departments to coordinate together to comply with the requirements of the City's National Pollutant Discharge Elimination System (NPDES) Municipal Stormwater Permit, which has been issued to the City of Seattle by the Washington State Department of Ecology under the provisions of the federal Clean Water Act.

WHEREAS, the City of Seattle has long prided itself on its commitment to the environment;

WHEREAS, the Mayor's Executive Order 03-04 directs City departments with responsibilities for and connections to water quality and aquatic habitat issues to develop a shared, broad-based strategy know as 'Restore our Waters' to better protect and restore water quality and aquatic habitat within the City;

WHEREAS, managing municipal stormwater runoff is a critical component of any strategy to meet the City of Seattle's long-standing objective to protect, improve, and enhance the City's lakes, creeks, bays, rivers, and other surface and ground waters;

WHEREAS, the Washington State Department of Ecology has issued to the City a permit under the National Pollutant Discharge Elimination System (NPDES) of the federal Clean Water Act that contains a suite of conditions and requirements for managing municipal stormwater runoff;

WHEREAS, compliance with the City's NPDES Municipal Stormwater Permit is a responsibility of the entire city and all City departments;

WHEREAS, the City's NPDES Municipal Stormwater Permit contains a specific requirement to establish in writing an Executive Directive requiring internal coordination among all departments affected by the permit;

NOW, THEREFORE, I, GREGORY J. NICKELS, Seattle Mayor, do order all City departments to coordinate all stormwater-related policies, programs, and projects to the maximum extent practicable and I order all City departments to eliminate barriers to compliance with the terms of the permit.

FURTHERMORE, I direct all City departments to review the NPDES Municipal Stormwater Permit that has been issued by Ecology and to identify all requirements for which they are responsible and each Director will be responsible for meeting those requirements and associated deadlines that apply to his or her respective department.

FUTHERMORE, I direct Seattle Public Utilities to serve as the lead department in all matters related to overall City compliance with the permit.

FURTHERMORE, I direct Seattle Public Utilities to provide sufficient information to each department, including technical support, and providing a forum for intra-governmental coordination so the City is able to meet the requirements of the permit.

FURTHERMORE, I direct all City departments to provide to Seattle Public Utilities all necessary reporting elements and supporting material necessary to comply with the reporting requirements and associated deadlines of the permit.

13 - Public Participation

The Permit (Section S5.C.4) requires the City to provide ongoing opportunities for public involvement in the SWMP and input on implementation priorities. The minimum performance measures include:

- Creating opportunities for the public to participate in the decision-making process involving development, implementation and update of the SWMP.
- Making the SWMP and the required annual report available to the public on the City's web site. All other submittals shall be available to the public upon request.

Public Participation Program

The City provides a variety of opportunities for public involvement in the stormwater management program. Public comments on budget, Stormwater Codes and the SWMP also help to refine ongoing development of stormwater management activities. SPU is the lead City department responsible for implementing the public involvement and participation program for the SWMP and Permit-related activities. The City Council provides opportunities for public participation in public hearings. The public has several means of participating in the SWMP development process and associated activities, as described below.

City Budget Process. The City budget process provides opportunities for public input on how monies are allocated for implementation of NPDES-related stormwater management. Adoption of the City Budget - one of the most important products of the work of City Council - always requires public hearings to be scheduled on two or more days. All meetings are held in Council Chambers unless otherwise noted. The public is encouraged to attend Council meetings, hear the debate, and offer public comment on issues. The City Council meeting schedule and methods for providing comments are listed on the City Council's web site: http://www.seattle.gov/council/default.htm.

Public Participation during SWMP Development. SPU facilitates several citizen advisory groups that provide an on-going opportunity for citizens to participate in planning and development of policies and programs and to advise SPU and other pertinent City entities of its findings and recommendations. SPU will continue to engage citizen advisory groups to provide a diversity of viewpoints on implementation of stormwater management activities.

To provide for additional public input beyond that provided by the stakeholder groups, SPU has created a stormwater management web site to host an electronic version of the SWMP and other related stormwater management information and documents (http://www.seattle.gov/util/MyServices/DrainageSewer/AbouttheDrainageSewerSystem/StormwaterManagementPlan/index.htm). In addition, the web site provides contact information (swmp@seattle.gov) for citizens to provide comments and ask questions.

Public Participation during Code and Directors' Rule Update. Beginning in January 2013, a series of meetings has been conducted to inform interested stakeholders about proposed updates to the 2009 Stormwater Code. These meetings covered modifications that are being proposed both as part of the "2015 Revision of Stormwater Code" and the "2016 Stormwater Code Update". These meetings included representatives of the business community, development interests, environmental advocacy groups, engineering and consulting firms, community groups, and other local and state regulators. The dates and the name of each group are shown below.

Date	Group
January 24, 2013	Thornton Creek Alliance
March 18, 2013	External User Stakeholders
May 8, 2013	Master Builders Association of King and Snohomish Counties
May 9, 2013	Fauntleroy Watershed Council
June 27, 2013	Seattle Builders Council Master Builders Association
November 7, 2013	Public Open House
November 19, 2013	Thornton Creek Alliance
November 26, 2013	North Seattle Industrial Association
December 17, 2013	King County
June 3, 2014	Public Meeting
June 5, 2014	Seattle Builders Council Master Builders Association
June 11, 2014	American Council of Engineering Companies (ACEC)
July 15, 2014	Washington Society of Landscape Architects (WASLA)
July 16, 2014	Master Builders Association (MBA)
July 17, 2014	American Society of Civil Engineers (ASCE)
July 18, 2014	American Public Works Association (APWA)
August 13, 2014	Urban Forestry Commission
January 26, 2015	Puget Soundkeeper Alliance (PSA)

There will be several opportunities to provide comments over the next year including:

- During the SEPA review process (anticipated for March 2015)
- During the legislative processes and formal public review
- 2015 Stormwater Code Revision to the 2009 Stormwater Code (anticipated for April 2015)
- 2016 Stormwater Code & Manual Update (anticipated for August 2015)
- At the City Council public hearing that will be part of their deliberation
- 2015 Stormwater Code Revision to the 2009 Stormwater Code (anticipated for April 2015)
- 2016 Stormwater Code & Manual Update (anticipated for August 2015)
- During the 2016 Stormwater Manual Directors' Rule administrative process and formal public review period (anticipated for September 2015)

Opportunities for Public Engagement and Public Review can be found on the Stormwater Code and Rules Update webpage:
http://www.seattle.gov/dpd/codesrules/changestocode/stormwatercode/whatwhy/default.htm.

Comments on the Stormwater Code and Rules can be emailed to: stormwatercode@seattle.gov.

Appendix 11 - Structural Source Control Project List

March, 2015

Project Name	Type[1]	Start Year	Status[2]	End Year	Cost Estimate[3]	Funding (%)			WQ Benefit[4]	Hydro Benefit[5]	Hydro Benefit #	Retrofit Incentive[6]	Other Benefit	Monitoring Planned	Lat	Long	Receiving Water Body	Comments
						Local	State	Federal										
Capitol Hill Water Quality Project (aka Swale on Yale)	2	2006	4,4,2*	2018	11.7 M	88%	1%		97,600 lbs TSS/yr	NA		580.0	Increased green space	Yes	47.621	-122.331	Lake Union	Biofiltration swales treating 439 acres. *Status: Phase 1 & 4 (Diversion, Pretreatment, Conveyance & Utility Relocation): **4** Phase 2 & 3 (Block 10 Swale): 4 Phase 5 & 6 (Block 11 Swale): **2** Local funding includes 1.8M SRF Loan. Private funding: 11%.
Venema Natural Drainage System (NDS) Project	2	2005	3	2016	7.65 M	85%	15%		12,000 lbs TSS/yr	92%	2	74.0	Increased green space	Yes	47.717	-122.361	Piper's Creek	Bioinfiltration followed by infiltration treating 80 acres.
South Park Water Quality Project	2	2005	2	2025	30 M*	100%			54,500 lbs TSS/yr	NA		225.0	Protects Duwamish sediments (Superfund site)	Yes	47.535	-122.325	Duwamish Waterway	Active treatment (e.g., chitosan enhanced sand filtration) for 240 acres of industrial/commercial/HDR. * Cost estimate includes pump station and water quality facility.
Street Sweeping for Water Quality Program	11	2011	4	Ongoing	1.16 M /yr	100%			1,688,000 lbs TS/yr (dry)	NA		310.0	Improved air quality; clean streets	Yes	City wide		Lake Washington, Lake Union, Ship Canal/Salmon Bay, Puget Sound, Duwamish Waterway, Longfellow Creek, Piper's Creek, Thornton Creek	High efficiency sweeping of 1240 acres of arterial roadways.

Project Type

Instructions: Do not alter this table. The type numbers and descriptions are for reference only.

[1]Type	Description
1	New flow control facility, including Low Impact Development (LID) Best Management Practices (BMPs)
2	New treatment facility (or treatment and flow control facility), including LID BMPs
3	Retrofit of existing treatment and/or flow control facility
4	Property acquisition for water quality and/or flow control benefits (not associated with future facility)
5	Maintenance with capital construction costs ≥ $25,000
6	Property acquisition for riparian habitat
7	Restoration of forest cover
8	Restoration of riparian buffer
9	Floodplain reconnection projects on water bodies that are not flow control exempt per Appendix 1
10	Capital projects related to the MS4 which implement an Ecology approved basin or watershed plan
11	Other actions to address stormwater runoff into or from the MS4 not otherwise required in S5.C

Project Status

Instructions: Do not alter this table. The status numbers and descriptions are for reference only.

[2]Status (as of December 31st of the reporting year)	Description
1	Planning
2	Design and permitting
3	Construction
4	Complete/Maintenance
5	Project cancelled
6	Property acquisition

Project Cost

Instructions: These descriptions are provided for reference only.

[3]Cost Estimate
Costs must be updated to reflect final costs when Status 4 or 6 is reached

Funding (%)
Estimate the percentage of funds from local, state, and federal sources

Water Quality Benefit

(Estimated Total Suspended Solids (TSS) or Total Solids (TS) reduction in pounds per year (lbs/yr))

Instructions: Use this tool to calculate the TSS or TS load reduction for each project. Enter contributing acreage for each land use category in the blue cells on the left, and the estimated unit area loading rate (from your S8.D data) in the blue cells on the right. Then enter the removal efficiency in the blue box under Treatment Efficiency. The value to enter into the main table will appear under Estimated TSS Reduction.

Land Use Category	Contributing Acres (ac)	Median TSS Unit Area Loading Rate (lbs/ac/yr)*	Treatment Removal Efficiency for TSS (%)	Estimated TSS Reduction (lbs/yr)
Commercial				
Industrial				
Low-density Residential				
High-density Residential				
Totals	0	-		-

← *Insert this number in Worksheet for* ***Water Quality Benefit*** [4]

Notes:

**Values derived from S8.D data collected under 2007/12 Phase I Permits*

Estimated Total Solids (TS): For maintenance projects involving solids removal, enter the estimated dry weight of TS removed in pounds (lbs) in the Worksheet for Water Quality Benefit [4]

For 2014, in absence of a Western Washington median TSS unit area loading rate, Permittees should base this on their own S8.D data.

Ecology may approve other methods for calculating an estimated TSS reduction if the Permittee justifies the method is appropriate for the relevant project type.

Hydro Benefit

Estimated average percent flow reduction

Instructions: Do not alter this table. The hydro benefit numbers and descriptions are for reference only.

Option # **Description**

1 *Standard Flow Control Requirement:* Enter the hydro benefit number in the reporting table under "Hydro Benefit" equal to the project's volume ratio, up to 100%. Refer to Volume Ratio Calculation.

2 *LID Performance Standard:* Enter the hydro benefit number in the reporting table under "Hydro Benefit" according to the following:

- 100% if the project meets the LID Performance Standard in Appendix 1, Section 4.5
- 100% if the project uses Full Dispersion functionally equivalent to BMP T 5.30 in Chapter 5 of Volume V of the Stormwater Management Manual for Western Washington
- Equal to the project's volume ratio, up to 100%. Refer to Volume Ratio Calculation

Volume Ratio Calculation

Instructions: Use one of the forms below to calculate the volume ratio, then copy and paste the value into the "Hydro Benefit" column of the worksheet. Units do not matter, as long as they are the same for the first and second fields. Use either Option 1 or Option 2.

Hydro Benefit Option 1

Actual Storage Volume Provided	Volume Required if Project had to Meet Standard Flow Control Requirement	Volume Ratio
75	100	75%

Hydro Benefit Option 2

Actual Storage Volume Provided	Volume Required if Project had to Meet LID Performance Standard	Volume Ratio
75	100	75%

Notes:

To calculate volume required if project had to meet the Standard Flow Control Requirement or the LID Performance Standard, use forested land cover as the pre-developed condition unless one of the following applies:

Reasonable, historic information is available that indicates the site was prairie prior to settlement (modeled as "pasture" in the WWHM).

The drainage area of the immediate stream and all subsequent downstream basins have had at least 40% total impervious area since 1985. In this case the pre-developed condition to be matched shall be the existing land cover condition. Where basin-specific studies determine a stream channel to be unstable, even though the above criterion is met, the pre-developed condition assumption shall be the "historic" land cover condition, or a land cover condition commensurate with achieving a target flow regime identified by an approved basin study.

Retrofit Incentive

Instructions: Determine the appropriate Project Achievement category from the table below based on project type and specifics. Then calculate the incentive using the formula below.

Retrofit Incentive Table

Incentive Points	Applicable Area (include the type of area listed below in the formula below in *acres*)	Project Achievement
100%	Impervious area	Water Quality: Better than Existing
150%	Impervious area	Water Quality: Better than Existing in known water quality problem area
150%	Impervious area	Water Quality: Basic treatment
175%	Impervious area	Water Quality: Enhanced treatment
200%	Impervious area	Water Quality: Meets WQ standards for target pollutant (assumed to be > level of treatment than Enhanced)
100%	Impervious area	Flow Control: Better than Existing
125%	Impervious area	Flow Control: Meets duration standard for Pasture
150%	Impervious area	Flow Control: Meets duration standard for Forest
150%	Impervious area	Flow Control: Protects habitat or prevents erosion and scour in known flow control problem area
200%	Impervious area	Flow Control: Meets LID Performance Standard
25%	Total area served by maintenance activity	Maintenance with capital construction costs ≥ $25,000 or other maintenance actions per S5.C.6.a.ii.(5)
50%	Total area acquired	Riparian Habitat Acquisition
25%	Total area restored	Restoration of Forest Cover
25%	Total area restored	Restoration of Riparian Buffer

Formula

Incentive Points	**Applicable area**	**Retrofit Incentive**
from table above	*from table above, in acres*	*Insert this number in Worksheet for Retrofit Incentive*[6]
150%	0.23	0.345

36 – Summary of Source Control Program Actions

Summary of Actions (S5.C7.b.iii):

The City implements a Source Control program (S5.C.7) to reduce pollutants in runoff from areas of existing development that discharge to the MS4. This includes an inspection program for businesses and/or properties identified based on the presence of activities that are pollutant generating. Below is a summary of the City's actions taken in 2014 to implement these source control requirements. (S5.C.7.b.iii)

(1) The City distributes site specific materials and provides technical assistance during inspections. Information of a general nature is provided on social media via twitter and Facebook at both SPU and Seattle Green Business Program pages. A direct mailing is planned for the future. (S5.C.7.b.iii.(1))

(2) In 2014, the City of Seattle conducted 535 source control inspections on properties draining to the MS4 in Seattle. As part of those inspections, there were 327 follow up inspections (some businesses required more than one follow up inspection to achieve compliance) for a total of 826 source control inspections, representing 21% of eligible sites. Sites are prioritized for inspection based on risk level, which determines inspection frequency (high = 2 yrs, medium = 4 yrs, low = 6 yrs). Risk level is determined by outdoor activity, business type, etc. (S5.C.7.b.iii.(2))

(3) All businesses identified through the complaint program received business inspections (100%). (S5.C.7.b.iii.(3))

Summary of Actions (S5.C7.b.iv.):

The City implements a progressive policy to require sites to come into compliance with stormwater requirements within a reasonable time period. The progressive enforcement policy includes a corrective action letter, a second and final letter, and a notice of violation. The violator can enter into a voluntary compliance agreement. If and when the violation cannot be resolved, the violation can be referred to Ecology for enforcement. Below is a summary of actions taken in the enforcement progression in 2014 for the Business Inspection Program, the Stormwater Facility Program, the Complaints/Spill Response Program, and the Illicit Discharge Detection and Elimination (IDDE) Program. Records are maintained electronically and by hard copy. Program records are kept in three custom databases.

Follow Up and Enforcement by Program Type

Program Type	Corrective Action Letter	Second and Final	Notice of Violation	Voluntary Compliance Agreement	Ecology Referral
Business Inspection Program	291	50	6	1	1
Stormwater Facility Program	215	32	0	0	0
Complaints/Spills	9	0	14	0	0
IDDE	0	0	11	0	0

Illicit Discharge Detection and Elimination Program

Quality Assurance Project Plan

Seattle Public Utilities

NPDES Phase I Municipal Stormwater Permit

June 2014

City of Seattle

1.0 Definitions, Acronyms and Abbreviations

In this QAPP, the following definitions, acronyms and abbreviations are used as indicated below.

C	Centigrade or Celsius
CFU	Colony forming unit
City	City of Seattle
Ecology	Washington State Department of Ecology
EPA	Environmental Protection Agency
ERTS	Environmental Report Tracking System
F	Fahrenheit
GIS	Geographic Information System
GPS	Global Positioning System
IDDE	Illicit discharge detection and elimination
mg/L	Milligrams per liter = Parts per million
mS/cm	MilliSiemens per centimeter
MH	Maintenance hole
MS4	Municipal separate storm sewer system
MQO	Measurement Quality Objective
NPDES	National Pollutant Discharge Elimination System
NTU	Nephelometric Turbidity Units
PCB	Polychlorinated biphenyl
Permit	Phase I Municipal Stormwater Permit
PSD	Piped storm drain
QAPP	Quality Assurance Project Plan
QC	Quality Control
SCPD	Source Control and Program Development
SM	Standard Methods
SPU	Seattle Public Utilities
SWMP	Stormwater Management Program
TMDL	Total Maximum Daily Load
µS/cm	MicroSiemens per centimeter

2.0 Contents

3.0 Introduction & Background

Seattle Public Utilities (SPU), a department of the City of Seattle (City), operates and maintains a municipal separate storm sewer system (MS4). The reissuance of the Phase I Municipal Stormwater Permit (Permit) by the Washington State Department of Ecology (Ecology) in 2007 requires the City to implement a Stormwater Management Program (Seattle, 2008a). The Permit requires the Stormwater Management Program to include a program to detect, remove, and prevent illicit connections and illicit discharges. SPU's Source Control and Program Development (SCPD) is responsible for developing and implementing the City's Illicit Discharge Detection and Elimination (IDDE) program.

3.1 IDDE Program context

The goal of the IDDE program is to detect, find, and remove non-permissible discharges to the MS4. The City currently implements IDDE through business inspections, water quality complaint response, and spill response in addition to sediment source tracing in the Lower Duwamish Waterway and East Waterway Superfund areas. The City also attempts to prevent illicit discharges through public education and outreach, and building code enforcement, as described in the City's Stormwater Management Program. In the summer of 2009, a a dry weather field screening element was added to the program.

The goal of the dry weather screening element of the IDDE program is to detect, find, and remove illicit discharges and connections from the MS4. The program element does this by:

- Performing dry weather field screening of the MS4
- Initiating source tracing investigations when the screening indicates the potential presence of illicit discharges or illicit connections
- Verifying illicit connections using additional tools such as dye-testing, smoke testing, or closed circuit TV (CCTV)
- Stopping/removing illicit discharges/illicit connections using the City's progressive enforcement process

3.2 Purpose of this QAPP

This Quality Assurance Project Plan (QAPP) describes the dry weather field screening element that will be used to detect illicit discharges. The enforcement process described in the Stormwater Management Program and the Seattle Municipal Code will be used to facilitate the removal of illicit discharges, once detected.

This QAPP is intended to describe the:

- Goals and objectives of the IDDE program
- Type and quality of data required to meet the objectives
- Sampling and analysis procedures required to acquire those data

- Quality assurance and quality control procedures to ensure that the data meets the objectives

This QAPP describes procedures to ensure that data of sufficient quality is generated and that a process is defined for the use of that data so that illicit connections and discharges are discovered and removed. The QAPP also serves the purpose of standardizing program procedures so that multiple field teams can pursue data screening in the same way.

3.3 Background

Illicit **discharges** are broadly defined as non-stormwater and non-natural waters entering the storm sewer system. Discharges may be continuous, intermittent, or transitory and include those discharges associated with illicit **connections**—those connections that by Code requirements should be made to the sanitary sewer rather than the drainage system. Examples of illicit **discharges** include the discharge of sewage, washwater, spills, improper disposal of materials, hyperchlorinated tap water, and sanitary or industrial wastewater. Section S5.C.8 of the Permit and Chapter 22.802 of the City Stormwater Code define illicit discharges and allowable exceptions.

Discharges to the MS4 travel to receiving water bodies without treatment. Receiving water bodies include streams, lakes, wetlands, and marine waters. Pollutants within illicit discharges may have adverse affects on aquatic ecosystems, wildlife, domestic animals, and humans that come in contact with the pollutants. Illicit discharges may also cause structural damage to drainage infrastructure.

3.4 Program Area

3.4.1 The MS4 outside of sediment remediation areas

The Permit requires that the City complete field screening of at least 12 percent of the stormwater conveyance system by January 2014. SPU will measure the percentage of MS4 screened as a measure of total drainage area (acreage). SPU will screen 12 percent of the MS4 in the separated and partially separated systems of the City. SPU conservatively estimates that the MS4 comprises 33,146 acres of drainage area. This estimate does include some drainage systems not owned by the City, such as the King County Airport. Systems not owned by the City will not be screened by the dry weather screening program.

The study area includes the separated and partially separated storm sewer systems within the City. The remainder of the city is on a combined system which conveys water to the West Point Treatment Plant. A description of the three types of drainage systems in the City is given below:

- Separated systems convey roof runoff and stormwater runoff to a storm drain system and wastewater to a sanitary sewer system in separate dedicated systems. The ditch and culvert drainage systems conveying stormwater north of 85th St are part of the separated system. These areas will be included in the field screening for this program. Approximately 30 percent of the City is served by separated drainage systems.
- Partially separated systems convey portions of the stormwater runoff to a storm drain system and wastewater with the remaining portions of the stormwater runoff to a sanitary sewer system. Partially separated systems are located in areas of the City where stormwater service was installed at a later time in an area that was previously served by combined

sewers. In these areas, portions of the stormwater runoff are usually reconnected into the newly installed stormwater service to decrease the amount of the stormwater runoff that discharges to the combined system. These areas will be included in the field screening for this program. Approximately 40 percent of the City is served by partially separated systems.

- Combined sewers carry both sanitary sewage and stormwater runoff and terminate at the West Point wastewater treatment plant. The combined sewer system is not covered by the 2007 Phase I Municipal Stormwater Permit and will not be field screened under this program. Approximately 30 percent of the City is served by combined sewer systems.

The City may need the cooperation of neighboring jurisdictions if problems are identified near City borders. Special Condition S5.C.3.b.ii of the Permit requires Permittees to establish a coordination mechanism clarifying roles and responsibilities for the control of pollutants between physically interconnected municipal storm sewer systems. The Special Condition goes on to state that failure to effectively coordinate is not a permit violation provided other entities, whose actions the Permittee has no or limited control over, refuse to cooperate. In February 2009, SPU sent notification letters to neighboring jurisdictions stating that the City will notify the jurisdiction and Ecology as soon as possible if an illicit discharge or connection is determined to be coming from a neighboring jurisdiction's drainage system. Jurisdictions notified include the City of Shoreline, King County, the Port of Seattle, Washington State Department of Transportation, the City of Tukwila, the University of Washington, and the Seattle School District.

3.4.2 Superfund Areas

The City's 2004 Comprehensive Drainage Plan (Seattle, 2005) recognized contaminated sediments as a threat to aquatic habitat and environmental health. The Lower Duwamish Work Group, a group of agencies and regulators pursuing early cleanup of contaminated sites, has identified basins where sediment remediation efforts are focused. Most of these basins are in industrial and commercial areas. Stormwater from these areas can carry pollutants that are not normally analyzed for in illicit discharge detection programs. However, the procedures used to detect on-going sources of pollutants from industrial and commercial runoff in the Duwamish area is similar to the techniques used to identify sources in the IDDE program. The City implemented a contaminated sediment source tracing program in 2002. The sediment source tracing project is described in two documents:

- Quality Assurance Project Plan: Duwamish River East Waterway Drainage Source Control (Seattle, 2008b)
- Sampling and Analysis Plan: Diagonal Avenue South Drainage Basin Pollutant Source Investigation (Seattle, 2003)

Sampling activities in these sediment remediation areas include grab samples at in-line maintenance holes, right-of-way catch basins, and catch basins on private property. In addition, monitoring is ongoing using sediment traps near outfalls and key maintenance holes throughout the targeted basins. These sediment samples have been analyzed for polychlorinated biphenyls (PCBs), semi-volatile organic compounds, metals (arsenic, copper, lead, mercury, and zinc), total petroleum hydrocarbons, total organic carbon, and grain size. These analyses have been selected to source trace contaminants of concern in the Lower Duwamish Waterway and East Waterway sediments. These analyses are also commonly associated with the upland industrial and commercial activities

found in the drainage basins of the Lower Duwamish Waterway and East Waterway. Additional analyses are included on an as-needed basis.

The Lower Duwamish Waterway sediment remediation area is comprised of 14 drainage basins totaling 11,000 acres. Approximately 1000 sediment samples have been collected in these basins and ongoing sediment trap samples are being collected at 39 locations. The East Waterway sediment remediation area is comprised of 4 drainage basins totaling 820 acres. Approximately 100 sediment samples have been collected in these basins and ongoing sediment trap samples are being collected at 6 locations. Business inspections and sediment sampling have been ongoing in these sediment remediation areas since 2003. However, only samples collected since the Permit effective date (February 2007) will be reported for compliance purposes.

Dry weather field screening may be used to supplement source control efforts in Superfund areas; however, the Superfund areas are given a lower screening priority because of the extensive sediment sampling and business inspection efforts that has occurred, and is ongoing, in these drainage basins. SPU's basin prioritization plan is discussed in Section 4.1.

The remainder of this QAPP refers only to the dry-weather screenings activities. Sediment source-tracing activities in the superfund areas are governed by a separate QAPP (Seattle 2003).

4.0 Program Description

The dry weather field screening program takes a systematic approach to finding illicit discharges and illicit connections. Field screening is designed to identify and characterize continuous dry-weather flows and attempts to identify suspect intermittent and transitory flows. The dry weather field screening program attempts to find illicit discharges by:

1. Prioritizing basins based on existing data and basin characteristics
2. Identifying screening parameters to use as indicators of generic types of pollution characteristic of illicit sources
3. Setting trigger levels for the screening parameters to initiate source tracing
4. Performing field screening at key locations within selected basins, starting near outfalls and working up the drainage system. Field screening consists of comparing screening results to trigger levels
5. Source tracing where the comparison suggests problems exist

4.1 Prioritization of Drainage Basins

Drainage basins will be prioritized for field screening using existing data and basin characteristics to evaluate the potential for illicit discharges and illicit connections. The following screening factors were tabulated by drainage basin to generate a priority list for field screening:

1. Drainage basin acreage: *larger drainage basins will have a higher priority because of the increased potential for more illicit connections per basin*
2. Data analysis from the 2005 Outfall Inspection Project (Herrera, 2005) that included an inspection for environmental conditions at piped storm drain (PSD) outfalls: *outfalls that had indications of contamination will have a higher priority*
3. Drainage basin listings, such as total maximum daily loads (TMDLs), where data suggest impaired water quality in receiving water bodies: *basins subject to TMDLs will have a higher priority*
4. Areas of separation projects from combined drainage systems to separated systems: *partially separated drainage basins will have a higher priority because there is an increased potential for illicit connections from separation projects*
5. Public exposure: *drainage basins with outfalls where there is higher potential for public exposure, such as outfalls near swimming beaches, will have a higher priority*
6. Superfund areas: *drainage basins that are included in the Lower Duwamish Waterway and East Waterway Superfund areas will be prioritized lower for additional screening because these areas have had the greatest frequency of business inspections and sediment sampling, and have already been screened using sediment traps*.

During the 2010 field season, a significant number of illicit connections were found at a public housing development where the sewer and drainage connections were made well after the streets and other utilities were installed. This development pattern involves the use of stubb markers where future connections to the sanitary and storm sewer are anticipated. Other developments having this pattern (delay between the time the sewers and drains were marked and the time the connection is

made) were identified City-wide to the extent possible. Basins with this development pattern coincided fairly well with the priorities for screening in 2011 as rated by the factors above, so no change in the overall basin priorities were made.

4.2 Screening parameters

The dry weather field screening element uses a limited number of parameters that are indicative of the presence of an illicit discharge or illicit connection. These parameters are not necessarily the most damaging constituent within a discharge, but act as surrogates to indicate that something is amiss and provide some indication of the source type.

The dry weather field screening element uses field observations, field analyses, and laboratory analyses of a select few chemical and biological parameters to characterize flowing discharges. When flow is not present, the field screening element relies on field observations, such as damage or staining, to suggest the presence of intermittent or transitory discharges.

As the program develops, each parameter is evaluated for usefulness in detecting illicit discharges. Other parameters may be evaluated andproposed for inclusion in future QAPP amendments, or used during source tracing investigations. Section 7 contains specific information on screening parameters used in the current IDDE program.

4.3 Trigger levels

Trigger values for the screening parameters are quantitative as well as qualitative. Trigger values are based on literature as well as the collective experience of SPU chemists, andfield scientists and are set to be at levels exceeding those of natural waters. The starting point for estimating the levels was Appendices E1 and E2 of the "Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assessments" (Brown, Caraco and Pitt, 2004a,b). Adjustments were made for some parameters based on values routinely observed in natural systems in the Seattle area, obtained from King County, Ecology, and Seattle websites. As data becomes available, the trigger and flow chart levels may be adjusted.

For instance, in 2011, the use of turbidity changed from use of a quantitative measurement to a qualitative visual observation made in the field. This change still provides adequate detection of problems in discharges while saving valuable field time.

4.4 Field screening

The general approach to field screening is to begin at an accessible location at or near the discharge point of a drainage basin, such as an outfall, key maintenance hole, ditch, or other structure. Field screening is performed at multiple key locations in most drainage basins instead of relying on elevated concentrations to be found only at the downstream discharge point. The size of the drainage basin is used to determine the number of locations screened. Key upstream maintenance holes representing major branches of the conveyance system are screened in larger basins in order

to decrease the size of the area screened by an individual sample. The purpose of this approach is to help detect discharges that may be diluted and, therefore, masked by groundwater intrusion or blended flows.

SCM staff will be performing the field sampling and analyses for all parameters except fecal coliform, potassium, and fluoride, for which the SPU Water Quality Laboratory will perform the analysis. Samples collected will be grab samples of flowing water. Most field screening will occur during the summer months during dry weather conditions.

The principal components of the SPU's field screening element are:

- Field observations of the physical and environmental conditions at each site
- Field analyses by in-situ chemical screening
- Source tracing if illicit discharges or illicit connections are suspected based on the field observations or field analyses
- Laboratory analysis of the collected samples for the remaining chemical parameters
- Additional source tracing based on laboratory analyses

4.5 Source tracing values over trigger levels

Immediate source tracing in order to follow a suspected illicit discharge or connection upstream will be initiated whenever field observation or data show that any of the trigger levels have been reached.

Immediate source tracing may not require that a sample be collected at each location or that each sample be analyzed for all parameters due to the importance of tracking the discharge quickly and efficiently to locate the source, especially for intermittent and transitory flows. In these cases, SCM staff use field observations (color, odor, floatables, and turbidity) and field analyses (pH, conductivity, temperature, ammonia, surfactants, and turbidity) as necessary to track the suspected illicit discharge or connection.

Once the discharge source has been located or isolated to a smaller section of the drainage system, it may be necessary to use other source tracing methods such as additional water sampling, side sewer research, dye testing, smoke testing, business inspections, stream walks, or CCTV. These investigations may require the participation of other City inspectors, operations and maintenance staff, and other agencies and may not be able to be conducted immediately.

Once the suspected source is identified, a source sample may be collected and analyzed for all parameters to compare with the downstream screening sample. The purpose of the source sample is to match the discharge types. In addition, the next upstream location will be sampled to confirm that there are no other suspected upstream illicit discharges or connections that may have been masked by the suspected source location.

If field screening activities identify an illicit discharge that requires immediate cleanup the City Spill Response Coordinator will be notified immediately.

5.0 Program Organization and Timing

This section discusses IDDE program organization including special training, staff roles, and project phases during the next several years.

5.1 Special Training Needs/Certification

Environmental Compliance Inspectors working on the dry weather field screening program are usually trained and certified in the following disciplines due to the situations and hazards they may encounter:

- Hazardous Waste Operations and Emergency Response – 40 hour
- Emergency Spill Response – 24 hour
- Washington State Traffic Control Flagger
- Confined Space Entry

5.2 Roles and Responsibilities

Dry weather field screening is typically carried out by a team of two inspectors. When a potential source is found, subsequent source tracing investigations may require the assistance of other personnel within SPU and from other agencies. Table 1 describes the roles and responsibilities of key personnel and the program schedule.

Table 1: Team Contact Information

Role	Name	Office/Cell Phone	Responsibility
Source Control & Program Development Manager	Louise Kulzer	206-733-9162 206-255-9595	Manages source control program, including budget, schedule, and permit compliance
Source Control Supervisor	Ellen Stewart	206-615-0023 206-295-6561	Supervises inspectors, acts as liaison to other agencies and SPU units for source tracing investigations, oversees permit compliance
NPDES Permit Coordinator	Kate Rhoads	206-684-8298	Responsible for permit implementation and coordination and reports to regulatory agencies.
Bacteriological Laboratory Lead	Winsome Robinson Williams	206-615-1353	Oversees fecal coliform analyses and reporting.
Chemistry Laboratory Lead	Jim Dunn	206-684-7406	Oversees potassium and fluoride analyses and reporting.

Role	Name	Office/Cell Phone	Responsibility
Environmental Compliance Inspector (Water Quality Complaint and Spill Response Lead)	Eric Autry	206-684-7988 206-954-4379	Works with responsible parties to resolve illicit discharges.
Environmental Compliance Inspector (IDDE Program Lead)	Adam Bailey	206 684-7805 206-423-0409	Program development, oversee field screening and chemical analyses, trigger follow-up, data management and reporting, arrange for business inspections, oversee illicit discharge resolution.
Environmental Compliance Inspector	Matthew Garcia	206-615-0464 206-423-0682	Field screening and chemical analyses, data management and reporting
Environmental Compliance Inspector (Sediment Source Tracing, Business Inspections)	Brian Robinson	206-733-9160 206-786-0286	Performs business inspections and sediment sampling and works with responsible parties to resolve illicit discharges.
Environmental Compliance Inspector (Sediment Source Tracing, Business Inspections)	Megan Wisdom	206-733-9002 206-255-7751	Performs business inspections and sediment sampling and works with responsible parties to resolve illicit discharges.
Environmental Compliance Inspector (Sediment Source Tracing, Business Inspections)	Mike Jeffers	206-386-9085 206-423-3424	Performs business inspections and sediment sampling and works with responsible parties to resolve illicit discharges.
Environmental Compliance Inspector (Sediment Source Tracing, Business Inspections)	Nathan Hart	206-684-5037 206-465-6668	Performs business inspections and sediment sampling and works with responsible parties to resolve illicit discharges.
Environmental Compliance Inspector (Sediment Source Tracing, Business Inspections)	Bri Silbaugh	206-684-3693 206-255-9983	Performs business inspections and sediment sampling and works with responsible parties to resolve illicit discharges.

5.3 General IDDE Program Phases

Table 2 describes the programmatic steps in administering the City's IDDE program to proactively detect and eliminate illicit discharges into the MS4 and to comply with the City's Permit.

Table 2: IDDE Program Elements

Timeline	Action
2003 to Present	Sediment source tracing efforts in the Lower Duwamish Waterway and East Waterway drainage basins
May to September 2009	First season of dry weather field screening efforts, initiating source tracing efforts as necessary

Timeline	Action
October to December 2009	Data analysis, document illicit connections found, and prepare annual report
January to April 2010	Program analysis, review effectiveness of chosen parameters and prepare QAPP Addendum
May to September 2010	Second season of dry weather field screening efforts, initiating source tracing efforts as necessary
October 2010 to April 2011	Data analysis, document illicit connections found, prepare annual report. Review and amend QAPP.
May to September 2011	Third season of dry weather field screening. Complete the 60% screening requirement in the City's Phase I Stormwater Permit.
October 2011 to February 2012	Data analysis, document illicit connections found, and prepare annual report. Determine format for reporting Superfund sediment screening data for the NPDES annual report.
Program function after 2012 Season	Evaluate program and continue proactive screening to discover illicit discharges and connections in City drainage basins or other proactive pollution detection work as determined by the Drainage & Wastewater Program Managers.

6.0 Quality Objectives

6.1 Decision Quality Objectives

The goal of the dry weather screening program is to obtain screening level data of sufficient quality to find illicit connections and discharges-- not to obtain research-level data or background data for comparison with other projects. Dry-weather screening by definition does not test stormwater or receiving waters but only water from sources such as:

- Intermittent streams that were undergrounded before sensitive area codes were adopted
- Seeps & shallow groundwater
- Foundation drain water
- Construction dewatering
- Flows from illicit discharges
- Flows from illicit connections.

Therefore the IDDE program screening data are not considered valuable for establishing urban background information for comparing with other stormwater studies. For this reason, SPU has chosen not to include the IDDE screening data in their corporate database.

The level of quality control for screening level data needs to be sufficient only to be confident that a numeric value obtained is precise enough to tell whether a threshold trigger is exceeded.

6.2 Measurement Quality Objectives (MQO)

Measurement quality objectives (MQOs) specify how good the data must be in order to meet the objectives of the project. MQOs are the performance or acceptance thresholds based primarily on the data quality indicators of precision, bias, and sensitivity. The MQOs and corrective action required are listed in the Quality Control section 10.0.

7.0 Sampling Process Design

7.1 Screening Parameters

The dry weather field screening program uses field observations, field analyses, and laboratory analyses of a select few chemical and microbiological parameters to characterize flowing discharges. When flow is not present, the field screening program relies on field observations, such as damage or staining, to suggest the presence of intermittent or transitory discharges. The screening parameters given in Table 3 below have been selected to determine if an illicit discharge is likely.

Table 3: Screening Parameters (updated for 2011 field season)

Screening Parameter	Parameter Type	Trigger Parameter*
Color	Field observation	Yes
Odor	Field observation	Yes
Floatables	Field observation	Yes
Turbidity	Field observation	Yes
Estimated flow volume	Field observation	No
Conductivity	Field Analysis	Yes
pH	Field Analysis	Yes
Temperature	Field Analysis	Yes
Surfactants	Field Analysis	Yes
Ammonia	Field Analysis	Yes
Fluoride	SPU Water Quality Laboratory	Yes
Potassium	SPU Water Quality Laboratory	Yes
Fecal Coliform	SPU Water Quality Laboratory	Yes
E. Coli	Spu Water Qulatiy Laboratory	Yes

*Note: corresponding trigger levels, as applicable, are found in Table 4 below

These screening parameters have been found to be useful for identifying and characterizing residential, commercial, and industrial discharges (Brown, Caraco & Pitt, 2004) and from experience in prior field seasons. Most of the City's drainage basins consist of mixed land uses and are highly variable in their composition. Flows vary considerably as well. SPU will attempt to utilize all screening parameters at all sample locations to the extent possible. Additional parameters may be added in response to specific situations based on the experience and observations of the screening team. Conversley, parameters may be removed if it is determined that they are no longer helpful in detecting prohibited discharges.

7.2 SPU Trigger Levels

The dry weather field screening program uses a trigger method as the primary action level for source tracing. The trigger method uses field and laboratory screening parameters to prioritize investigations for source tracing. Trigger levels are estimates that are greater than what is encountered in natural systems.

As listed below in Table 4, SPU has established trigger levels for 12 screening parameters to initiate source tracing for suspected illicit discharges and illicit connections.

Table 4: SPU Trigger Values

Screening Parameter	SPU Trigger Values	Analysis Location
pH	<5.5 or >9	Field
Conductivity	>700 µS/cm***	Field
Turbidity	Severity Index 2	Field
Temperature	>80° F (26.67° C)	Field
Odor	Severity Index of 2	Field
Color	Severity Index of 2	Field
Floatables	Severity Index of 2	Field
Surfactants	> 1 mg/L	Field
Ammonia	> 5 mg/L	Field
Fecal coliform*	> 5000 CFU/100mL	SPU Water Quality Laboratory
E. Coli	>2419 Mpn	SPU Water Quality Laboratory
Fluoride	> 0.6 mg/L	SPU Water Quality Laboratory
Potassium	> 5 mg/L	SPU Water Quality Laboratory

Notes:
*Fecal coliform values are set fairly high due to the very frequent contamination of flows by pet waste and urban wildlife (squirrels, rats, etc.). Experience has shown that values above 5,000 CFU/100mL are above the chronic "urban background" level.
*** Conductivity was set at a higher level for the 2011 field season to roughly mirror the acceptable Total Dissolved Solids levels for drinking water.
Fluoride was increased to better account for the values often seen in urban groundwater. Note: Jim Dunn suggested that fluoride in drinking water is being decreased to 0.7 mg/L and we might want to adjust this level downward in 2012.

7.3 Field Screening

The general approach to field screening is to begin at an accessible location at or near the discharge point of a drainage basin, such as an outfall, key maintenance hole, ditch, or other structure. Field screening is performed at multiple key locations in most drainage basins instead of relying on elevated concentrations to be found only at the downstream discharge point. The size of the drainage basin is used to determine the number of locations screened. Key upstream maintenance holes representing major branches of the conveyance system are screened in larger basins in order to decrease the size of the area screened by an individual sample. The purpose of this approach is to help detect discharges that may be diluted and, therefore, masked by groundwater intrusion or blended flows.

SCPD staff will be performing the field sampling and analyses for all parameters except fecal coliform, E. Coli, potassium, and fluoride, which will be performed by the SPU Water Quality Laboratory. Most of the samples collected will be grab samples of flowing water. Most field screening will occur during the summer months during dry weather conditions.

Dry weather definition: For the purposes of the IDDE program, dry weather means a maximum of 0.04 inches of rainfall in the preceding six-hour period, with no more than 0.02 inches of rainfall in

any one-hour period. If runoff can be observed entering the drainage system samples will not be collected, regardless of rainfall measured.

The City operates more than 17 rain measurement stations providing real-time data. Rainfall data will be obtained from the rain gauge station nearest the basin to be screened. The sampling schedule will also be adjusted to account for tidal intrusion in areas of the City influenced by tidal flows.

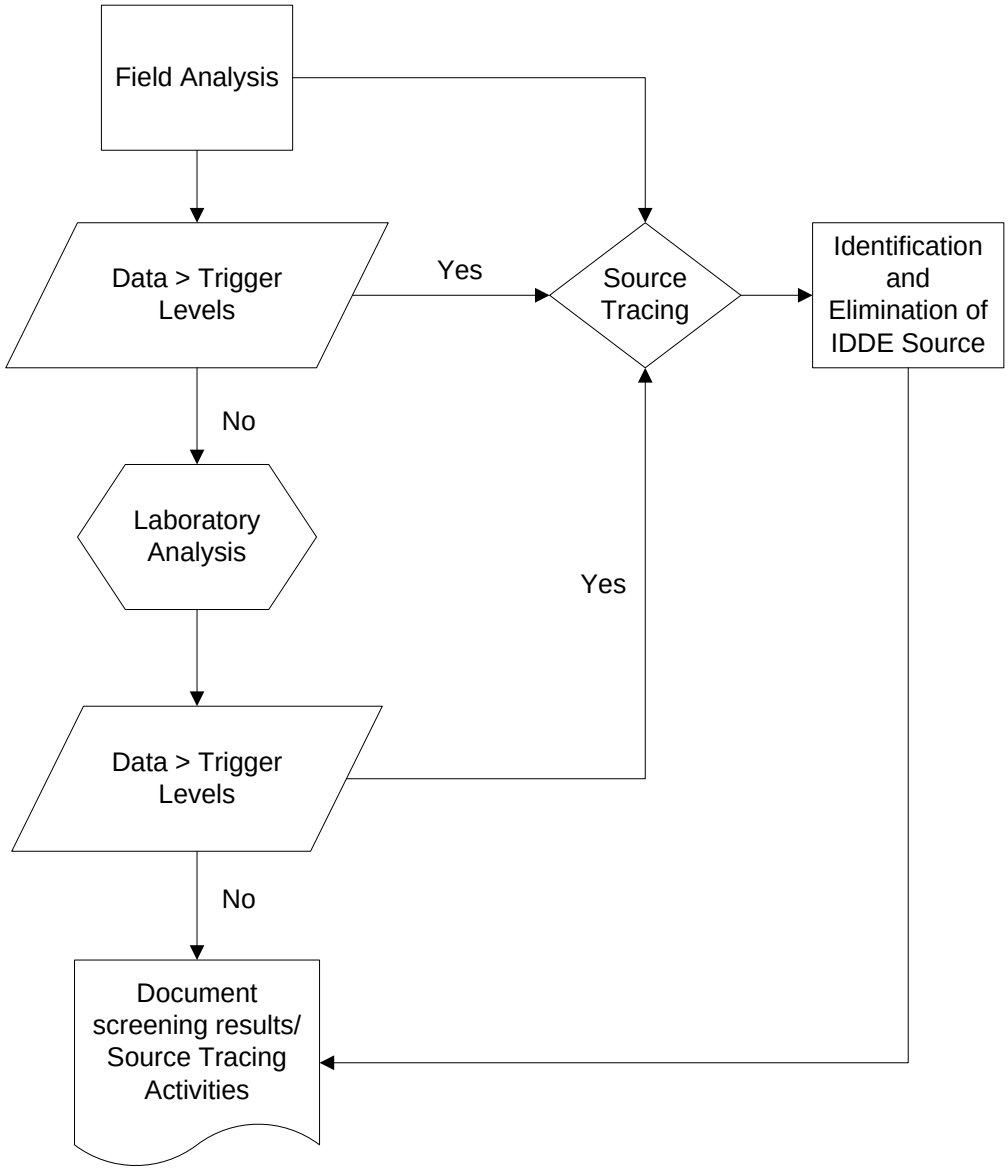
7.4 Source Tracing Process Using Screening Data

An iterative process to locate illicit connections based on screening data is shown in Figure 1. This process has two components: one triggered by field data and the other triggered by lab results, which are not available until well after the field data has been collected. The principal components of SPU's sample screening element are:

- Field observations of the physical and environmental conditions at each site
- Field analyses by in-situ chemical screening
- Source tracing if illicit discharges or illicit connections are suspected based on the field observations or field analyses
- Laboratory analysis of the collected samples for the remaining chemical parameters
- Additional source tracing based on laboratory analyses

Figure 1 illustrates how these components work together to result in identification and elimination of illicit discharge sources. Detailed procedures for field screening activities are included as an appendix to this QAPP.

Figure 1: Sample Screening Flow Chart



7.4.1 Immediate Source Tracing

Immediate source tracing will be initiated whenever field observation or data show that any of the trigger values listed in Table 4 above have been reached.

Immediate source tracing may not require that a sample be collected at each location or that each sample be analyzed for all parameters due to the importance of tracking the discharge quickly to locate the source, especially for intermittent and transitory flows. In these cases, SCPD staff may

use field observations (color, odor, floatables, and turbidity) and selected field analyses (pH, conductivity, temperature, turbidity, etc.) to track the suspected illicit discharge or connection.

Once the source has been located or isolated to a smaller section of the drainage system, it may be necessary to use other source tracing methods such as additional water sampling, side sewer research, dye testing, smoke testing, business inspections, stream walks, or CCTV to identify and verify the illicit connection. These investigations may require the participation of other City inspectors, operations and maintenance staff, and other agencies and may not be able to be conducted immediately. The SPU SCPD Inspection Procedures Manual provides additional information on many of these investigative procedures.

Once the suspected source is identified, a source sample will be collected and analyzed for all screening parameters to compare with the downstream screening sample. The purpose of the source sample is to match the discharge types. In addition, the next upstream location will be sampled to confirm that there are no other suspected upstream illicit discharges or connections that may have been masked by the suspected source location.

In some instances, source tracing specific triggers will not lead to any obvious source of pollution. This is most likely to happen with conductivity, as groundwater contains minerals, organic matter, and nutrients which increase conductivity. Groundwater infiltration into the city storm system is a common occurrence. SCPD field staff will use their best judgment in determining whether or not a trigger, such as conductivity, should be investigated further. When source tracing does not lead to an obvious pollution source, the surrounding area will be investigated visually for any potential pollution source/s and field and lab data will be carefully looked over to ensure that there are no patterns suggesting a pollution source. Once field staff have exhausted these techniques, the trigger will be closed citing the "probable" source of the elevated trigger if one is suspected or will indicate "source unknown" if more appropriate.

Because many maintenance holes in the city have multiple inlets, it is possible for SCM staff to discover multiple triggers from several inlet flows at one site. In these cases SCM staff will prioritize public health and safety in deciding which trigger/s to source trace first. In general, parameters will be weighed in the following order:

- Field observations (staining, odor, floatables, etc.)
- Fecal Coliform/E. Coli
- Ammonia
- Surfactants
- pH
- Potassium
- Temperature
- Conductivity
- Fluoride
- Turbidity

7.4.2 Additional Source Tracing

Additional source tracing is required when field observations and field analysis results have not triggered immediate source tracing, but the results from the laboratory analyses are above the trigger values listed in Table 4. The SPU Water Quality Lab completes fecal coliform analysis daily while potassium and fluoride analysis is completed weekly. Results will be provided to SCPD staff within 2 weeks of sample collection and additional source tracing will be initiated within 21 days of receiving the data if results are above trigger values.

On occasion SCPD staff may receive multiple triggers in the bi-monthly lab reports. Source tracing prioritization will be based on public health and safety as listed above. In some instances, field observations and field analysis results will trigger source tracing and SPU staff will be able to locate the source immediately. Laboratory analysis results may also later confirm the suspected illicit discharge or connection with elevated trigger values, but additional source tracing will not be required in these instances as the source was already eliminated.

As the field season ends, field staff may have outstanding triggers, that is, may not have completed tracing values exceeding triggers to a source location. In this case, field staff will assess each individual trigger in relation to public health and safety. Triggers deemed likely to be the cause of a public health or safety issue will be investigated further into the wet season to the extent possible. Sampling will be performed during 'dry weather' conditions (a maximum of 0.04 inches of rainfall in the preceding six-hour period, with no more than 0.02 inches of rainfall in any one hour period) to the extent weather allows. However, data gathered from the use of dry weather screening during wet weather will be used carefully due to inputs to the MS4 such as groundwater, stormwater discharge from detention systems, etc. which can dilute or obsure source tracing efficiency. Other techniques, such as CCTV and basic investigation of the storm drainage network and drainage area (i.e. visual observations, odor etc.), will be used in an attempt to locate these sources late in the season. On occasion, smoke testing may be done if the problem is deemed to be a high priority and SPU management agrees.

7.5 Data Review and followup

Data review is performed on all collected data including field observations, field analyses, and laboratory analyses. The purpose of the data review is to:

- Confirm that source tracing has been initiated on all results from field screening that are over the trigger levels including field observations, field analyses, and laboratory analyses
- Use best professional judgment when the screening results are not over the trigger levels, but the data patterns suggest the potential for an illicit discharge or connection

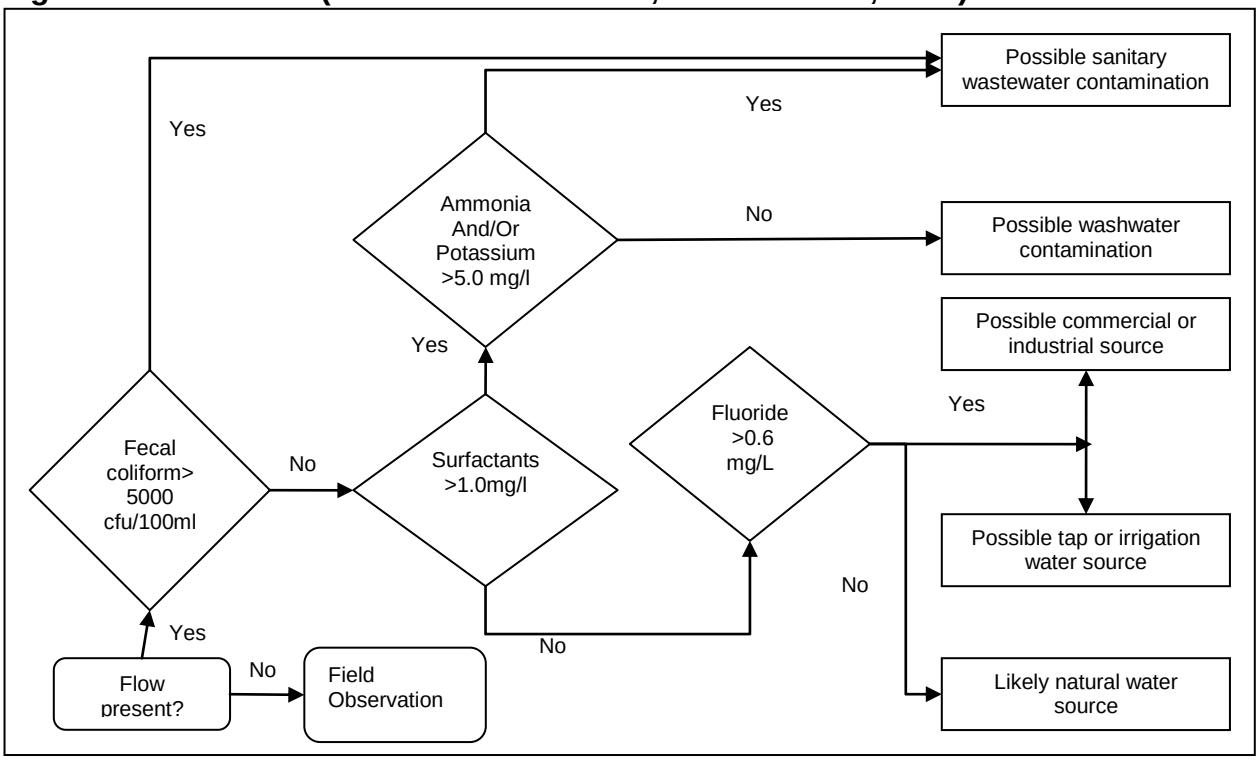
7.5.1 Comparing Data to Trigger Levels

The data review process involves comparing all screening parameters from field observations, field analyses, and laboratory analyses to the trigger levels to verify that source tracing has been initiated for all results over the trigger levels. In some instances, source tracing may be initiated after the data review process when the screening results are not over the trigger levels, but the data and best professional judgement suggest the potential for an illicit discharge or connection.

7.5.2 Comparing Data to the Flow Chart

The flow chart in Figure 2 is a tool that uses five of the SPU screening parameters to differentiate between potential sources in order to form a better idea about the nature of the suspected illicit source. Details are available in the document "Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assessments" (Brown, Caraco and Pitt, 2004a,b). Three flow charts are discussed in the guidance manual. The City is using a modified version of the guidance manual Figure H.1 (Figure 2 is adapted from this source).

Figure 2: Flow Chart (Modified from Brown, Caraco & Pitt, 2004)



The purpose of the flow chart is to help identify the likely source of flow using five screening parameters: fecal coliform, surfactants, ammonia, potassium, and fluoride. SPU trigger levels correspond to the flow chart concentrations for identifying flow types. The flow chart is to differentiate between the following flow types and assist with source tracing efforts:

- Sanitary wastewater contamination
- Washwater contamination
- Commercial or industrial sources
- Tap or irrigation water source
- Natural water source

7.6 Removing Illicit Discharges and Illicit Connections

When screening parameters are triggered and an illicit connection is suspected, an investigation must be initiated within 21 days according to the City's NPDES Permit to determine the source and responsible party. The following should also be followed:

1. Contact Ecology upon discovering an illicit connection that presents a severe threat to human health or the environment.
2. Assign an Environmental Response Tracking System (ERTS) number, document on a Water Quality Complaint Investigation Field Form and track the trigger in the Water Quality Complaint database.
3. Continue source tracing to locate the source of the high trigger values.

When a specific illicit connection is identified, the following should occur:

1. Response to eliminate the illicit connection is a top priority and initial action should occur within 24 hours.
2. Use enforcement authority in a documented effort to eliminate the illicit connection within 6 months of confirming that an illicit connection exists.
3. If the connection is verified to be a private source, inspectors initiate contact to the property owner(s) responsible for the illicit connection. Follow the procedures in the Inspector's procedures manual and fill out the "follow-up illicit form"as a basis to determine if a by-pass should be installed(..\..\..\Codes, Policy,Procedures and Opinions\Procedures\Procedures Manual\Inspector Manual\Inspection Procedures\Procedures_Manual_-2010_Update__FINAL.docx, page 7-1).
4. A "Notice of Violation" is sent to the property owner, per the enforcement section of the SPU Source Control procedures manual, specifying a compliance deadline based on the specific activity and severity of human, environmental, and public safety impact. The deadline to correct an illicit connection is given within the SPU Source Control Procedures Manual, and may vary based on the nature of the connection. The NOV deadline may be extended for valid reason at the discretion of the inspector. In no case should the correction date be extended beyond 6 months without involving the Source Control & Program Develpment Supervisor and the NPDES Permit Manager.
5. Fill out the "Illicit Connection Found" form and the "Follow-up Information on Illicit Connection" form ..\..\..\..\..\..\Inspection Programs\All Programs - Forms, BMP Fact Sheets, Outreach Info\Insp Form - Illicit Connection Notification forms.docx. Submit to the Health Dept. See Inspection Procedures Manual, p.7-1, Section 7.3 Residential Illicit connections.
6. Notify the Department of Planning and Development via sidesewerinfo@seattle.gov that SPU has sent a recent corrective action requiring a permit with the specific address noted.
7. If the illicit connection is verified to be City owned, SPU Drainage and Wastewater Asset Management Division (Frank McDonald and Jeff Williams) are notified to initiate a repair.
8. If the suspected or known pollutant discharges from a municipal outfall into a receiving water body **that is on the 303(d) list or is known to violate WQ standards**, contact the SCPD Supervisor and City of Seattle Permit coordinator. It may be necessary to file an SF4 letter concerning this situation.
9. After the source has been removed or eliminated, perform follow up inspection and/or monitoring to confirm that the source of pollution has been successfully removed.

Existing City enforcement authority and protocols will be used for correcting illicit connections to the storm water system. The procedures are described in:

1. The City of Seattle Stormwater Code, Chapter 22.800
2. The City of Seattle Source Control Requirements and Technical Guidance Manual, 2000
3. Seattle Public Utilities Source Control and Monitoring Team Inspection Procedures Manual, 2008

8.0 Sampling Procedures

Fecal coliform, e. coli, fluoride, and potassium samples will be collected in the field by SCPD staff and transported on ice to the SPU Water Quality Laboratory for analysis by laboratory staff. The transfer of samples between SCPD and laboratory staff will be documented using Chain of Custody forms.

8.1 Safety

Refer to the Source Control & Monitoring Team Inspection Procedures Manual for safety guidance.

8.2 Sample Collection

If flow is present, samples are collected for analysis of pH, conductivity, temperature, surfactants, ammonia, fluoride, potassium, fecal coliform, and e. coli. The field analysis results are recorded in a Field Log notebook and then entered into the geodatabase via ArcMap from a laptop. Table 5 lists container types & sizes for collecting and submitting field and laboratory parameters. Detailed methods for conducting field analysis are included in Appendix A to this QAPP. Table 6 lists the holding times and preservatives for samples not immediately analyzed in the field.

Table 5: Sample Container Requirements

<table>
<tr><th rowspan="2">Parameter</th><th colspan="2">Sample Collection</th><th colspan="2">Sample Analysis</th><th rowspan="2">Field Container Preparation</th></tr>
<tr><th>Type</th><th>Volume</th><th>Type</th><th>Volume</th></tr>
<tr><td>Temperature</td><td rowspan="4">Plastic</td><td rowspan="4">1000 mL</td><td rowspan="4">Plastic</td><td rowspan="4">1000 mL</td><td rowspan="7">Rinsed</td></tr>
<tr><td>pH</td></tr>
<tr><td>Conductivity</td></tr>
<tr><td>Dissolved Oxygen</td></tr>
<tr><td>Ammonia & Surfactants</td><td>Plastic</td><td>1000 mL</td><td>Plastic</td><td>60 mL</td></tr>
<tr><td>Fluoride</td><td rowspan="2">Plastic</td><td rowspan="2">1000 mL</td><td rowspan="2">Plastic</td><td rowspan="2">125 mL</td></tr>
<tr><td>Potassium</td></tr>
<tr><td>Fecal coliform</td><td>Plastic</td><td>290 mL</td><td>Plastic</td><td>290 mL</td><td>Sterile</td></tr>
</table>

Note: This table is repeated in Appendix A3 for ease of reference. Any changes to this Table must also be made to the Appendix.

Table 6: Sample Additives, Preservation, and Holding Times

Parameter***	Preservation	Holding Time
Fluoride	Cool to 4°C	28 days
Potassium	*Nitric acid (HNO_3) to pH 2*, Cool to 4°C	6 months
Fecal coliform	Sodium thiosulfate powder, Cool to 4°C	24 hours**

* Samples will be analyzed for fluoride prior to being acidified for potassium analysis and preservation will not be completed in the field.

** The Standard Methods for the Examination of Water and Wastewater specifies a 6 hour transport and 2 hour holding time for fecal coliform samples. Ecology typically allows a 24 hour holding time before results must be flagged with qualifiers if the samples are not NPDES compliance samples.

*** All other parameters will be analyzed upon collection.

9.0 Measurement Procedures

The method of analysis for each parameter has been selected based on a literature review,consultation with similar programs, and SPU chemists at the Water Quality Laboratory.

The intent of the dry weather field screening program is to find sources of contaminated water, not to provide research-level analysis of environmental samples of long-term interest. The methods chosen allow a relatively quick turn-around time for sample results at the expense of accuracy and sensitivity.

Contaminated waters may have concentrations levles several orders of magnitude higher than the selected methods can determine without diluting samples. When this occurs, results will be reported as greater than the maximum range instead of performing dilutions to determine an absolute value. Dilutions will not typically be employed to determine how much a concentration is above the SPU trigger levels.

9.1 Analytical Methods and Procedures

Table 7 below lists the methods for parameters used in dry-weather screening along with the detection method, range, resolution, and reporting limit for the parameter.

Table 7: Measurement Methods for Water Matrix

Parameter	Method	Range	Resolution	Reporting Limit
Field				
Discharge/Flow	Multiple methods	Variable	Variable	NA
Conductivity	SM 2510	0 to 3000 mS/cm	±1 µS/cm	10 µS/cm
pH	SM 4500H+	1.00 to 14.00	0.01 SU	0.01 S.U.
Ammonia	Salicylate method adapted from Clinica Chimica Acta, 14 403 (1966), Hach 8155	0.01 to 0.5 mg/L	0.1 mg/L	0.01 mg/L
Surfactants	SM 5540C, Chemetrics Colorimetric Comparator	0 to 3.00 mg/L		0.25 mg/L
Laboratory				
Fluoride	ASTM D1179-93B	0.1 to 1.50 mg/L		0.1 mg/L
Potassium	SM 3111-B	0.5 to 20.0 mg/L		0.5 mg/L
Fecal coliform	SM 9222D-	10 to 60,000 CFU/100mL		10 CFU/100mL

9.2 Field Observations

SCPD staff note physical and environmental field conditions of each field screening location. These observations are recorded using a geodatabase in ArcMap on a laptop. As presented

previously in Table 4, SPU has set trigger levels for four primary field observations: color, odor, turbidity, and floatables. Field observations are rated by a relative severity index that uses a scale from 0 to 2 (see Table 8 below). The SPU trigger level for each field observation is set at Severity Index 2, which indicates obvious signs of illicit discharges and connections.

Table 8: Field Observation Severity Indices

Field Parameter	Severity index		
	0	1	2
Color	No color or staining	Noticeable color or staining	Pronounced color or staining
Odor	Little noticeable odor	Noticeable odor	Pronounced odor
Turbidity	Slight discoloration	Moderate discoloration	Pronounced discoloration
Floatables	Floatables cover minor amount of surface area sampled	Floatables cover about 25% of surface	Floatables cover over half of surface

9.3 Field Measurement Procedure

Instrument calibration against pH buffer and standard concentration solutions is performed regularly to confirm that instruments are attaining stated accuracy and resolution specifications. Multiparameter meter calibration procedures are given in Appendix A2.

9.4 Laboratory Analysis of Collected Samples

Samples collected for fluoride, potassium, fecal coliform, and e. coli are transported on ice to the SPU Water Quality Laboratory for analysis. These samples are submitted to the SPU Water Quality Lab the same day that samples are collected and are analyzed within the holding time for each parameter. Samples will be analyzed and results will typically be received within two weeks of sample collection. Laboratory standard operating procedures (SOPs) are available from the lead chemist and bacteriologist, but a summary description follows.

Potassium

The SPU Water Quality Lab is no longer accredited by Ecology (2009) to test non-potable waters by the Standard Methods 3111-B, Flame Atomic Emission (FAE) procedure. However, this method will be used as a screening tool to determine if high concentrations of potassium occurs in the drainage system. Samples will be acidified to 0.5% with HNO3 and analyzed using a Thermo Jarrell Ash SH4000 Spectrophotometer.

The detection limit is 0.5 mg/L and the precision for this method is 0.06 mg/L. Calibration standards are 5.00, 10.0, and 20.0 mg/L.

In this method, the sample is aspirated into an acetylene torch. The potassium atoms are thermally excited and emit a specific wavelength of light. The intensity of this wavelength is directly

proportional to the concentration of potassium in the sample. Intensities are then compared to the standards that are analyzed and a resulting concentration is recorded by the instrument. Hold time for acidified samples is 6 months.

Fluoride

The SPU Water Quality Lab is accredited by Ecology to test non-potable waters by the American Society for Testing and Materials, No: D 1179-93B, Ion Selective Electrode (ISE) procedure. Sample volume is modified to use only 10.0 mL sample volume thus reducing reagent use for this method. Analysis is completed using a Thermo Electron pH/ISE meter.

The detection limit is 0.1 mg/L and the precision for this method is 0.02 mg/L. Calibration standards are 0.50, 1.00, and 1.50 mg/L.

In this method, 1.5 mL of TISAB is added to 10 mL of sample and the resulting solution is measured by a fluoride sensing electrode with a reference electrode comparison. The milli-volt potential is compared to the potential of the standards with the resulting concentration displayed by the meter.

Fecal Coliform

The SPU Water Quality Lab (WQL) is accredited by Ecology to test non-potable waters by the Standard Methods for the Examination of Water and Wastewater, No: 9222 D, 24-hour Membrane Filter (MF) procedure. This method will be used by this program with the following exceptions:

- Holding temperature is to be between zero and 4°C (SM allows up 10°C)
- Holding time is not to exceed 24 hours (Standard Methods recommends no more than 8 hours but allows up to 24 hours)

Densities are reported as colony forming units (CFU)/100 mL. The WQL will as standard practice for the IDDE program perform a 0.1 mL, and 1.0 mL dilution on each sample. The method detection limit for these two dilutions is between 100 CFU/100 mL and 60,000 CFU/100 mL. If a lower detection level is needed, for instance to check contamination of blanks, a dilution of 10 mL should also be added. This will lower the detection limit to 10 CFU/100 mL. Similarly, a 100 mL dilution will result in a 1 CFU/100mL detection limit. These lower detection limits may be desired when sampling receiving waters to determine the impact of illicit connections. The table below shows the relationship between the volume analyzed and the quantitation level.

Analyzed Volume (mL)	Range of Results (CFU/100mL) (Low to High)	
100	1	60
50	2	120
10	10	600
5	20	1,200
1	100	6,000
0.5	200	12,000
0.1	1,000	60,000

0.05	2,000	120,000
0.01	10,000	600,000
0.005	20,000	1,200,000
0.001	100,000	6,000,000

In this method, samples are filtered using varying volumes to establish fecal coliform density in the range of 20 and 60 fecal coliform colonies. The filtered samples are incubated for 24 ± 2 hours at 44.5 ± 0.2°C. The colonies produced by fecal coliform bacteria are various shades of blue. The colonies are counted with a low power microscope or other optical device.

10.0 Quality Control (QC)

The SPU Water Quality Lab has a routine set of quality control activities they undertake. Among those are sterility checks, analysis of blanks and for the fecal coliform analysis, media control samples (e. coli?). In addition, the laboratory analyzes proficiency test samples once per year to maintain accreditation. Lab instruments are calibrated according to the manufacturer's specifications or as specified by the listed method.

Table 9 below describes the types of blanks, duplicates, and replicates that are typically used in projects and defines how they will be used during dry-weather screening.

Table 9: Blanks, Duplicates and Replicates Used in the IDDE Program

QC type	Definition/Reason
Check Standards	Standards purchased from an analytical supply house that are of a known value. Used to check if instrument drift is occurring after a number of samples have been analyzed. In the IDDE program, check standards will be used for the multimeter parameters of pH & conductivity.
Field duplicates	A field duplicate is a sample collected in a separate bottle at the same time and location as the primary sample. It is used to determine the variability of the sample matrix, environment or collection practices.
Analytical Duplicates/Replicates	A second analysis from the same bottle as the primary sample. Used to test the precision of the laboratory or field measurement.
Matrix Spike	A QC sample prepared by adding a known amount of the target analyte to an aliquot of a sample to check for bias due to interference or matrix effects.
Blanks	Blanks evaluate the effectiveness of cleaning and rinsing the sampling apparatus and sample containers. They consist of deionized water processed as actual samples, with appropriate reagents added. Blank results are expected to be below the method reporting limit. High results may indicate contaminatin of equipment, conainter, or the deionized water supply.

Tables 10 & 11 below describe the frequency with which the QC measure will be carried out, the measurement quality objective for the QC and the action that will be taken if the MQO is not met. In the case of fecal coliform, testing of duplicates during the 2010 field season revealed that variability in the sample matrix was often very high. Rather than use duplicates to determine whether fecal coliform values near the trigger are reliable enough to initiate source tracing, the following procedure will be used. For fecal coliform values over 3,250 CFU/100 mL, SPU will look at the other parameters for threshold exceedances. Based on the suite of values, field staff will determine whether further investigation of the fecal coliform trigger should be pursued.

Table 10: QC Frequency to be used in the IDDE Program

Screening Parameter	Check Standard (LCS)	Blanks		Duplicates		Matrix Spikes
		Method	Field	Analytical	Field	
Field Analysis						
Conductivity	1/day				1/month	
pH	1/day				1/month	
Temperature					1/month	
Surfactants			1/month		1/month	
Ammonia			1/month			
Laboratory Analysis						
Fluoride	1/week		1/month	1/batch	1/month	1/week
Potassium	1/batch	1/batch	1/month	1/batch	1/month	1/batch
Fecal Coliform		2/batch	1/month			

= Not Applicable

Table 11: MQOs and Corrective action to be used in the IDDE Program

QC type	Criteria	Corrective Action
Check Standards and Laboratory Control Samples	15% of true value	Stop analysis. Re-calibrate and re-analyze the last sample. If sample result is > ± 20% of the original value, reanalyze all samples that are close to a trigger level after the last acceptable check standard.
Method Blanks	≤ RL	Stop analysis and investigate for the cause of contamination. Make adjustments to the analytical protocol as necessary to improve performance. Re-analyze all samples with results >RL and < 10X RL. Samples, with those results, that cannot be re-analyzed will be qualified with a "J" for estimated.
Field Blanks	< RL	Re-assess bottle washing procedures to ensure no cross contamination is taking place.
Analytical Duplicates/ Replicates	RPD ≤ 25% for results > 5x RL	Resample locations if variance is effecting trigger identification. Make adjustments to the analytical protocol as necessary to improve performance.
Field duplicates	RPD ≤ 35% for results > 5x RL	Resample field duplicate location if the results exceed criteria. Determine if variance is effecting trigger identification. Make adjustments to the sampling protocol as necessary.
Matrix Spike Recovery	70 - 130%	If other recoveries are acceptable (e.g., blank spike, certified reference material, etc.), the data user should be informed that the result in the unfortified sample is suspect due to heterogeneity or an uncorrected interference. Criteria is not required if the concentration of the analyte added is < 30% of parent sample. Determine if variance is effecting trigger level.

* Since the IDDE threshold for initiating source tracing is greater than 5,000 CFU/100mL, some glassware contamination can be tolerated as it will very rarely affect the initiation of source tracing.

RL = reporting limit.
RPD = relative percent difference.

Field meter calibration

The IDDE Team uses a VWR Symphony Multiparameter Research Meter SP90M5 which measures pH, dissolved oxygen, conductivity and temperature. The meter is calibrated before use every day to confirm that the instrument is attaining stated accuracy and resolution specifications and values are recorded into a Calibration Field Logbook noting the date, conductivity cell constant, pH slope, and any applicable notes. pH is calibrated using a 3-point calibration with a 4, 7 and 10 buffer and conductivity is calibrated using a 2-point calibration with 100 and 1413 us/cm standard solution. If necessary, dissolved oxygen is calibrated by creating 100% saturated air.

Afternoon field checks are conducted for pH and conductivity by measuring both against known values and making sure the instrument is reading within 15% of the know values. pH is checked against the buffer closest to the previous sample and conductivity is checked against the standard closest to the previous sample. If either of these values are outside the allowable 15%, the instruments are re-calibrated and the last sample is re-analyzed for both parameters. If the instrument reads >20% of the last value, all prior data exceeding triggers levels for pH and conductivy will be re-analyzed once the instrument has been repaired. All data taken prior to the instrument malfunction will be flagged with a J qualifier which means the data was qualified as it does not conform to the measured quality objectives.

Nitrogen, Ammonia is meausured using a Hach DR/890 Portable Colorimeter. The DR/890 is a microprocessor-controlled, LED-sourced filter photometer and is precalibrated for common colorimetric measurements including Nitrogen, Ammonia. The instrument is checked against a known value during the afternoon field check and if the instrument is out of the specified range of 15% the previous data is qualified and the instrument is sent in for repair.

More detailed multiparameter meter calibration procedures are given in Appendix 2.

11.0 Data Management Procedures

Table 12 below describes the types of records that will be generated during screening, source tracing, and enforcement activities.

Table 12: Records Management

Document	Media	Comment
Field Log	Paper (notebook)	Used as backup for parameter data in case the geodatabase crashes and data is lost. Also used to document sample QC data (duplicate samples).
Locational information & field screening results	Electronic, transferred to database	A laptop equipped with ARC Map 10 (with a geodatabase) will be used to record location and all field screening data. Laboratory data will be entered as received. See Appendix A1, Field Operations, for more information.
Photographs	Electronic	Used to document sample locations in some instances and retained in SCM IDDE network folders. See Appendix A1, Field Operations, for more information.
Lab results	Electronic, transferred to database	Provided by SPU Water Quality Lab for potassium, fluoride, and fecal coliform.
Calibration Log	Paper (notebook)	Used to note all calibrations, maintenance, troubleshooting, and repair for multi-parameter meter and turbidimeter.
Ecology Environmental Report Tracking System (ERTS)	Electronic	Used to report source tracing investigations and filed in the SCM ERTS network folder.
Water Quality Complaint Investigation Field Form	Paper & Database	Used to record details of source tracing investigations and filed in the SCM complaints database.
Business Inspection Form	Paper & Database	Used to record details of business inspections resulting from source tracing investigations and filed in the SCM business inspection database.
Enforcement Letters	Paper/Electronic	Copies of originals retained with complaint files and electronic copies maintained in SCM Complaints network folder.

All field screening records will ultimately be recorded using the geodatabase, Excel database, and SCM complaint and business inspection databases. Log notebooks will be retained for backup and reference. Complaint Investigation and Business Inspection forms will be filed according to SCPD standard procedure. All record sources will be linked using the GIS "feakey" or other unique identifier for each station location.

12.0 Audits and Reports

12.1 Audits

The field screening team assigned to this program is responsible for both sample collection and analysis. They will periodically review the field, laboratory, and quality control results as well as document any process deficiencies and actions taken to correct deficiencies.

The IDDE Program Lead will review the program for adherence to this QAPP and report findings to the SCPD Manager at the end of each dry weather screening season. Any deviations from the QAPP that are intended to be permanent must be changed in the QAPP prior the commencement of the next dry-weather screening season. The report shall note deficiencies related to sampling or discrepancies in procedures that do not follow this QAPP. The IDDE Audit form will be completed noting functional areas of the program, as well as noting areas that need modification. Areas to be addressed include:

- Deficiencies related to sampling methods include but are not limited to : sample container, volume, and preservation variations; improper storage temperature; holding-time exceedances; and sample site adjustments;
- Deficiencies related to chain-of-custody include but are not limited to delays in transfer, resulting in holding time violations; incomplete documentation; possible tampering of samples; broken or spilled samples, etc.
- Deficiencies related to field and laboratory measurement systems include but are not limited to instrument malfunctions, blank contamination, quality control sample failures, etc.
- Deficiencies should be documented in logbooks, field data sheets, etc., by field or laboratory staff and reported to the IDDE Program lead, who will inform the Source Control Supervisor if the deficiency is persistent and may initiate procedural or program changes.

Due to the nature of field screening, changes to sampling procedures will occur frequently, and must be properly documented.

12.2 Reports

Six types of reports may be generated during the course of the dry weather field screening program:

1. Water Quality Complaint Investigations - field personnel will use the existing water quality complaint investigation forms to document investigation of found or suspected illicit discharges. IDDE Blue Form Instructions

2. Business Inspections - field personnel will use the existing business inspection forms to document business inspections that are conducted as a result of source tracing investigations, in addition to using the water quality complaint investigation forms.

3. Ecology ERTS Reports - field personnel will file ERTS reports using an electronic form (http://www.ecy.wa.gov/programs/spills/forms/nerts_online/NWRO_nerts_online.html)

upon discovery of parameters over the trigger values that present a potential threat to human health or the environment. ERTS reports will be updated by email (TSAC461@ECY.WA.GOV) to reflect final disposition of source tracing activities.

4. SF.4 Reports - field personnel will send reports of fecal coliform samples to the S4F fact discovery coordinator within five days of sample validation if the sample satisfies all of the following:

   a) the sample/s were collected in a 303d listed water body that is a category 4 or 5

   b) sample results are greater than 14 CFU/100mL and less than the trigger value of 5,000 CFU/100mL, (results greater than 5000 cfu/100mL will still be sent through ERTS notifications. The fact discovery person will be able to review the results greater than 5000 cfu/100mL through reviewing the ERTS.)

   c) sample is representative sample furthest downstream screening value in a MS4 discharging to a water body. A representative sample for purposed of S4F notification is defined as a MS4 location that receives no additional inputs prior to discharging to the receiving water body

   That fact discovery person will then compile facts and present it to the Source Control Supervisor. Review for S4F shall occur within 7 days of the date of data validation. Information to be reported may include details of the discharge uncovered, steps taken to address this discharge, and the plan moving forward. The NPDES Permit Coordinator will use this information to prepare the S4F Report within 30 days of the incident.

5. Monthly Reports (or as needed) - the IDDE Program Lead will prepare written or oral reports for the Source Control & Monitoring Program Manager that may include the following information:

   - Percentage of MS4 screened (completed basins)
   - Number-of outfalls screened and basin percentage completion estimate (in-progress basins)
   - Number of source tracing investigations initiated
   - Number of illicit discharges and connections identified

6. Annual Dry Weather Field Screening Report - the IDDE Program Lead will provide the following information to the Source Control Supervisor, to be included in the Annual Report required by the Permit:

   - Number of source tracing investigations and verification that all investigations were initiated within 21 days of receiving knowledge of the trigger. If the investigation occurred later than the 21-day window a description of the circumstances that prevented the attainment of this goal will be included.
   - Number of enforcement actions
   - Number of illicit connections eliminated and verification that elimination occurred within 6 months of discovery
   - Number of referrals to Ecology (ERTS reports)

12.3 Evaluation of Dry-Season Activities

After the completion of the IDDE field season, the IDDE Program lead will prepare an evaluation of the utility of the screening parameters and their usefulness in detecting illicit connections. The evaluation shall include ideas on what other types of screening or other information might make the program more useful. This evaluation will be provided to the Source Control & Program Development Manager as well as the NPDES Permit Coordinator via the end of year audit form. This evaluation may also be in the form of a meeting with other inspectors and/or interested parties provided meeting minutes are taken and made available to the Manger and Permit coordinator.

13.0 Data Verification

Data verification is a completeness check that is performed before the data review process continues in order to determine whether the required information is available for further review. Although this step is not designed for use in qualitative review, it is essential for ensuring the availability of sufficient information for subsequent steps of the data review process.

Data verification involves examining the data for transcription errors or omissions as well as examining the results for compliance with quality control (QC) frequency criteria.

Once the measurement results are recorded, they are verified to ensure that:

- Data are consistent and complete, with no transcription errors or omissions
- Results for QC samples are recorded in the Field Log
- Instrument calibrations are recorded in the Calibration Log
- Established criteria for QC and calibration frequency are met
- Methods and protocols specified in the QAPP are followed

This program aims to verify data through the following process:

Basis	Data	Check
Per Station	Field Log and Geo-database	Reviewed to ensure all information is recorded correctly.
Weekly	SPU Water Quality Lab Results	Reviewed for omissions and errors.
Weekly	Field Results	Reviewed for omissions and errors.

14.0 Data Validation (Usability) Assessment

Data validation is an analyte-specific and sample-specific process that extends the evaluation of data beyond data verification to determine the analytical quality of a specific data set. It involves a detailed examination of the data package using professional judgment to determine whether the MQOs for precision, bias, and sensitivity have been met. Validation is the responsibility of the project manager (Ecology, 2004).

Validation is a process that includes evaluating data against criteria based on the quality objectives. The purpose of validation is to assess the performance of the sampling and analysis process to determine the quality of specified data.

The data verification, validation, and usability assessment are typically exercises to prepare data for potential enforcement, compliance, and litigation requirements. As the data objects for the IDDE program are specific to source tracing purposes, data validation considerations, while still important, are simplified to match data objectives. IDDE screening data is seldom used to build an enforcement case. Dye testing, CCTV and/or smoke testing are used to confirm illicit connections for corrective action enforcement.

Three classes of data quality are used when assessing the usability of data collected during field screening activities:

- **Accepted** - Data conform to all requirements, all quality control criteria are met, methods were followed, and documentation is complete
- **Qualified** - Data conform to most, but not all, requirements, critical QC criteria are met, methods were followed or had only minor deviations, and critical documentation is complete
- **Rejected** - Data do not conform to some or all requirements, critical QC criteria are not met, methods were not followed or had significant deviations, or critical documentation is missing or incomplete

14.1 Validation procedure

All sample results will be checked against the MQOs (Table 11) and sampling procedures (Tables 7 and 8). Samples exceeding criteria will be qualified as "J". The project manager will determine if the exceedance(s) are sufficient to hinder the evaluation of trigger levels. Data that is sufficiently suspect using the project manager's best professional judgment will be rejected and qualified as "R."

Field Data- If data are qualified as estimated, a "J" will be entered onto the field sheet and also into the master IDDE data spreadsheet. If data are rejected in the field, they will not be entered into the IDDE database.

Lab data –All qualified lab data will be entered into the master IDDE data spreadsheet.

14.2 Usability

Ecology gives the following guidance about data usability:

After the data have been verified and validated, Data Quality Assessment (DQA) or Usability Assessment is done. If the MQOs have been met, the quality of the data should be useable for meeting project objectives. If the MQOs have not been met for data (i.e., data have been qualified), you need to determine if they are still useable. You also need to determine if the quantity of data is sufficient to meet project objectives. This includes an assessment of whether the requirements for representativeness and comparability have been met. If you set an MQO for completeness, compare the number of valid measurements completed with those established by the MQO. And you need to evaluate whether the implementation of the sampling design gave the information expected for meeting project objectives.

DQA is built on a fundamental premise: data quality is meaningful only when it relates to the intended use of the data. DQA determines whether the study questions can be answered and the necessary decisions made with the desired confidence. (Ecology, 2004)

The dry weather field screening program is using a limited number of parameters and is performing fairly simple computations to make decisions. Therefore, the data usability assessment is fairly straightforward.

After the data quality validation procedure is performed, all Accepted and J-qualified data is considered to be usable for the source tracing flow chart and trigger levels. Rejected data will not be used.

15.0 References

Brown, Edward, Deb Caraco and Robert Pitt, 2004a. Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assessments. October 2004.

Brown, Edward, Deb Caraco and Robert Pitt, 2004b. Illicit Discharge Detection and Elimination: Technical Appendices. October 2004.

Ecology 2009. Ecology River and Stream Water Quality Monitoring. www.ecy.wa.gov/programs/eap/fw_riv/rv_main.html

Ecology 2004. Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies. Washington State Department of Ecology, Olympia, WA. Publication No. 04-03-030. http://www.ecy.wa.gov/biblio/0103003.html

Hach, 2007. Hach DR/890 Colorimeter Procedures Manual. Hach Company, Loveland Colorado.

Herrera, 2005. Outfall Inspection Project: Condition Assessment and Criticality Analysis: Findings and Recommendations. Prepared for Seattle Public Utilities by Herrera Environmental Consultants. May 31, 2005.

IDQTF, Intergovernmental Data Quality Task Force, 2005 Uniform Federal Policy for Quality Assurance Project Plans. Publication No. EPA-505-B-04-900A http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf

King County, 2009. King County Streams Water Quality Monitoring Data. http://green.kingcounty.gov/WLR/Waterres/StreamsData/Data.aspx

Lombard, Stewart M., and Cliff J. Kirchmer, 2004. Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies. Washington State Department of Ecology Publication 04-03-003. July 2004.

Robert Pitt, 2001. Methods for Detection of Inappropriate Discharges to Storm Drain Systems: Background Literature and Summary of Findings. November 2001.

Seattle, 2003. Sampling and Analysis Plan: Diagonal Avenue South Drainage Basin Pollutant Source Investigation. Prepared for Seattle Public Utilities by Herrera Environmental Consultants. June 2003

Seattle, 2005. City of Seattle 2004 Comprehensive Drainage Plan, Volumes 1 and 2. Prepared by Seattle Public Utilities with Herrera Environmental Consultants, R.W. Beck Inc., and Shannon and Wilson Inc. January 3, 2005

Seattle, 2008a. Attachment A: City of Seattle: 2008 NPDES Phase I Municipal Stormwater Permit Stormwater Management Program. Prepared by Seattle Public Utilities and Brown and Caldwell. March 27, 2008

Seattle 2008b. Quality Assurance Project Plan: Duwamish River East Waterway Drainage Source Control. Prepared for Seattle Public Utilities by Integral Consulting. August 19, 2008

Seattle, 2009a. Stormwater Characterization Quality Assurance Project Plan: NPDES Phase I Municipal Stormwater Permit. Seattle Public Utilities. February 12, 2009

Seattle, 2009b. Seattle Public Utilities Drinking Water Quality Reports. http://www.seattle.gov/util/About_SPU/Water_System/Water_Quality/Water_Quality_Analyses/index.asp

Appendices

Procedures

A1 Daily Checklist
A2 Multiparameter Meter Calibration
A3 Field Operations
A4 Surfactant Analysis
A5 Ammonia Analysis
A6 Laborartory Procedures
A7 Glassware and Bottle Cleaning

Material Safety Data Sheets

Manuals

VWR sympHony Multiparameter Meter
VWR sympHony Ammonia ISE Probe
VWR sympHony DO Probe
VWR sympHony pH Probe
VWR sympHony Conductivity Probe
Hach Portable Turbidimeter

Appendix A: Procedures

A1 Daily Checklist

Prior to leaving for the first station:

- Check rainfall data and download tide data if the Basin to be screened is in the tidally influenced areas of Seattle (mainly in the upper Duwamish valley). A map of these areas can be found on the GIS layers.
- Inspect the multi-parameter meter and probes for deposits, damage, and battery warnings, and make sure all probes are connected securely to the meter.
- Immerse the pH and conductivity probes in tap water. The pH probe should be given a few minutes to "warm up" before calibration, particularly if there have been recent calibration problems.
- **On the first day of the week or whenever batteries are changed**, verify all meter and probe settings in setup mode.
- Calibrate the multiparameter meter for pH and conductivity, according to the calibration procedures.
- Leave the meter on.
- Verify all equipment and supplies are in the vehicle.

Table A1: Field Equipment

General			
○ DI water carboys ○ Squirt bottles ○ Spare batteries ○ Hand towels ○ Permanent markers ○ White board	○ Dry erase markers ○ Sample bottles ○ pH indicator paper ○ Hand sanitizer ○ Ice chest ○ Field bottles	○ Stopwatch ○ Clip boards ○ Masking and duct tape ○ Waste bottles for ammonia & surfactant tests	○ Spare sample cells ○ Calculator
Instruments			
○ Laptop ○ Camera	○ Turbidimeter ○ Multiparameter meter	○ Ampoule breaker ○ Colorimeter	○ 0.1 to 1 mL pipettor ○ Pipettor tips
Tools			
○ Sampling poles ○ Flashlights ○ Tape measure	○ Inspection mirror ○ Ropes ○ Sledge hammer	○ Sampling devices ○ Shovel	○ Machete and pruner ○ MH puller
Chemicals			
○ Silicone oil ○ Oiling cloth	○ Gelex standards ○ Surfactants kits	○ pH buffers ○ pH probe storage solution	○ Conductivity standards ○ DO probe electrolyte

Documents			
○ QAPP and Appendices ○ Tide charts ○ Notebook ○ Confined Space permits	○ IDDE Manual ○ Bottle labels ○ Chain of custody forms	○ Field Log ○ Traffic Flagger Certs ○ Complaint forms ○ MSDS sheets	○ Calibration Log ○ Business Inspection forms
Safety Gear			
○ Safety vests ○ Leather gloves ○ Traffic cones and signs ○ Confined space entry gear	○ Hardhats ○ First aid kit ○ Sunscreen ○ Fire extinguisher	○ Safety glasses ○ Chest waders ○ Tyvek suits	○ Nitrile gloves ○ Steel toe boots ○ Sharps container

At the end of the day:

- Complete Chain of Custody forms and submit the fecal coliform, fluoride and potassium samples to the SPU Water Quality Laboratory for analysis.
- Store the pH probe in a capful of storage solution and the dissolved oxygen probe in its sleeve with a moist sponge. The conductivity probe should be stored dry.
    - All probes may be left connected to the meter unless there is a reason to disconnect them. Do not store the probes in distilled or deionized water.
- Place the used 125 mL acid-rinsed sample collection bottles in the tub labeled "for acid-washing."
- Pour liquid waste from the surfactant reaction tubes into the labeled hazardous waste accumulation container and place the empty tubes in the tub labeled for acid-washing. Small CHEMets are considered hazardous waste as well. After proper labeling, both methylene blue and CHEMets may be stored in the HAZ WASTE cupboard in the Organic Chemistry lab room.
- Use pH test strips to determine the pH of the ammonia waste. Use soda ash as necessary to adjust the pH of the waste to between 6 and 9. Dispose of pH-adjusted waste in the laboratory sink with copious amounts of running cold water.

A2 Multiparameter Meter Calibration

Conductivity and pH vary with temperature. The temperature probe is integrated within the conductivity probe. Investigators should use buffers, standards and deionized water that have been stored together so they are near the same temperature. Ideally, buffer and standard temperatures should be near 25°C.

Replace buffers and standards once each week, or more often as necessary if readings become unstable.

On a weekly basis and after battery changes verify that the meter is still programmed to the correct settings.

Table A2: Meter Preferred Setup Table

Category	Description	Selection
General	Manual Temperature Setting	25.0
	Auto Shutoff	On
Time and Date	Six submenus - self explanatory	
Read	Continuous, Timed or Auto-Read	Continuous preferred, Auto-read acceptable
Due	Calibration Alarms	Set all to 0000 (off)
Datalog	Roll-over or delete data upon downloading	YES preferred, either acceptable
Log View	View and send data	Purpose dependent – consult manual
RS232	Baud rate selection	9600
Printout	Data format	Comp
pH Setup	pH resolution	0.01
	pH buffer set	USA
DO Setup	% saturation resolution	0.1
	Concentration resolution	0.01
	Barometric pressure compensation	Auto
	Salinity correction	Auto
	Calibration type	Air
Conductivity Setup	Temperature compensation	NLF (non-linear)
	Linear compensation coefficient	2.1
	TDS Factor	0.49
	Autocalibration default cell constant	0.475
	Temperature reference	25
	Cell type	Standard

Morning Calibration

The following is a summary of the calibration steps to be performed at the start of each field day. Refer to the instrument and probe manuals for detailed calibration instructions:

1. Conductivity
    a. Rinse the probe with deionized water. Gently shake the probe to remove water drops. Place the probe in the **100 µS/cm** solution.
    b. Select the conductivity measurement line. When the conductivity concentration icon stops flashing press the **Calibrate** button.

c. Wait until the concentration icon stops flashing. The meter will display the temperature corrected value if it recognizes the reference standard. If the displayed value is acceptable, press the **Calibrate** button (the AutoCal method). If the value is not acceptable, use the scroll and digit jump buttons to adjust the conductivity value (the DirectCal method). When it is acceptable, press the **Calibrate** button.
d. Rinse the probe with deionized water and place it in the **1413 µS/cm** standard.
e. Repeat steps b and c until ready to accept the value for the 1413 µS/cm standard. Press the **Measure** button instead of the calibration button.
f. For the next few seconds the screen will display CELL and a value. Record the value on the Calibration Log under cell constant.

2. pH
   a. Calibrate with fresh buffers each day. Don't risk contaminating the large bottles of pH buffers. Transfer pH buffers from the vendor bottle to one of the smaller calibration bottles.
   b. Rinse the conductivity probe with deionized water, gently shake it, and place it into the conductivity standard, which should be close to the same temperature as the pH buffers.
   c. Rinse the pH electrode with deionized water. Gently shake the water off and place it in the **pH 7.00 buffer**.
   d. Select the pH measurement line and then press the **Calibrate** button. Gently stir the buffer with the probe for a few seconds.
   e. Either the Auto-Buffer Recognition or Manual Calibration methods can be used. If the Automatic method has been selected, a temperature-corrected value will appear after the pH values stop flashing. If the Manual Calibration method is being used, the investigator will need to change the value after it stops flashing. Interpolate using values printed on the buffer bottle or box.
   f. Press the **Calibrate** button to accept the value. Remove the probe and rinse it with deionized water. Shake gently, and then place it in the **pH 4.01 buffer.** Gently stir the buffer with the probe. Repeat step e.
   g. Press the **Calibrate** button to accept the value. Remove the probe and rinse it with deionized water. Shake gently then place it in the **pH 10.01 buffer.** Gently stir the buffer with the probe. Repeat step e.
   h. To accept the calibration, press the **Measure** button. The slope will be displayed for about 2 seconds. Record this value on the Calibration Log. If the slope is not between 92% and 102%, consult the troubleshooting section.

3. Dissolved oxygen
   a. Remove the cap from the calibration sleeve and remove the sponge from the cap.
   b. Saturate the sponge with distilled/deionized water and squeeze excess water from the sponge.
   c. Reassemble the calibration sleeve and insert the DO probe into the sleeve (do not let the probe touch the sponge).
   d. Make sure the probe is connected to the meter.
   e. Select measurement mode.
   f. Select the DO measurement line.
   g. Press the **Calibrate** key.
   h. When the reading stabilizes the meter will display 102.3% saturation, proceed to measurement mode.

Afternoon Field Check

The following is a summary of the field check steps to be performed after analyzing the last sample before lunch during each field day. Refer to the instrument and probe manuals for detailed calibration instructions:

1. Rinse the conductivity probe with deionized water, gently shake it, and place it into one of the conductivity standards, which should be close to the same temperature as the pH buffers and ammonia standards.

2. Remove the pH probe from the storage solution. Rinse with deionized water and shake gently to remove water drops. Place it in the buffer nearest to the same pH as the sample just measured.

3. After readings stabilize, compare the result to the temperature-corrected interpolated value for the buffer in use. Be aware that the pH 4 buffer is the least temperature dependent, and the pH 10 buffer is the most temperature dependent.

4. If the pH measured value differs from the interpolated expected value:
    a. By less than 0.15, the measurement is still within accepted limits
    b. By greater than 0.15, recalibrate

5. If the conductivity reading is not within 15% of the standard, proceed to troubleshooting. The following ranges are acceptable:
    a. 95 to 105 µS/cm if using the 100 µS/cm standard
    b. 1350 to 1480 µS/cm if using the 1413 µS/cm standard

6. Prepare the Nitrogen-Ammonia Standard Solutions as NH3-N, 1 mg/L, 500 mL by pipetting 1 milliliter prepared standard into the ammonia vial. Add 9 milliliters of waterto the same vial and insert the prepared vial into the SR/890. Prepare a blank ammonia vial by pouring 10 mL of deionized water into a second ammonia vial. Prepare the vials according to Hach Method 8155. The prepared sample should be within 15% of .1 mg/L of NH3-N. If the result is not within 15% send the instrument to the manufacturer for troubleshooting.

7. Record all results in the Calibration Log.

Troubleshooting

The following is a summary of troubleshooting techniques to be used if calibration fails to establish stable readings. Refer to the instrument and probe manuals for detailed troubleshooting instructions:

1. Conductivity
    a. Verify that the reference temperature is correctly programmed into the meter to match the reference temperature of the standard.
    b. Verify that non-linear temperature compensation is selected.
    c. Use fresh standards to recalibrate.
    d. If readings become erratic or unstable, verify that the probe is securely attached and that the electrical contacts are clean and not corroded. If the problem persists or if the probe has been in very contaminated samples then cleaning may be required. Perform the following cleanings:
        i. Water soluble contaminants – thorough rinse with deionized water

ii. Lubricants or oil contamination – soak in warm water and liquid detergent (if severe contamination, soak in ethanol or acetone for up to 5 minutes)
iii. Lime or hydroxide coating – soak in 10% acetic or hydrochloric acid

e. If the probe works correctly in standards but not in the sample, then there may be interfering substances or substances causing physical damage to the probe within the sample. These may be indicative of an illicit discharge. If possible, collect additional sample in order to have laboratory analyses performed.

2. pH
   a. If the slope is not between 92 and 102%:
      i. Make sure the NIST [USA] buffer set is selected in setup mode
      ii. Recalibrate with buffers from different bottles
      iii. Clean calibration bottles by wiping with a wet cloth and rinsing with water. Refill with fresh buffer.
   b. If recalibration fails, inaccurate measurement is suspected, the meter drifts, or takes more than 90 seconds to stabilize, perform one or more of the following:
      i. Change the pH buffer and probe filling solutions and recalibrate
      ii. Soak the probe in hot water for 15 minutes and recalibrate
      iii. Remove all pH filling solutions, fill probe with hot water and let soak for 5 minutes, rinse with filling solution then refill with filling solution, and recalibrate
   c. If problems persist:
      i. Soak the probe in 0.1 M HCl or HNO_3 for 5 to 15 minutes (if the problem is slow response or drifting)
      ii. Use the pepsin, EDTA, or mild detergent treatments described in the probe instruction manual
      iii. Alternate soaking in household ammonia and pH 4 solution several times for 5-minute intervals
      iv. Perform a meter self-test, as described in the meter instruction manual
      v. Perform the millivolt test as described in the probe instruction manual
      vi. Try a different probe.
   d. If the electrode and meter operate properly in the buffers but not in a sample, then the problem may be due to interferences, incompatibilities, or temperature effects within the sample. These may be indicative of an illicit discharge and initiating source tracing may be warranted.

3. Dissolved oxygen
   a. If calibration is difficult or not possible, it is likely due to:
      i. The probe membrane not touching the sponge
      ii. Drops of water present on the membrane
      iii. Air bubbles under the membrane
      iv. Damage to the membrane
      v. Old membrane or electrolyte
   b. If readings are unrealistic or do not stabilize, it is likely due to:
      i. Probe placement in area with too much flow
      ii. Air bubbles under the membrane
      iii. Old membrane or electrolyte

c. If readings are very low (<1 mg/L), then anoxic conditions may exist. The meter and probe are not accurate below 1 mg/L unless additional calibrations are performed. Low dissolved oxygen may be due to natural conditions or to wastes with high oxygen demand, in which case an illicit discharge may be present.
d. If readings are 0 mg/L, the probe may not be attached to the meter or the electrical connections may not be clean, or corrosion may be present.

DR/890 Colorimeter

a. The DR/890 Colorimeter is precalibrated for common colorimetric measurements including Nitrogen, Ammonia. If the instrument is not within the acceptable measured quality objective range send the instrument to the manufacture for troubleshooting and/or repair.

Multimeter Tech Support: Thermo Orion: 800 225-1480

A3 Field Operations

General recommendations while collecting and processing samples:

- Collect samples by pointing the open end of the bottle into the flow and when possible, the bottle should be dipped below the surface without hitting bottom
- Wear nitrile gloves while collecting samples and safety glasses when conducting analysis
- Don't touch the inside or threads of the bottle and cap
- Be careful to not dislodge debris from the structure, as it could contaminate the sample
- Wear safety vests and steel toed boots while working in and around traffic at all times
- Set up traffic control in situations where it is needed
- If accessing a maintenance hole, use confined space entry equipment and trained personnel. Also, fill out a confined space entry permit for the individual site if confined space entry is required. The permit shall be filed in the office and be accessible on demand.
- Using vehicles flashing amber lights when working in and around traffic

At outfalls and ditches it may be possible to hand-dip the bottles or it may be necessary to use a pole. At maintenance holes use a pole or a sampling device attached to a rope. It may be necessary to perform confined space entry in order to construct caulk dams or otherwise collect samples in low flow situations where pole or other sampling from the ground surface is not possible.

Three grab samples will be collected at each sample location in order to fill a 125 mL plastic bottle a1000 mL plastic bottle and a 290 mL plastic bottle. Sample bottles collected will be divided amongst analysis containers as necessary for both transport to the SPU Water Quality Lab and completion of field screening activities, as described below.

Table A3: Sample Container Requirements

<table>
<tr><th rowspan="2">Parameter</th><th colspan="2">Sample Collection</th><th colspan="2">Sample Analysis</th><th rowspan="2">Field Container Preparation</th></tr>
<tr><th>Type</th><th>Volume</th><th>Type</th><th>Volume</th></tr>
<tr><td>Temperature</td><td rowspan="4">Plastic</td><td rowspan="4">1000 mL</td><td rowspan="4">Plastic</td><td rowspan="4">1000 mL</td><td rowspan="6">Rinsed</td></tr>
<tr><td>pH</td></tr>
<tr><td>Conductivity</td></tr>
<tr><td>Dissolved Oxygen</td></tr>
<tr><td>Ammonia & Surfactants</td><td>Plastic</td><td>1000 mL</td><td>Plastic</td><td>60 mL</td></tr>
<tr><td>Fluoride</td><td rowspan="2">Plastic</td><td rowspan="2">1000 mL</td><td rowspan="2">Plastic</td><td rowspan="2">125 mL</td></tr>
<tr><td>Potassium</td></tr>
<tr><td>Fecal coliform</td><td>Plastic</td><td>290 mL</td><td>Plastic</td><td>290 mL</td><td>Sterile</td></tr>
</table>

Adhere to the following good laboratory practices:

- Safety glasses and appropriate gloves will be worn while performing all analyses
- Keep material on hand to prevent and clean up spills
- Keep incompatible chemicals segregated (i.e., do not store acids and bases together)
- Keep a fire extinguisher of the correct rating near where chemicals are stored
- Keep containers closed when not in use to reduce vapors and spills
- Return chemicals to their proper storage place
- Properly label containers with their contents and primary hazards

Sample Collection

1. Don proper personal protective equipment, including safety glasses or face shield and nitrile gloves, before sampling.
2. Collect 1000 mL, 290 mL and 125 mL of sample in each respective bottle. If you are not able to fill the 290 mL bottle directly from the discharge use a pre-washed 1 liter bottle to collect the sample and fill the 290 mL bottle from this bottle.
3. Fill the 125 mL bottle from the 1000 mL bottle for potassium and fluoride analysis. Fill the 60 mL plastic bottle with sample from the 1000 mL bottle for ammonia analysis.
4. Label the 290 mL, 125 mL (potassium and fluoride sample bottle) and 60 mL bottles with the following information
    a. Sample collection date and time
    b. Sample identifier with the date and "feakey" in the following format: mmddyy_feakey
        i. Add directional indicators at the end of the sample name when there are multiple inputs to a single feakey location: mmddyy_feakey_N
        ii. Indicate duplicate samples as follows: mmddyy_feakey_dup
    c. Sample location description (i.e., NW 101st Ave and 98th St NW)
5. Place the 290 mL, 125mL (potassium and fluoride bottle) and 60 mL sample bottles in the ice chest for transport to the SPU Water Quality Laboratory.
6. Transfer 10 mL of sample from the 60 mL bottle to the ammonia test vial bottle. Rinse the ammonia test vial with the sample and discard. Again, transfer 10 mL of sample to the ammonia test vial and reserve the remaining sample for dilutions if needed. Perform analysis in accordance to the Ammonia test procedures (Hach Method 8155) and record in the field log book.
7. Rinse the pH, conductivity and dissolved oxygen probes with deionized water and shake gently to remove any excess water.
8. Place the pH and conductivity probes in the 1000 mL sample bottle. Deploy the dissolved oxygen probe in situ if possible; otherwise, place in the sample bottle with the other probes.
9. Press measure and record the displayed values in the field log book. Repeat the measurement two or three times to ensure the readings are stable. Recalibrate the meter for any parameters that do not appear stable.
10. Perform surfactant analysis in accordance with the method card included with the test kit (and QAPP Appendix) and record the results in the field log book.
    a. Place the broken ampoule tips into a labeled sharps container.
    b. Dispose of flexible CHEMet assembly tubing in the garbage.
    c. Return spent ampoule and CHEMet assembly to paper rack included with the test kit.
11. Dispose of the ammonia and surfactant samples in labeled waste bottles. Other remaining sample water can be disposed of at source or on ground.
12. Rinse the 1000 mL sample collection bottle with deionized water to be used at the next sampling site. Place the surfactant reaction tube in a labeled container for acid-washing at the lab.
13. Rinse the pH, conductivity and dissolved oxygen probes with deionized water. Leave the dissolved oxygen and conductivity probes in deionized water and the pH probe in electrode storage solution between stations.
14. Proceed with data entry into the geodatabase using ArcMap on the laptop. Instructions found here.

Photo Log

1. Label the white board with the following information:
   Date and Time
   Field Staff Initials
   Feakey Number the structure type the sample was taken from (eg Maintenance Hole: MH, SandBox: SB). If the structure has no Feakey number write the cross streets and the direction the structure is from them.
   Sample Number. If no sample was taken write "No Sample"
   If source tracing: Source Tracing and Source Feakey
2. Place the white board next to the maintenance hole, sandbox, catch basin, etc and take a picture of the white board and structure.
3. Remove the lid from the structure and take a second picture of the inside of the structure.
4. Take a third photo of the general area; Street signs, addresses ect.

A4 Surfactant Analysis

*The following is a summary of the Detergents CHEMets procedure for surfactant analysis. See the instruction card included with the test kit for further guidance.

Procedure:

1. Rinse the reaction tube with sample then fill it to the 5 mL mark with sample.
2. Hold the double-tipped ampoule in a vertical position then snap the upper tip using the tip breaking tool.
3. Place broken tip into a labeled sharps container.
4. Invert the ampoule and position the open end over the reaction tube.
5. Snap the upper tip and allow the contents to drain into the reaction tube.
6. Place broken tip into a labeled sharps container.
7. Cap the reaction tube and shake it vigorously for 30 seconds.
8. Allow the tube to stand undisturbed for approximately 1 minute.
9. Make sure that the flexible tubing is firmly attached to the CHEMet ampoule tip.
10. Insert the CHEMet assembly (tubing first) into the reaction tube making sure that the end of the flexible tubing is at the bottom of the tube.
11. Break the tip of the CHEMet ampoule by gently pressing it against the side of the reaction tube. The ampoule should draw in fluid only from the organic phase (bottom layer).
12. When filling is complete (1-2 seconds), remove the CHEMet assembly from the reaction tube.
13. Remove the flexible tubing from the CHEMet ampoule and wipe all liquid from the exterior of the ampoule.
14. Place an ampoule cap firmly on to the tip of the CHEMet ampoule.
15. Invert the ampoule several times, allowing the bubble to travel from end to end each time.
16. Place the CHEMet ampoule, flat end downward, into the center tube of the comparator.
17. Direct the top of the comparator up toward a source of bright light while viewing from the bottom.
18. Rotate the comparator until the color standard below the CHEMet ampoule shows the closest match. If the color of the CHEMet ampoule is between two color standards, a concentration estimate can be made.

Note: Occasionally the CHEMet break improperly drawing up the “methylene blue” portion of the test vessel. This could give false positives if not caught.

A5 Ammonia Analysis

Ammonia Analysis: Method 8155

A6 Laboratory Procedures

Fecal coliform, fluoride, and potassium samples will be collected in the field by SCPD staff and transported to the SPU Water Quality Laboratory for analysis by laboratory staff. Transfer of samples between SCPD and laboratory staff will be documented using Chain of Custody forms.

Sample Preservation and Holding Times

The Standard Methods for the Examination of Water and Wastewater specifies a 6 hour transport and 2 hour holding time for fecal coliform and e. coli samples. Fecal coliform samples for NPDES monitoring are subject to a 6 hour holding time. The dry weather field screening samples are not subject to NPDES or SM requirements. Ecology typically allows a 24 hour holding time before results must be flagged with qualifiers if the samples are not NPDES compliance samples.

Table 1 below describes the preservation requirements and holding times for each parameter that will be transported to the SPU Water Quality Laboratory for analysis.

Table 1: Sample Additives, Preservation, and Holding Times

Parameter	Preservation	Holding Time
Fluoride	Cool to 4°C	7 days
Potassium	Nitric acid (HNO_3) to pH 2*, Cool to 4°C	6 months
Fecal coliform/e. coli	Sodium thiosulfate powder, Cool to 4°C	24 hours (8 hrs*)

*Note: Sample will be analyzed for fluoride prior to being acidified for potassium analysis and preservation will not be completed in the field.

Methods

The intent of the dry weather field screening program is to find sources of contaminated water, not to provide model-grade or research-grade analysis of the water in the conveyance system. The methods chosen allow fast turn-around of sample results at some expense of accuracy and sensitivity. Contaminated waters may have concentrations several orders of magnitude higher than what the selected methods can determine without diluting samples. When this occurs, results will be reported as greater than the maximum range instead of performing dilutions to determine an absolute value. Dilutions will not be necessary to determine whether a concentration is above the SPU trigger levels.

Potassium (See Appendix 6 "Potassium SOP" for a Detailed Method)

The SPU Water Quality Lab is no longer accredited by Ecology (2009) to test non-potable waters by the Standard Methods 3111-B, Flame Atomic Emission (FAE) procedure, but will use the method as a screening tool only. Samples will be acidified to 0.5% with HNO3 and analyzed using a Thermo Jarrell Ash SH4000 Spectrophotometer.

The detection limit is 0.5 mg/L and the precision for this method is 0.06 mg/L. Calibration standards are 5.00, 10.0, and 20.0 mg/L.

In this method, the sample is aspirated into an acetylene torch. The potassium atoms are thermally excited and emit a specific wavelength of light. The intensity of this wavelength is directly proportional to the concentration of potassium in the sample. Intensities are then compared to the standards that are analyzed and a resulting concentration is recorded by the instrument. Hold time for acidified samples is 6 months.

Fluoride (See Appendix 6 "Fluoride Low Level SOP" for a Detailed Method)

The SPU Water Quality Lab is accredited by Ecology to test non-potable waters by the American Society for Testing and Materials, No: D 1179-93B, Ion Selective Electrode (ISE) procedure. Sample volume is modified to use only 10.0 ml sample volume thus reducing reagent use for this method. Analysis is completed using a Thermo Electron pH/ISE meter.

The detection limit is 0.1 mg/L and the precision for this method is 0.02 mg/L. Calibration standards are 0.50, 1.00, and 1.50 mg/L.

In this method, 1.5 ml of TISAB is added to 10 ml of sample and the resulting solution is measured by a fluoride sensing electrode with a reference electrode comparison. The milli-volt potential is compared to the potential of the standards with the resulting concentration displayed by the meter.

Fecal Coliform (See Appendix 6 "SM-9222D-FC-01-06" for a Detailed Method)

The SPU Water Quality Lab is accredited by Ecology to test non-potable waters by the Standard Methods for the Examination of Water and Wastewater, No: 9222 D, 24 hour Membrane Filter (MF) procedure. This method will be used by this program with the following exceptions:

- Holding temperature is to be between zero and four degrees Celsius (SM allows up to ten degrees Celsius)
- Holding time is not to exceed 24 hours (Standard Methods recommends no more than eight hours but allows up to 24 hours)

The detection limit and the precision for this method are both 1 colony per 100 mL. Densities are reported as colony forming units per 100 mL.

In this method, samples are filtered using varying volumes to establish fecal coliform density in the range of 20 and 60 fecal coliform colonies. The filtered samples are incubated for 24 ± 2 hours at 44.5 ± 0.2°C. The colonies produced by fecal coliform bacteria are various shades of blue. The colonies are counted with a low power microscope or other optical device.

Quality Assurance and Quality Control

The SPU Water Quality Lab performs sterility checks and analyzes blanks and media control samples for quality control purposes for the fecal coliform analysis. Once per year the laboratory analyzes proficiency test samples to maintain accreditation. Lab duplicates are performed once per week for fluoride and potassium analysis and no lab duplicates are performed for fecal coliform analysis Instruments are calibrated according to the manufacturer's specifications or as specified by the listed method.

A7 Glassware and Bottle Cleaning

Use proper personal protective equipment and engineering controls when preparing glassware and bottles. Face shields or chemical goggles, aprons and gloves shall be worn when working with acids. Use fume hoods with fan on high when possible and provide adequate ventilation otherwise.

- NEVER ADD WATER TO ACID! Always add acid to water. Mixing acid and water generates heat and causes the acid to splatter. Water is able to absorb the heat when acid is added.
- KEEP ACIDS AND BASES SEPARATE!
- KEEP INCOMPATIBLE CHEMICALS SEPARATE!
    - Hydrochloric acid is incompatible with bleach, strong bases, metals, metal oxides, hydroxides, amines, carbonates, cyanides, sulfides, sulfites and formaldehyde
    - Nitric acid is incompatible with acetic acid, acetone, alcohol, aniline, chromic acid, flammable gases and liquids, hydrocyanic acid, hydrogen sulfide and nitratable substances
    - Sulfuric Acid is incompatible with chlorates, perchlorates, permanganates, compounds with light metals such as sodium, lithium and potassium.

Prior to performing cleaning duties, ensure that appropriate gloves are selected for the type of chemicals that will be utilized.

Table A5-1: North and Ansell Gloves Chemical Resistance*

North Gloves	**Silver Shield**	**Viton**	**Butyl**	**Nitrile**	**Natural Rubber**
Hydrochloric acid	>8 hours, Excellent	I/D	I/D	>6 hours, Excellent	>6 hours, Excellent
Sulfuric acid	>8 hours, Excellent	>8 hours, Excellent	>8 hours, Excellent	1.9 hours, Fair	5.1 hours, Good
Ansell Gloves	**Laminate Film Barrier**	**Neoprene 29-865**	**Neoprene/Natural Rubber Blend Chemi-Pro**	**Nitrile Sol-vex**	**Natural Rubber**
Hydrochloric acid	>8 hours, Not rated	>8 hours, Excellent	>6 hours, Excellent	>6 hours, Excellent	4.8 hours, Excellent
Sulfuric Acid	>8 hours, Excellent	1.75 hours, Fair	Not recommended	Not recommended	Not recommended

Sources: North Chemical Resistance Guide at www.northsafety.com , Ansell Chemical Resistance Guide at www.ansellpro.com

*Time rating is Breakthrough Time. Qualitative rating is Degradation. Excellent and Good can be used for total immersion. Fair is for accidental splash protection and intermittent contact.

Perform glassware and bottle cleaning according to the procedures outlined in Table A6-2 below.

Table A5-2: Glassware and Bottle Cleaning Guidelines

Parameter	Laboratory Glassware Cleaning	Sample Bottle Preparation	Field Bottle Preparation
Fluoride	Per SPU Water Quality Laboratory Standard Operating Procedure	Clean with laboratory detergent. Rinse thoroughly with deionized water. Air dry.	Rinse with deionized water between stations. Clean with laboratory detergent if deposits observed or otherwise deemed necessary. Rinse thoroughly with deionized water.
Potassium	Per SPU Water Quality Laboratory Standard Operating Procedure		
Ammonia	Clean with laboratory detergent and tap water. Rinse thoroughly (at least 4 times) with deionized water. Air dry.	Clean with laboratory detergent and tap water. Rinse thoroughly (at least 4 times) with deionized water. Air dry.	
Surfactants	Ampoules are already clean.	Clean with tap water. Rinse with deionized water. Rinse with dilute sulfuric acid (0.7% v/v). Rinse thoroughly (at least 4 times) with deionized water. Air dry.	New bottle cleaned according to sample bottle preparation used for each sample location. No field cleaning necessary.
Fecal Coliform	Per SPU Water Quality Laboratory Standard Operating Procedure	Sterile	Use sterile sample bottle

Appendix B: Material Safety Data Sheets

Chemetrics Surfactants:

Conductivity Standard 100.pdf

Conductivity Standard 1413 us/cm:

Hach Method 8155: Nitrogen, Ammonia:

pH Buffers:

pH Electrode Storage Solution:

Sulfuric Acid:

Appendix C: Manuals

Hach DR/890 Colorimeter:

VWR Symphony Multiparameter Research Meter SP90M5:

48 - Actions taken to characterize, trace, and eliminate each illicit discharge found

	Nature of Discharge: ID = Illicit Discharge; IC = Illicit Connection				
Date	**SiteAddress**	**Nature of Discharge**	**Program Type**	**Summary**	**ProblemCause**
1/2/2014	7001 Seaview Ave NW	ID	Water Quality	Caller reported discharge from storm outfall. Traced to potable water line break at SFR. Break occurred under brick driveway causing turbid discharge.	Potable Water Line Break
1/6/2014	809 NE 45th St	ID	Spill Response		Accidental Spill
1/9/2014	8425 1st Ave S	ID	Spill Response	Summary: Diesel release likely from truck saddle tank occurred a 8425 1st Ave S. Property Manager attempted rudimentary clean-up of spill with oil absorbent pads. Inspectors advised clean-up crew to clean area with kitty litter absorbent as well. Clean-up was undertaken. Product reached MS4 and Dept. of Ecology was notified. Site manager was advised to monitor trucks to avoid future spill, as well as to quickly call in spills to spill hotline.	Accidental Spill
1/15/2014	825 S STACY ST	ID	Business	Implement proper washing practices. Don't discharge process wastewater to stormdrain.	
1/16/2014	3106 NE 125th St	ID	Water Quality	Report of improper disposal of acetone into the stormwater system. Investigated and confirmed report. Cleaned the affected infrastructure and issued an NOV with penalty to the responsible party.	Fixed business not implementing BMPs
1/17/2014	1484 NW 90th St	ID	Business	Implement proper washing practices.	
1/20/2014	1265 S Main St	ID	Water Quality	Report of private SSO. Problem fixed prior to arrival. Forward to FOG b/c there are FSE's in the building.	Broken/Blocked side sewer or pipe
1/22/2014	2763 4th Ave S	ID	Business	Don't discharge process wastewater to stormdrain.	
1/24/2014	300 S SULLIVAN ST	ID	Business	Implement proper washing practices.	
1/24/2014	2501 Harbor Ave SW	ID	Business	Don't discharge process wastewater to stormdrain. Implement proper washing practices.	
1/24/2014	2625 HARBOR AVE SW	ID	Business	Don't discharge process wastewater to stormdrain. Implement proper washing practices.	
1/28/2014	20th Ave S & S King St	ID	Spill Response	Report of unknown material in CB. Unable to determine source. Suspect FSE in area. DWW crews cleaned CB & EA inspected FSE.	Unknown

Date	SiteAddress	Nature of Discharge	Program Type	Summary	ProblemCause
1/28/2014	930 N 130th St	ID	Water Quality	Report of hot water going to storm drain. Determined source was plumbing project. Conducted business inspection.	Mobile business not implementing BMPs
1/29/2014	32nd Ave NE & NE 135th St	ID	Spill Response	Summary: Diesel release at a 32nd Ave NE & 135th St., resulting from improperly secured fuel cap. Spill responder and site manager cleaned product as best as could. Product reached MS4. Dept. of Ecology notified. Formal business inspection will be undertaken on site in the next 10 work days.	Accidental Spill
1/29/2014	4715 9TH AVE NE	ID	Water Quality	Report of broken SS at construction project. Pipe repaired by RP prior to arrival. Found turbid water from site to MS4, issued NOV. RP cleaned road & inlet.	Construction
2/6/2014	5711 24th Ave NW	ID	Water Quality	Report of concrete spill at construction project. Responsible party cleaned spill with onsite personnel and contracted services. Case reviewed for progressive enforcement. R/P cleaned up spill when they noticed it. No enforcement.	Construction
2/7/2014	13701 Lake City Wy NE	ID	Business	Implement proper washing practices.	
2/7/2014	3840 W Marginal Wy SW	ID	Business	Implement proper washing practices.	
2/8/2014	14323 Greenwood Ave N	ID	Business	Implement proper washing practices.	
2/12/2014	2500 BEACON AVE S	ID	Business	Implement proper washing practices.	
2/13/2014	3700 9th Ave S	ID	Business	Implement proper washing practices.	
2/13/2014	2700 Airport Wy S	ID	Water Quality	Baker tank of chlorinated water was improperly connected causing it to overflow and discharge 3000-5000 gallons of waster into the stormwater system. Water was in process of dechlorination when it overflowed. Not a SWQ issue.	Accidental Spill
2/14/2014	8560 Sand Point Wy NE	ID	Spill Response	Report of large sheen in Lake Washington. Arrived at reported location. Creek runs behind callers house to the lake. Inspector observed foam building up and a diesel odor. I began source tracing the area. Inspector was unable to find the source. Inspector did come across some backhoes doing underground utility work but did not see any product or sheen coming from them.	Unknown
2/14/2014	12600 Stone Ave N	ID	Water Quality	Sediment & Water from soils pile entered a drain after the sanitary drain conveying runoff from the soils pile became blocked. Spill was cleaned by City Crews.	Accidental Spill

Date	SiteAddress	Nature of Discharge	Program Type	Summary	ProblemCause
2/18/2014	8498 Seaview Pl NW	ID	Water Quality	Report of uncovered spols pile at Seattle Parks facility causing turbid discharge. Seattle Parks crews fixed problem. SPU issued internal enforcement letter.	Fixed business not implementing BMPs
2/19/2014	10822 Roosevelt Wy NE	ID	Water Quality	Dye testing verified broken side sewer. Business & property owner notified that cleanup & repair must begin immediately. NOV 2014_007 issued. Cleanup via City contractor occurred following day, due to lack of owner response.	Broken/Blocked side sewer or pipe
2/19/2014	13002 10th Ave NW	ID	Water Quality	IDDE discovery of fuel in the MS4. Investigated and determined the source to be coming from 13002 10th Ave NW. Issued NOV. Tank was removed and discharge has stoped.	Heating Oil Tank Leak
2/21/2014	714 E Pike St	ID	Spill Response	Report of oil spill at construction site. After arriving at reported area, 3 different construction sites were found. After observing a small fuel spill as well as runoff from one of them the site super was contacted and asked to clean the spill as well as have the impacted drainage structure and street cleaned and vactored. Referred to ECY & DPD as well.	Construction
2/21/2014	N 117th St & Meridian Ave N	ID	Water Quality	SPU crews used BMP's to mitigate release of City water to the MS4 during an emergency shutdown of an 8" main.	Potable Water Line Break
2/27/2014	14th Ave NW & NW 90th St	ID	Water Quality	Investigate RV dumping sewage. Unable to locate RV or contact PRP. Drain cleaned.	RV Dumping
3/5/2014	3913 1st ave ne	ID	Water Quality	Side sewer blocked with roots going to MS4. Property owner repaired problem.	Broken/Blocked side sewer or pipe
3/17/2014	3014 NW MARKET ST	ID	Spill Response	Report of paint being poured on curb and going to the storm drain. Arrived onsite and observed what appeared to be paint waste on pavement. Checked downstream CB and observed paint waste in CB as well. Nearby apartment building looked to have been freshly painted. Inspector called contractor to come and clean the pavement and impacted drainage structures. After speaking to manager for building, the inspector got contact info for the contractor. Inspector was told that one of his workers had dumped waste into street. Inspector educated him on code and got contact info so an invoice could be sent.	Mobile business not implementing BMPs

Date	SiteAddress	Nature of Discharge	Program Type	Summary	ProblemCause
3/17/2014	8650 55TH AVE S	ID	Spill Response	Report from parks crew about oil spill of about 5 quarts at the Atlantic City boat ramp. Arrived at site and observed sheen had reached nearby detention ponds due to heavy rain. Called NRC and had them bring a vactor truck and pressure washer to come and clean the surrounding area and any impacted structures.	Unknown
3/19/2014	120 NE 92ND ST	ID	Water Quality	Received a report of turbidity entering Thornton Creek from neighboring construction site. Conducted site visit with DPD. Observed turbid water leaving site going into private pipe. Unknown where this private pipe goes without dye test. Likely connects to MS4 then Thornton Creek. Made referral to DPD and told business to implement construction BMP's per DPD's instruction.	Construction
3/28/2014	ALKI AVE SW & 64TH PL SW	ID	Spill Response	Report of latex paint spill in bike lane on Alki Ave SW. Arrived at site and found spill. Was raining at time and paint was bleeding to curb and gutter going to inlet. Asorbent was used to pick up spill, bagged and disposed of in solid waste.	Accidental Spill
3/29/2014	S 87TH PL & EAST MARGINAL WAY S	ID	Spill Response	Report of sheen on the Duwamish river coming from upstream of South Park Bridge project. Arrived on scene and observed sheen coming from outfall belonging to KCIA. Went to KCIA property and found MH with sheen in it. After meeting with KCIA staff we inspected pump station and observed O/W sep with heavy sheen. This appears to be the source. This is on KCIA property and the outfall is in Tukwila. Inspector advised ECY that KC will take over investigation.	Unknown
3/31/2014	2107 23rd Ave S	ID	Business	Implement proper washing practices.	
4/4/2014	9731 GREENWOOD AVE N	ID	Business	Implement proper washing practices.	
4/16/2014	2642 20TH AVE W	ID	Spill Response	Report of discharge of rusty like material. Determined the responsible party and required cleanup and will issue NOV.	Fixed business not implementing BMPs
4/17/2014	S GRAHAM ST & WILSON AVE S	ID	Spill Response	Oil spill in the roadway entering the MS4. Cleaned MS4 and roadway with vac-truck and pressure washer (NRC-ES)	Unknown
4/18/2014	7115 W Marginal Wy SW	ID	Business	Implement proper washing practices.	
4/18/2014	6301 CALIFORNIA AVE SW	ID	Business	Implement proper washing practices.	

Date	SiteAddress	Nature of Discharge	Program Type	Summary	ProblemCause
4/19/2014	10329 MERIDIAN AVE N	ID	Spill Response	Report of parked car leaking auto fluids. Arrived at site and found signs of leaking vehicle in parking spot. Vehicle itself was not there. CB in parking lot had signs of transmission fluid in it. I put boom in detention system it was connected too. Caller was advised to call property manager and have them clean out affected drainage structures.	Leaking Vehicle (no repair)
4/24/2014	1722 Bellevue Ave	ID, IC	Business	Correct illicit connection.	
5/1/2014	1400 S Lane St	ID	Business	Implement proper washing practices.	
5/6/2014	12801 AURORA AVE N	ID	Business	Implement proper washing practices.	
5/6/2014	12800 Aurora Ave N	ID	Business	Don’t discharge process wastewater to stormdrain. Implement proper washing practices.	
5/7/2014	3800 S OTHELLO ST	ID	Business	Implement proper washing practices.	
5/12/2014	I-5 Hwy & I-90 Hwy	ID	Spill Response	<1 gallon fuel spill to WSDOT's CB on I-5 which connects to SPU MS4. Unable to clean the spill before it entered the SPU lines. SPU Spill Responders deployed containment boom and oil absorbents at the outfall to collect fuel that discharged.	Motor Vehicle Accident
5/15/2014	2601 W MARINA PL	ID	Business	Don’t discharge process wastewater to stormdrain. Implement proper washing practices.	
5/16/2014	3700 6TH AVE S	ID	Business	Don’t discharge process wastewater to stormdrain.	
5/19/2014	NE 90TH PL & 51ST AVE NE	ID	Water Quality	Caller reported white material in creek. Creek was cloudy at time of visit but MS4 was running clear & found no obvious source in basin.	Unknown
5/21/2014	OCCIDENTAL AVE S & S LANDER ST	IC	Water Quality	IDDE MH sample from storm line on Occidental Ave S. south of Lander St. showed trigger level for surfactants. Ammonia levels in this line were elevated indicative of possible illicit connection or discharge.	Illicit Connnection
5/22/2014	9TH AVE & PIKE ST	ID	Water Quality	Received report of sewage on shoulder of freeway off-ramp. Verified discharge. Field crews set up pump and bypass and issued emergency repair order.	Broken/Blocked side sewer or pipe
5/22/2014	2733 3RD AVE S	ID	Water Quality	SPU IDDE received trigger ammonia on 3rd Ave S, and visually noted Rabanco Recycling using fire hose to clean driveway. Noted flow from fire hose was impacting storm, and commanded business to halt discharge. Conducted business inspection and referral to Ecology.	Fixed business not implementing BMPs

Date	SiteAddress	Nature of Discharge	Program Type	Summary	ProblemCause
5/24/2014	29TH AVE SW & SW BARTON ST	ID	Spill Response	Vehicle accident caused gasoline spill to street and drains. Contractor was called in and they used vactor truck and pressure washer to clean all affected structures and areas.	Motor Vehicle Accident
5/27/2014	2733 3RD AVE S	ID	Business	Implement proper washing practices.	
5/27/2014	S INDUSTRIAL WAY & 6TH AVE S	IC	Water Quality	Discovered Illicit connection @ 601 S Nevada St. NOV was issued & the repair was made. The impacted storm line was also cleaned.	Illicit Connnection
5/27/2014	S INDUSTRIAL WAY & 4TH AVE S	IC	Water Quality	SPU IDDE received a trigger values for potassium, conductivity and visual triggers in line. Traced to commercial property on 4th Ave S where property inspection was conducted. Found illicit connection from sink, drafted NOV and received confirmation connection had been severed.	Illicit Connnection
5/28/2014	ALASKAN WAY & MARION ST	ID	Spill Response	Sewage came out of private maintenance hole. This occurred around mid day on 05.28.14. When the spill was observed, the OCC response line was called at 11:13. Locations effected were ROW, sidewalk, CB asset #566300 and the other C/B to the south. Follow-up actions needed at this point is for SWQ to issue an NOV.	Broken/Blocked side sewer or pipe
5/28/2014	S LANDER ST & 6TH AVE S	IC	Water Quality	SPU IDDE traced trigger conductivity and ammonia to a segment of storm line on 6th Ave S between S Walker and S Holgate. Illicit connection was found at Green Depot (1950 6th Ave S) and determined to be the result of a City separation project conducted in 1991. City planned and bid out repair due to error resulting from the project.	Illicit Connnection
5/29/2014	6TH AVE S & S CHARLESTOWN ST	ID	Water Quality	Received elevated conductivity which was likely the result of tidally-influenced sample.	Other
5/30/2014	127 S KENYON ST	ID	Business	Implement proper washing practices.	
6/3/2014	I-5 Hwy & W Seattle Hwy	ID	Water Quality	Bus had a coolant spill on I-5. some got into the drain. Metro & WSDOT staff cleaned up the spill. Nothing made it to the City MS4.	Leaking Vehicle (no repair)
6/3/2014	S DAKOTA ST & 6TH AVE S	ID	Water Quality	IDDE sample revealed elevated potassium value which was attributed to groundwater.	Other
6/4/2014	310 NE 72ND ST	ID	Business	Implement proper washing practices.	
6/4/2014	7200 EAST GREEN LAKE DR N	ID	Business	Implement proper washing practices.	

Date	SiteAddress	Nature of Discharge	Program Type	Summary	ProblemCause
6/4/2014	8TH AVE S & S LANDER ST	ID	Water Quality	SPU IDDE received trigger value conductivity, potassium, and ammonia from storm line on 8th Ave originating from the City owned Airport Way complex. Sampling from two groundwater sumps showed that the multiple discharges of groundwater had these triggers uniformly. All groundwater in this area had high ammonia and have determined that the source was natural.	None
6/4/2014	7TH AVE S & S SNOQUALMIE ST	ID	Water Quality	SPU IDDE received trigger value potassium in storm line at this location. Traced to flow from hillside with heavy groundwater flow. No other possible source but groundwater.	Unknown
6/10/2014	6000 WEST MARGINAL WAY SW	ID	Water Quality	Sampled tidally influenced line and received trigger for potassium and conductivity. Sampled upstream due to elevated surfactants. No non-tidal triggers received.	None
6/10/2014	AIRPORT WAY S & S SNOQUALMIE ST	ID	Water Quality	SPU IDDE received trigger value potassium in storm line at location. Investigation is ongoing.	Unknown
6/11/2014	6TH AVE S & S HINDS ST	ID	Water Quality	Trigger levels of conductivity (940 us/cm) and ammonia (12 mg/L) in MH . CCTV showed infiltration from a crack in pipe wall. Elevated trigger levels likely due to groundwater.	None
6/12/2014	1745 24TH AVE S	ID	Business	Implement proper washing practices. Don't discharge process wastewater to stormdrain.	
6/17/2014	3639 M L KING JR WAY S	ID, IC	Business	Correct illicit connection. Don't discharge process wastewater to stormdrain.	
6/17/2014	150 S RIVER ST	IC	Water Quality	SPU IDDE received trigger value surfactant downstream in tidally influenced stormwater line. Conducted dye testing of neighboring businesses and determined that a shop sink in the repair bay was illicitly connected to the stormwater catch basin in their driveway and thus the storm line on S River St. Business was notified of the connection and they quickly disconnected and plugged the illicit connection.	Illicit Connnection
6/17/2014	RAINIER AVE S & S BAYVIEW ST	ID	Water Quality	Elevated fluoride trigger (0.64 mg/L) was attributed to irrigation from the property.	None
6/17/2014	S SNOQUALMIE ST & 11TH AVE S	ID	Water Quality	Elevated fluoride values were traced to 1660 S Columbian Way where irrigation water from the campus was found to be the source.	None
6/17/2014	S BAYVIEW ST & 21ST AVE S	ID	Water Quality	Received elevated fecals in the storm system which was most likely from an isolated event & we were unable to determine where the source came from.	Unknown

Date	SiteAddress	Nature of Discharge	Program Type	Summary	ProblemCause
6/18/2014	S SNOQUALMIE ST & 11TH AVE S	ID	Water Quality	Elevated fluoride value, attributed to irrigation from mainly lawn watering.	None
6/19/2014	820 OCCIDENTAL AVE S	ID	Business	Don't discharge process wastewater to stormdrain.	
6/19/2014	26TH AVE S & S HOLGATE ST	IC	Water Quality	Elevated surfactant result led to the discovery of 6 cross connections (2705, 2707 & 2709 S Irving St & 1352, 1356 & 1362 MLK Jr Way S). The cross connections were repaired by the developer of the homes.	Illicit Connnection
6/20/2014	BROADWAY E & E OLIVE WAY	ID	Spill Response	55 gallon drum of grease was pushed over in an alley. Grease spilled down alleyway to street and sidewalk. SDOT/SPU crews used on hand spill materials to clean. Vactor & sweeper truck were also called in. Unknown at this time who did it. SPD was called in and case # created.	Illegal Dumping
6/20/2014	12888 North Park Ave N	ID	Spill Response	Report of plumbing company pumping unknown material to CB. Talked to staff of plumbing company; they were working on a site that had a detention system with a sump pump that seized. They had pumped out accumulated rain water so could install new pump. Not a SWQ issue.	Other
6/24/2014	S CHARLESTOWN ST & S COLUMBIAN WAY	ID	Water Quality	SPU IDDE received elevated potassium in storm line. Investigation is ongoing.	Unknown
6/26/2014	309 S CLOVERDALE ST	ID	Business	Don't discharge process wastewater to stormdrain. Implement proper washing practices.	
6/26/2014	6185 4TH AVE S	ID	Business	Don't discharge process wastewater to stormdrain.	
6/26/2014	2900 SW FLORIDA ST	ID	Water Quality	Received trigger value surfactant from pipe in property. Sampled upstream and determined that it appeared the surfactant came from a gated port property. Conducted dye testing and sampling on property, and determined no discharge or connection occurred at the site. Suspect that one-off discharge was caught in tidally-influenced line during initial sample.	Unknown
6/30/2014	5020 40TH AVE NE	ID	Business	Implement proper washing practices.	
7/1/2014	1ST AVE S & S DAKOTA ST	ID	Water Quality	IDDE received elevated fluoride which is most likely from chiller condensate from 3844 1st Ave S. This is an allowable discharge as stated in the Phase 1 NPDES permit.	None
7/1/2014	S MCCLELLAN ST & 30TH AVE S	ID	Water Quality	Elevated fluoride results most likely from irrigation in a residential neighborhood.	Other
7/3/2014	4203 9th Ave NW	ID	Business	Implement proper washing practices.	
7/10/2014	12351 8TH AVE NE	ID	Business	Implement proper washing practices.	

Date	SiteAddress	Nature of Discharge	Program Type	Summary	ProblemCause
7/13/2014	2513 11TH AVE SW	ID	Spill Response	Vehicle fire caused auto fluids mixed with fire fighting foam to go to drain on Harbor Island. NRC was called in by the spiller to clean up any impacted structures and the surrounding area. I checked the outfall and did not observe anything had reached the river yet.	Other
7/16/2014	14340 15th Ave NE	ID	Business	Implement proper washing practices.	
7/16/2014	N 90TH ST & AURORA AVE N	ID	Water Quality	Came across what appeared to be concrete slurry dumped on the street. Nothing entered MS4. Educated property owner on code.	Construction
7/18/2014	S EDMUNDS ST & M L KING JR WAY S	ID	Spill Response	MVA caused auto fluids to spill to street and drains. SDOT cleaned and swept up surface of streets. NRC was called in to clean the impacted drains.	Motor Vehicle Accident
7/21/2014	6815 RAINIER AVE S	ID	Business	Implement proper washing practices.	
7/21/2014	6815 RAINIER AVE S	ID	Water Quality	Came across business pressure washing near gas fueling pad. Educated about code & conducted business inspection.	Fixed business not implementing BMPs
7/22/2014	WEST MARGINAL WAY SW & SW FRONT ST	ID	Water Quality	Team 1 received trigger potassium and elevated Fecal Coliform from MH at SW Front St & W Marginal. Team 2 traced elevated fecals to discharge from Duwamish Greenbelt.	Drainage Problem
7/22/2014	S NORMAN ST & 21ST AVE S	IC	Water Quality	Received elevated results for fluoride. Source tracing led inspectors to 2006 S Weller St. where a cross connection from a newly installed large freezer was discovered.	Illicit Connnection
7/22/2014	S DEARBORN ST & HIAWATHA PL S	ID	Water Quality	Elevated fluoride in maintenance hole led inspectors to broken water line. Created a work order for the repairs.	Potable Water Line Break
7/22/2014	1ST AVE S & S LANDER ST	ID	Water Quality	SPU IDDE received trigger value fecal coliform in storm line. Known contamination from illicit connection upstream is hitting tidally-influenced section of pipe. Pipe cleaned and contamination stopped so that it can be resampled.	Unknown
7/28/2014	8309 24TH AVE NW	ID	Business	Don’t discharge process wastewater to stormdrain.	
8/5/2014	11033 LAKE CITY WAY NE	ID	Business	Implement proper washing practices.	
8/5/2014	WEST MARGINAL WAY SW & SW IDAHO ST	ID	Water Quality	SPU IDDE received trigger level conductivity and potassium in stormline. Line is heavily tidally-influenced. Subsequent sampling determined this was likely tidal flow.	Unknown

Date	SiteAddress	Nature of Discharge	Program Type	Summary	ProblemCause
8/18/2014	3233 WALNUT AVE SW	ID	Spill Response	Sewage spill from holding tank on RV when owner was trying to clean out his grey water tank he accidently turned valve for black water instead. He hosed it into catch basin. RP hired contractor to clean up the street & impacted structures.	Accidental Spill
8/18/2014	4847 CALIFORNIA AVE SW	ID	Water Quality	Caller reported wash water being discharged to MS4. Conducted business inspection w/the contractor. There was not a significant discharge to the MS4.	Mobile business not implementing BMPs
8/20/2014	6851 EAST MARGINAL WAY S	ID, IC	Business	Correct illicit connection.	
8/21/2014	WESTLAKE AVE N & VALLEY ST	ID	Water Quality	SPU IDDE received trigger value conductivity and pH in storm line. Investigation is ongoing.	Unknown
8/25/2014	6040 Martin Luther King Jr Wy S	ID	Business	Don’t discharge process wastewater to stormdrain, Implement proper washing practices.	
8/27/2014	8411 GREENWOOD AVE N	ID	Business	Don’t discharge process wastewater to stormdrain.	
8/29/2014	3025 NW MARKET ST	ID	Business	Don’t discharge process wastewater to stormdrain.	
9/2/2014	44 S NEVADA ST	ID	Water Quality	Fluoride trigger levels were attributed to broken water line. SPU is addressing this issue.	Potable Water Line Break
9/9/2014	S BRIGHTON ST & FOX AVE S	IC	Water Quality	Received elevated surfactant trigger & source traced to 525 S Brighton St. where an internal drain was discovered to be cross connected.	Illicit Connnection
9/10/2014	1900 Occidental Ave S	ID	Business	Don’t discharge process wastewater to stormdrain.	
9/10/2014	3101 25TH AVE S	ID	Water Quality	Illicit connection fixed on 10.28.14. Dye tested post plumbing work and turned out perfect.	Broken/Blocked side sewer or pipe
9/12/2014	7801 Detroit Ave SW	ID	Business	Implement proper washing practices.	
9/17/2014	2335 Rainier Ave S	ID	Business	Implement proper washing practices.	
9/19/2014	1ST AVE S & S HANFORD ST	ID	Spill Response	Several boxes of cooking oil fell off of truck and spilled onto roadway. CB's were impacted. Created work order and had the crews pump and clean the impacted structures.	Illegal Dumping
9/25/2014	MADISON ST & ALASKAN WAY	ID	Spill Response	Release of high pH water and some slurry due to heavy rains. CB was impacted. Site vactored up surface. Due to heavy rains impacted CB was washed through. Not currently impacted.	Construction

Date	SiteAddress	Nature of Discharge	Program Type	Summary	ProblemCause
10/1/2014	5445 26TH AVE SW	ID	Spill Response	On October 1, 2014 Inspector responded to citizen's call of high turbidity in Longfellow Creek. Source traced sediment to city crews repairing 8 inch drinking water main. De-clor tablets and sediment bags were deployed, but were not successful in mitigating sediment release. Dept. of Ecology was ERTS with spill. Photos taken.	Potable Water Line Break
10/7/2014	300 E Pike St	ID	Business	Implement proper washing practices.	
10/7/2014	7201 W Marginal Wy SW	ID	Business	Don't discharge process wastewater to stormdrain.	
10/8/2014	2557 20th Ave W	ID	Business	Implement proper washing practices.	
10/8/2014	7019 47TH AVE SW	ID	Spill Response	Summary of conversation with Business owner. Business owner did not know of illicit discharge code. Owner asked a lot of questions indicating a lack of agreement and understanding of local codes. Asked questions about what level is ok of bleach to send to the Puget Sound said there has got to be a cut off number of an ok amount to go down the drain. Owner made statements about dilution and it not being a problem. He asked questions about any roof work and any use of any product on the roofs. Inspector explained code and discussed next steps. Explained that there may be a fine and a need to change practices.	Mobile business not implementing BMPs
10/15/2014	2147 N NORTHGATE WAY	ID	Business	Implement proper washing practices.	
10/20/2014	I-5 Hwy & NE 103rd St	ID	Spill Response	Semi truck had accident on I-5 southbound, fuel tank ruptured and diesel went to drains then to creek. Contractor was called in by spiller to clean up spill. Boom & sweep were placed in creek and surrounding drainage structures.	Motor Vehicle Accident
10/21/2014	9537 1ST AVE NE	ID	Water Quality	Report of turbidity on a ditch line. Issue self resolved no source determined.	Unknown
10/22/2014	1200 UNIVERSITY ST	ID	Spill Response	Truck broke a hydraulic line and spilled about 15 gallons w/about 1/2 gallon going to drain. They hired contractor to clean up area and any impacted drains.	Accidental Spill
10/26/2014	3739 SW Ida St	ID	Spill Response	Transformer was hit by tree and leaked oil to ground. Approx. 1-2 gallons of oil went to soil underneath transformer. Nearby drains were checked and there was no evidence that it had been impacted. SCL hired NRC to pressure wash street and clean nearby CB.	Accidental Spill
10/28/2014	525 S BRIGHTON ST	ID	Business	Implement proper washing practices.	
10/28/2014	9999 HOLMAN RD NW	ID	Business	Implement proper washing practices.	
10/30/2014	25TH AVE SW & SW BARTON ST	ID	Spill Response	Diesel spill reported at 25th Ave SW & SW Barton St. Sheen over large area of roads. Non-Recoverable. Could not locate resp. party. Ecology notified. Booms placed in 3 CB's.	Leaking Vehicle (no repair)

Date	SiteAddress	Nature of Discharge	Program Type	Summary	ProblemCause
11/6/2014	35TH AVE S & S HANFORD ST	ID	Spill Response	On 11/6/14 inspector responded to call of pain in CB. Minimal paint was in CB, slightly murky. Did not have CB cleaned. Inspector discussed spill responsible party. Treated as educational opportunity, No ERTS submitted.	Accidental Spill
11/10/2014	2140 N NORTHGATE WAY	ID	Spill Response	On 11/10/14 Inspector responded to side sewer break at 2140 N Northgate Way. One catch basin & parking lot were impacted by break. Inspector instructed responsible party to clean affected areas. Responsible party hired contractor & cleaned impacted areas.	Broken/Blocked side sewer or pipe
11/12/2014	9000 25TH AVE SW	ID	Spill Response	On 11/12/14 Inspector found a private catch basin with product likely a solvent. After an on-site meeting with property manager & Home owner association president the catch basin was professionally cleaned with a vacuum truck.	Illegal Dumping
11/17/2014	FAIRVIEW AVE E & E HAMLIN ST	ID	Water Quality	Caller reported construction site washing sidewalks, silt is filling up a catch basin. Permitted site, referred to DPD.	Construction
11/18/2014	3132 NE 133RD ST	ID	Business	Implement proper washing practices.	
11/20/2014	12645 STONE AVE N	ID	Water Quality		Mobile business not implementing BMPs
11/21/2014	1935 N Northgate Wy	ID	Spill Response	Spill at gas station that entered the MS4. Gas station failed to report spill. Required gas station to clean the residual spill. Issued NOV.	Fixed business not implementing BMPs
11/24/2014	1127 POPLAR PL S	ID	Business	Implement proper washing practices.	
11/24/2014	1400 NW 56TH ST	ID	Business	Implement proper washing practices.	
12/12/2014	6315 182nd St SW	ID	Business	Don’t discharge process wastewater to stormdrain.	
12/12/2014	1601 W ARMORY WAY	ID	Business	Implement proper washing practices.	
12/19/2014	S SPOKANE ST & S COLUMBIAN WAY	ID	Spill Response	Construction site was pumping turbid water out of an excavation they were doing for footing. Inspector advised them that they were not allowed to discharge to the street. Inspector advised DPD & ECY about the site. DPD said they would send an inspector out.	Construction
12/21/2014	S SPOKANE ST & S COLUMBIAN WAY	ID	Spill Response	Site was pumping turbid water onto street from an excavation pit. This is second visit to this site. DPD was notified for a site visit. Responsible party was told that they were not allowed to discharge offsite.	Construction

Date	SiteAddress	Nature of Discharge	Program Type	Summary	ProblemCause
12/24/2014	E DENNY WAY & 11TH AVE E	ID	Spill Response	Received report of sheen in curb line. Found sheen for two blocks to empty construction site. Swept up capturable oil, referred to DPD.	Leaking Vehicle (no repair)
12/24/2014	NE 93RD ST & SAND POINT WAY NE	ID	Spill Response	Received indirect report of sediment in creek. Isolated to wooded section of ravine. Heavy rain appears to have caused landslide.	Other

67 – Public Education and Outreach Efforts

The 2013 NPDES Phase I Municipal Stormwater Permit directed the City of Seattle to implement a program for conducting education and outreach to specific audiences on specific topics. The City has prepared an education and outreach program of best management practices to meet these requirements. The following sections include a brief description of the education and outreach activities associated with each of the BMPs, what strategies are in place to track improvements in the target audience's understanding of the problems, and a summary of 2014 activities.

Protect Our Waters (POW) Community and Youth Programs
This program educates the general public about the impacts of stormwater flows into surface waters and the impacts associated with impervious surfaces. The program includes teacher training, curriculum resources, field trips and community service/service learning activities. Programs are implemented through a partnership between Seattle Public Utilities (SPU) and Seattle Public Schools (SPS).

SPU and SPS have identified existing curriculum areas where applied stormwater issues can support and enrich student learning. As a result local geographic references, stormwater-related content and new lessons have been added to district-wide science curriculum for elementary (5th grade) and middle school (6th grade) students. In addition, field trips at the elementary level tie the investigation of an applied problem - the impacts of stormwater on a real stream - to district-wide grade level content (either the Land and Water science kit or Salmon in the Classroom program). The field trips bring children to a local urban stream where they explore hydrologic concepts and the impacts of urbanization on lotic systems. Community service and service learning opportunities, such as storm drain stenciling, extend the reach of this content into the adult community and build a personal stewardship ethic.

In 2014 SPU provided materials for 50 stormwater related district-wide science kits. Materials included the Ecology GROSS grant-funded *Lost and (Puget) Sound* video and lessons and an original power point presentation titled *Discovering Seattle's Land and Water*. Twenty-five teachers received training on the kits and the use of the new materials. In addition 800 children attended urban watershed fieldtrips related to Salmon in the Schools at Piper's Creek, and over 2,200 students attended a field trip extension to the Land and Water unit at either Longfellow, Piper's, Taylor or Thornton Creek. More than thirty different public, private and parochial schools in Seattle participated in the program. Several years of teacher surveys have indicated that teachers that participate in these programs see increases in student understanding of the impacts of stormwater and impervious surfaces.

Working with the Seattle School District provides an opportunity to reach a diverse geographic audience and engage students with direct, applied learning. The program links closely with current

school science curriculum to reinforce target messages and illustrate concepts with real, local examples.

In 2014, programs for the general public included direct education, social marketing, partnerships, inclusive engagement and personal stewardship strategies to promote water quality and watershed health. SPU provided public tours of creek watersheds and stormwater projects, staffed public festivals and events and supported volunteer storm drain marker and stencil events. In addition educational materials such as E-newsletters and BMP beverage coasters were distributed. SPU also supported public stewardship programs such as Salmon Watcher and Salmon Stewards, community advisory councils, and the Green Infrastructure Partnership and collaborated with regional Tribes to produce Salmon Homecoming reaching over 1000 students.

Doo Diligence Pet Waste Program

The Doo Diligence Pet Waste Program is a city-wide outreach effort that educates the general public about the impacts of pet waste on water quality. In 2014, the program employed several programmatic strategies to engage residents on the topic of source control BMPs, environmental stewardship actions, and opportunities to improve pet waste disposal practices. Strategies in 2014 included: highly visible signage in public places, the distribution of targeted outreach materials, and maintenance of pet waste baggie dispensers at key locations throughout Seattle.

Partnerships in 2014 included collaborations with Seattle Animal Control, Seattle Parks and Recreation, Block Watch organizations, and multiple local businesses such as veterinarians, animal hospitals, clinics, and pet stores. In 2014 the program increased outreach to Seattle communities by installing new pet waste baggie dispensers bringing the total to 65 and distributing over 132,000 mutt-mitts.

Automotive Maintenance Program (AMP)

In 2014, SPU continued to educate residents and the general public about the impacts of vehicle fluids on stormwater quality through our free Auto Leaks Workshops. The goal of each four-hour workshop is to remove barriers for BMP adoption and create the connection between clean water and vehicle maintenance. All participants receive a Vehicle Maintenance Kit after completion of the workshop. A total of 361 Maintenance Kits were given to participants who attended the workshop. In 2014, three-hundred and sixty-one (361) people participated in the 39 auto leaks workshops offered to the public.

The grant received from the Washington State Department of Ecology that supports AMP's effort on a regional level ended in Fall 2014. During the grant period, 2012-2014, AMP provided a total of 95 workshops in three different cities (Seattle, Shoreline, & Renton) serving an estimated number of 1,120 people. The post-workshop survey indicated that 88% of the participants attending the workshop checked for leaks on their cars and 78% changed how they maintained their cars. An online survey found that an estimated 76% of participants had repaired all or some of the problems found during the workshop. About 61% of workshop participants reported that they made repairs

because they didn't want to pollute the waterways of Puget Sound. Evaluation of the program's effort from 2012-2014 indicates that AMP successfully contributed to changing car maintenance behaviors and is an effective program for influencing BMPs that can help protect Puget Sound.

To increase workshop participation and raise awareness, SPU continued to partner with King County, WA State Department of Ecology, and other agencies/institutions in the region. Workshop posters, brochures, and social media with information about car maintenance BMPs were shared with the public through our community partners. Three issues of SPU's Curb Waste and Conserve direct mail newsletter (distribution approx. 280,000) included information promoting the auto leaks classes. In addition, a 4-week radio campaign promoting the workshops ran on KUOW. Partnerships with King County and the Washington Department of Ecology continue to play a pivotal role in Seattle's AMP campaign and regional messaging.

Natural Soil Building

The Natural Soil Building Program (NSB) is supported by SPU Solid Waste and Water Supply funding as well as SPU Drainage funding and the Local Hazardous Waste Management Program in King County. The NSB Program has two components: the Master Composter Soil Builder (MCSB) volunteer training and outreach program, and the Garden Hotline (which answers phone and email requests, and also conducts classes especially for underserved and ESL audiences). The NSB program provides outreach and education on Natural Yard Care (including pesticide and fertilizer reduction) and also on RainWise techniques (LID and GSI) for the general public, residents, property owners and landscape professionals.

In 2014 the Master Composter Soil Builder program conducted two multi-day trainings for volunteers: one in the Spring for a diverse group of English-speaking MCSB volunteers, one in summer for multi-ethnic at-risk youth in collaboration with Safe Futures Youth Center in SW Seattle, and one in early fall for diverse low-income young volunteers participating in the Seattle Youth Garden Works program who will be doing outreach with future low-income participants. The newly trained volunteers joined the existing volunteer cadre in completing 959 hours of outreach and making 13,210 customer contacts on Natural Yard Care and RainWise at community events, demonstrations, and classes around Seattle.

The Garden Hotline serves all of King County through additional funding from the county-wide Saving Water Partnership and the Local Hazardous Waste Management Program in King County. The Garden Hotline responded to 9,503 public requests for information on Integrated Pest Management (IPM), plant selection, soil building, RainWise, and other resource conservation issues. Seventy-nine percent of the Garden Hotline contacts were with residents within the City of Seattle, and 21% in King County outside Seattle. Besides phone and email contacts the Hotline conducted 49 classes and outreach events, with 38% of event contacts provided in underserved, immigrant, or communities of color. Hotline staff also wrote articles for community media, updated factsheets and guides, and assisted in preparing materials for translation. A survey of Hotline customers in 2014 indicated 92% satisfaction and usefulness of the information they received in helping them change behaviors.

Seattle reLeaf

Seattle reLeaf is a citywide interdepartmental program that focuses on increasing and maintaining healthy tree cover. Seattle reLeaf has two main projects: Tree Ambassador and Trees for Neighborhoods. Seattle reLeaf is an appropriate BMP for educating the public about landscaping and buffers and it engages residents in the stewardship and restoration of the urban forest canopy.

Seattle reLeaf's Tree Ambassador project empowers Seattle residents to become local leaders in urban forest stewardship. Tree Ambassador volunteers lead community events in their neighborhoods, including street tree weeding and mulching work parties, small-scale landscape renewal projects, and public tours of neighborhood trees. In 2014, reLeaf trained 45 new Tree Ambassadors. With the help of volunteer Tree Ambassadors, the reLeaf engaged over 600 people in 35 community Tree Ambassador events. Events included 13 tree walks and 12 community work parties in neighborhoods including Ballard, Rainier Beach, North Delridge, Lake City, and Beacon Hill.

The Trees for Neighborhoods project builds a healthier, greener Seattle by engaging residents in planting trees on private residential property. In October and November 2014, residents planted 995 trees at 427 households in neighborhoods across Seattle. Trees included evergreens, Pacific Northwest natives, fruit, and power line friendly trees. All participants attended a tree planting and care workshop before picking up their new trees—80% reported learning something new about tree planting and 100% said that they would recommend the program to others. One participant commented, "Didn't know the proper technique for planting trees prior to participating in this awesome program. Feel much more empowered to plant trees now!" Residents who have planted program trees in the past years receive opportunities to attend free pruning workshops and regular reminders to water their trees during Seattle's hot, dry summer months. Since 2009, Trees for Neighborhoods has helped residents plant over 5,300 trees across the city.

Seattle Green Business Program (formerly Resource Venture)

To provide outreach to businesses, SPU funds the Seattle Green Business Program, a free resource conservation program for Seattle businesses, currently being implemented by Cascadia Consulting, under contract with SPU. Under this contract, the program provides site specific technical assistance to businesses, develops targeted outreach materials in multiple languages and implements SPU's Spill Kit Incentive Program, which provides spill kits and assistance in developing a spill plan to participating businesses. The program offers the 'Get on the Map' campaign to publicly recognize businesses taking actions to cut waste, save water and energy, and reduce pollution. In 2014, SPU participated in an effort to create a larger, regional green business program within the state.

In 2014, separate from the Seattle Green Business Program and funded by Ecology under the Local Source Control Contract, ECOSS, under contract with SPU, put on two separate workshops. The audience was Spanish-speaking mobile vendors. A total of 32 people attended, representing the

following sectors: mobile food trucks, landscapers, cleaning, maintenance, construction, painters, and others. All the attendees found the information useful and 92% reported that they would implement all of the best-management practices discussed during the workshops.

Spill Kit Program

To supplement inspections and provide outreach to businesses, SPU funds the Seattle Green Business Program (formerly Resource Venture, a resource conservation program for Seattle businesses, currently being implemented by Cascadia Consulting, under contract with SPU. Under this contract, the program provides site specific technical assistance to businesses, develops targeted outreach materials in multiple languages and implements SPU's Spill Kit Incentive Program, which provides free spill kits, assistance in developing a spill plan and onsite spill training to participating businesses. The spill kit program is promoted on the web, during inspections and during 'Get on the Map' outreach visits. In 2014, 291 businesses were provided with spill kits, spill plans and spill training as a result of the program.

Car Wash Program

In 2014 the Car Wash Program focused on gathering information from high schools to determine the frequency of charity car washes in Seattle. SPU partnered with the Puget Soundkeeper Alliance to survey high schools in the Seattle area and establish which high schools, and organizations within high schools, were organizing charity car wash events. Twenty-seven schools where contacted, three schools admitted to hosting a charity car wash event within the last few years, 16 schools have not hosted a charity car wash, and 8 were undetermined. In West Seattle, where traditional charity carwash BMPs (e.g. tickets) are not available, four high schools were targeted with outreach materials designed to promote a new BMP. The suggested practice is to contact SPU for approval for car wash events so that locations can be vetted for drainage connectivity.

For the general public SPU partnered with Brown Bear to offer coupons for a free car wash in the Utility's @ Your Service and Curb Waste Conserve newsletters. SPU's @ Your Service publication reaches approximately 180,000 households. Curb Waste and Conserve reaches approximately 290,000 residents.

In an effort to discourage car wash events in the MS4, SPU water quality inspectors handed out information to car wash fundraisers and host sites in locations when car was events were discovered. In addition, businesses located in the MS4 that were reported for hosting car wash events are contacted, educated and informed that they should discontinue those activities.

STORM/Puget Sound Starts Here (PSSH)

In 2014, the City continued to participate in STORM (Stormwater Outreach for Regional Municipalities) strategic planning and program activities. SPU supports STORM as an active member of the Core Team and participates in the North King County Stormwater Outreach Group (SOGgie). In 2014 SPU partnered with North King County SOGgie in a bus ad campaign to raise awareness about stormwater pollution. SPU is a partner in the STORM grant for the Vehicle Leaks Campaign,

which complements the City's grant for the Automotive Maintenance Program. SPU co-led planning for PSSH month including the major outreach event at a Mariners Game. SPU staff also regularly shared examples of programs and materials with other municipalities (both Phase I and Phase II permitees) through STORM. The City continued to include the PSSH brand and website address on many related outreach materials. The Puget Sound Starts Here (PSSH) website focuses on stormwater BMPs for cars, pets, yard care and home cleaning. STORM and the PSSH campaign are appropriate BMPs because information is available and accessible for a wide general public audience.

Water Quality Hotline

The City maintains a Water Quality Hotline to allow the public to report water quality concerns within Seattle. Each case is investigated and issues are resolved using the City's source control procedures and progressive enforcement policy. This BMP provides a mechanism for the public to take an active role in stormwater pollution prevention and help the City increase awareness of activities that have negative impacts on stormwater. Outreach to the public includes magnets, bill inserts, business cards and creek-watershed newsletters.

Staff responds to water quality issues during business hours. For spills during non-business hours, callers are instructed to call the Operations Response Center to dispatch an on call Spill Responder. In 2014, the program logged 350 water quality concerns. Of those, 37 were received via the hotline. A larger number were reported using the City's web page for reporting pollution.

Green Gardening Program

The Green Gardening Program educates nursery and landscape professionals and horticulture students on how to reduce their use of pesticides. The program promotes Best Management Practices (BMPs) for environmentally-sensitive landscaping practices, with an emphasis on Integrated Pest Management (IPM), as well as water conservation, landscape stormwater mitigation, and the recycling of organic materials, either on-site or via collection programs.

Two IPM Workshops were held in 2014, reaching 339 participants. The workshops serve private sector landscape professionals who generally work throughout Seattle and King County, as well as public sector landscapers, landscape business managers and owners, program managers, students, and educators. The first workshop: "Water from the Ground UP: Getting the Most from What You Put In" focused on soil/water/plant relationships. It was held at South Seattle Community College on March 12, reaching 105 participants. The second workshop: "What's HOT in Sustainable Landscaping", was held at South Seattle Community College on October 22 and reached 234 participants.

Two trainings were offered to Spanish-speaking landscapers in Spanish. Sustainable Weed Management was held in collaboration with the Envirostars program and reached 56 attendees. The second session, on Plant Health Care and Integrated Pest Management, was held as part of the fall IPM workshop and reached 21. An effort to more effectively engage Vietnamese landscapers culminated in development of a concise bilingual flyer, informed by interviews with target audience

members. This will be distributed beginning in late winter, 2015. Four IPM classes were presented at three local horticulture schools reaching a total of 53 students.

The Natural Yard Care Nurseries Recognition Program completed its transition into the King County EnviroStars program in 2012. This change resulted in continuing to motivate nurseries to commit to sustainable practices and education, while reducing program costs and increasing efficiencies. Ten trainings to nursery professionals reached a total of 143 nursery staff representing 15 nurseries. This is an appropriate BMP for yard care techniques protective of water quality as it provides the target audience with information on how to change their behaviors to improve stormwater quality.

RainWise

The RainWise program provides education to the general public, homeowners, landscapers and property managers about low impact development techniques, including site design, pervious paving, retention and expansion of existing vegetation, and installation of rain gardens and cisterns within City of Seattle MS4 areas. This program provides education and outreach on how to slow, spread, filter and infiltrate stormwater. The program will implement the following educational/technical elements to raise awareness about Green Stormwater Infrastructure (GSI), including stormwater treatment and flow control:

- SPU posts rain garden designs, plant lists and maintenance guidelines that can be downloaded from the internet. The RainWise program provides information and brochures on various GSI techniques on our website (www.seattle.gov/util/rainwise) as well as in hardcopy.
- RainWise Tools (www.rainwise.seattle.gov) is an internet-based education, recruitment, tracking and marketplace outreach tool that helps educate property owners about GSI techniques they can use on their property.
- Two RainWise training workshops were held for contractors in 2014. To date over 500 contractors have been trained, and 54 are represented as participating contractors.

Natural Landscaping Professional Development

This program is a series of well attended professional workshops (and supporting guides and web content) which target the specified behaviors and practices in the permit (low impact development (LID) techniques: including sustainable site design, soil BMPs and retention of native vegetation, plant selection and maintenance options that reduce pesticide and fertilizer use, and Natural Drainage/LID strategies for on-site stormwater management, and stormwater treatment and flow control). These workshops target permit audiences including engineers, design professionals, landscape contractors (including non-English-speakers), developers, builders, permitting and inspection staff, and land use planners. The program is built on survey and focus group work with these professionals and customers. Professionals who attend the workshops incorporate LID techniques into their designs and pass on information to the homeowners, landscapers and property managers that they work with. Many participants fill out in-class evaluations and they identify (pledge) the actions they intend to take as a result of the training.

In 2014 the program conducted 46 training events, in collaboration with professional organizations and local governments, which were attended by a total of 1,580 professionals: landscape and building contractors, developers, landscape architects and designers, engineers, architects, inspection and permitting staff, and outreach trainers. While the funding comes from several sources, most training events focused on LID and Green Stormwater Infrastructure design, construction, and maintenance, IPM and other chemical-reduction maintenance practices, soil best practices, and construction site erosion and sediment control. Ninety-three percent of respondents to post-workshop surveys rated the workshops as good or excellent, and 78% said they would use the guidelines and techniques presented in the workshops in current or future projects.

2014 also brought progress in professional standards and certification. The national Sustainable Sites (www.sustainablesites.org – the site and landscape equivalent of the LEED green building standards) launched its project certification program after 7 years of development. And Washington's ecoPRO Sustainable Landscape Professional (www.walp.org/ecopro) entered its 2nd year with a complete training curriculum and certification for landscape installation and maintenance professionals. SPU is a founding and technical advisory member of both those programs, which are shaped by concepts, BMPs, and training materials developed here, refer to www.seattle.gov/util/landscapeprofessionals.

For More Information

- For more information on Protect Our Waters visit: http://www.seattle.gov/protectourwaters

- For more information on the Doo Diligence Pet Waste Program visit: http://www.seattle.gov/util/EnvironmentConservation/MyHome/PreventPollution/PetWaste/index.htm

- For more information on the Auto Maintenance Program visit: http://www.seattle.gov/util/EnvironmentConservation/OurWatersheds/ProtectOurWaters/PreventPollution/AutoLeaks/index.htm

- For more information on the Water Quality hotline visit: http://www.seattle.gov/util/myservices/drainagesewer/pollutioncontrol/surfacewaterqualityinvestigations/

- For more information on the Green Gardening program visit: http://www.seattle.gov/util/ForBusinesses/Landscapes/TrainingCertification/GreenGardeningProgram/index.htm

- For more information on the Natural Soil Building program visit: http://www.seattle.gov/util/EnvironmentConservation/MyLawnGarden/CompostSoil/index.htm

- For more information on reLeaf visit: http://www.seattle.gov/trees/

- For more information on RainWise visit: http://www.seattle.gov/util/environmentconservation/projects/drainagesystem/greenstormwaterinfrastructure/rainwise/

- For more information on Natural Landscape Professional Development visit: http://www.seattle.gov/util/ForBusinesses/Landscapes/index.htm
- For more information on the Green Business Program, a free resource conservation program for Seattle businesses, visit http://www.seattle.gov/util/ForBusinesses/GreenYourBusiness/index.htm

- For general questions about this SWMP or more information about this section, email swmp@seattle.gov or visit http://www.seattle.gov/util/myservices/drainagesewer/aboutthedrainagesewersystem/stormwatermanagementplan/

72 - Stormwater Monitoring or Stormwater-Related Studies

In accordance with S8.A, this summary provides a brief description of the stormwater monitoring or related monitoring studies conducted during 2014 by or for the City outside of the permit required monitoring:

Water Quality

Pollutant Source Control Sampling - This monitoring was conducted by SPU in support of and associated with the Water Quality Hotline, IDDE, and business inspections for source control from existing development.

Lower Duwamish source sediment samples - In 2014, SPU continued to collect source sediment samples (i.e., catch basins, inline sediment traps, and inline grab samples) to support the source control program for the Lower Duwamish Waterway superfund site. In 2014, SPU took 102 samples, which were analyzed for the LDW contaminants of concern, including TOC, SVOC's, TPH-Dx, select Metals, PCB's, Grain Size and occasionally site specific parameters, such as pH, additional metals, VOC's.

Street Sweeping

The objective of the Street Sweeping for Water Quality Program (SS4WQP) is to cost-effectively reduce the pollutant load carried by stormwater runoff from Seattle's streets to receiving water bodies. The purpose of the monitoring program is to collect & evaluate performance metric data in order to (A) provide information for regulatory requirements for solids disposal, (B) to track program performance, and (C) for developing a baseline for future effectiveness studies. Performance metrics currently being collected include mileage swept (street curb miles within a combined [sanitary] basin, and miles within an MS4 basin), sweeping velocity, solids load removed, cost, and sweeping solids chemistry (metals, SVOCs, PCBs, BTEX, grain size, total solids, Nutrients (Tot Phosphorous, TKN), total organic carbon, pH, NWTPH-Dx/Gx, BOD/COD, Fecal coliform).

Thornton Creek

Several concurrent efforts were conducted as part of the on-going SPU Thornton Creek Bacteria Investigation (TCBI) to locate and address sources of bacteria in Thornton Creek. Continuation of focused in-stream E.coli sampling has identified the South Fork of Thornton Creek as the section of stream where most of the bacteria load originates and is, therefore, the section of stream where most of the source identification efforts are focused.

Seattle City Light inspections

Washington Department of Ecology (Ecology) conducted stormwater inspections with sampling at City Light's South Service Center and Duwamish Substation on December, 11 and December, 16 2014, respectively. The inspections were conducted by Rachel McCrea, Ecology's Municipal Stormwater Specialist and Lead Water Quality Planner for the Lower Duwamish, as part of Ecology's efforts to control sources of pollutants to the Lower Duwamish Waterway Superfund cleanup site. Sediment and water samples were collected by Ecology's consultant Leidos. Sediment samples were collected from selected catch basins at SSC and trench drains at the Duwamish Substation as there was insufficient sediment in the Substation catch basins to collect samples. Water samples were collected from catch basins and/or oil water separators. Split samples were provided to City Light. These samples were submitted to Onsite Environmental Inc., an Ecology accredited laboratory, located in Redmond, WA.

Sediment samples provided to City Light were analyzed for PCB Aroclors, volatile organic compounds (VOCs), semi-volatile organics (SVOCs), diesel-range and gasoline-range total petroleum hydrocarbons (TPH), total metals (arsenic, barium, cadmium, chromium, copper, lead, mercury, selenium, silver, and zinc), total solids, and total organic carbon (TOC). Water samples provided to City Light were analyzed for SVOCs, total metals, alkalinity, anions, TOC, dissolved organic carbon (DOC), and total suspended solids (TSS). A summary of City Light's analytical results is available upon request.

In addition to the analytes above, based on the chain-of-custody prepared by Leidos and provided to City Light, Ecology's samples were also to be analyzed for PCB congeners and dioxins/furans. City Light understands that Ecology expects to receive a report from Leidos mid-year summarizing the analytical results and that a copy of the report will be provided to City Light. These results will be summarized in the 2015 Annual Report to ensure compliance with S8.A (i.e., if stormwater-related investigations, conducted by other entities were reported to the Permittee during the reporting period, a brief description of the type of information gathered shall be included in the annual report.)

84. Effectiveness Study Interim Results and Status Report

CITY OF SEATTLE

NPDES PHASE I MUNICIPAL STORMWATER PERMIT

2014 STORMWATER MONITORING REPORT

Street Sweeping Effectiveness Independent Study

Prepared by
Seattle Public Utilities

March 2, 2015

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1 INTRODUCTION

1.1 Introduction

This document serves as the City of Seattle's (City) calendar year 2014 monitoring report as required by Special Condition S8.C.3 of the 2013-2018 National Pollutant Discharge Elimination System (NPDES) Phase I Municipal Stormwater Permit (Permit). On August 1, 2012, Ecology issued an updated 2013-2018 Permit that became effective on August 1, 2013. The Permit was modified on January 16, 2015.

The Permit uses a collective funding approach to fund the three components of a Regional Stormwater Monitoring Program (RSMP) created under the Permit: 1) status and trends monitoring, 2) stormwater management effectiveness studies, and 3) source identification and diagnostic monitoring. Components 1 and 2 have an option that allows Permittees to perform their own monitoring or studies in lieu of paying all or some of their allotted payment amount to the regional fund.

In a letter dated November 26, 2013, the City notified Ecology that the City had selected the Effectiveness Studies option that allows the City to both pay into a collective fund to implement RSMP effectiveness studies and independently conduct an effectiveness study that will not be undertaken as part of the RSMP. The effectiveness study that the City selected, which is the subject of this interim report, is to evaluate the effectiveness of street sweeping at reducing pollution in urban stormwater runoff.

Monitoring for this study began in October 2014 and is expected to be completed by September 2016. Based on the design of the study, conclusions about the effectiveness of street sweeping will not be available until all the monitoring is completed. The purpose of this document is to comply with Permit Condition S8.C.3.b.iv: "*Describe interim results and status of the study implementation in annual reports throughout the duration of the study*."

1.2 Background

The City elected to support the regional stormwater monitoring funded by the Permit with one exception; we chose to conduct an independent study to evaluate the effectiveness of street sweeping on stormwater quality. With technological improvements in street sweepers, the ability of sweepers to reduce street dirt, and remove finer particulate matter specifically, has been documented by an ongoing Seattle Public Utilities (SPU) study and several recent national

studies. However, the effect of street sweeping on stormwater quality has not been well studied recently and/or the limited recent studies have not had sufficient rigor.

The Seattle Department of Transportation (SDOT) owns and operates a fleet of mechanical broom and regenerative air street sweepers. Under the direction of SPU's Street Sweeping for Water Quality (SS4WQ) program, a limited number of regenerative air sweepers are used on roadways that drain to surface waters as a stormwater management/source control activity. To address the data gap of the effectiveness of street sweeping on stormwater quality, SPU created the 2-year monitoring study which is the subject of this report.

The City submitted a detailed study proposal to Ecology on January 30, 2014. On July 20, 2014, the City submitted a draft Quality Assurance Project Plan (QAPP) to Ecology. Ecology provided comments on the draft QAPP in a letter dated September 10, 2014. The comments were addressed in the final QAPP which is dated September 22, 2014 and was submitted to Ecology on October 2, 2014.

2 STREET SWEEPING PROGRAM AND MONITORING STUDY OVERVIEW

2.1 Street Sweeping Program Overview

The City has been using street sweeping as a good housekeeping practice since the early 1900s. Street sweeping technology has changed significantly over the last two decades and the newer model sweepers use regenerative air and vacuum technology to remove very fine particulates (less than 10 microns [µm]). By mass, these smaller particles carry more pollutants than larger street dirt particles.

In 2006, SPU conducted a pilot study, which showed that street sweeping was effective at reducing roadway pollutants. In 2009, SPU further evaluated the economics of street sweeping and found it to be a cost-effective method for reducing the stormwater pollutant load from City roadways.

In February 2011, SPU launched the SS4WQ program which is a partnership between SPU and the SDOT. Under the direction and funding of SPU, a limited number of SDOT's regenerative air sweepers are used on roadways that drain to surface waters as a source control/stormwater management activity.

SPU sets the program direction and provides water quality expertise and funding for the portion of routes that discharge directly to Seattle's receiving waters. Currently, 24 street sweeping routes covering 660 lane miles, of which 490 drain to surface waters, are swept using regenerative air sweepers. SDOT provides operational expertise, street sweeping services, and funding for the portion of the non-SS4WQ routes on roadways that drain to sewage treatment plants.

2.2 Study Overview

2.2.1 Study Goals

The goal of this study is to quantify the effect of street sweeping on stormwater quality by directly measuring runoff concentrations from roadways from swept and unswept treatments. Specifically, this study will assess the ability of the City's current fleet of regenerative air Schwarze® A9 Monsoon™ street sweepers utilized on a weekly basis to reduce pollution in stormwater runoff.

2.2.2 Study Design Overview

A paired Before/After–Control/Impact (BACI) design will be used to test if stormwater quality differences can be detected when street sweeping is discontinued. Since sweeping is the normal

condition for arterial roadways in Seattle, sweeping will be considered the "control" and not sweeping will be considered the "impact;" meaning that this study will be testing if by not sweeping, there is a measurable impact to stormwater quality.

Stormwater monitoring will be conducted at four sites located on the same arterial street with similar characteristics, where two sites will serve as Control sites (swept on a weekly basis) and two sites will serve as Impact sites (not swept). The four sites will be monitored over a two year period where Year 1 (2014-2015) represents the Before condition and Year 2 (2015-2016) represents the After condition.

The two Control sites will be monitored under typical, weekly street sweeping operations in both years. The two Impact sites will be monitored under typical, weekly street sweeping operations in Year 1 and under unswept conditions in Year 2. Sampling will be initiated in October to sample seasonal first flush conditions and continue through July of the following year to sample under both wet and dry season conditions. Thus, Year 1 sampling will be targeted from October 2014 through July 2015 and Year 2 sampling will be targeted from October 2015 through July 2016. Sweeping will be discontinued at the Impact sites by July 2015, or when Year 1 sampling goals are met. This schedule provides 2 to 3 months of street dirt accumulation and equilibration at the Impact sites between Before (Year 1) and After (Year 2) conditions. The goal is to collect 12 composite and grabs samples from each location per each year for a total of 24 samples sets at each site.

2.2.3 Monitoring Site Selection

Finding suitable and representative monitoring locations for stormwater studies of this nature is critical to the success of the study but can be very challenging. To ensure comparable sample data, the following requirements were imposed on the stormwater monitoring site selection:

- Each monitoring site will be located on the same arterial where the basin area of each site extends only the distance between two adjacent storm drain inlets (typically 200-300 lineal feet) and from the curb line to the roadway crown.
- Sites with no significant run-on from impervious and pervious areas adjacent to the travel lanes (e.g., driveways, sloped planting strips, lack of curb).
- Sites with no nighttime parking will be selected so sweepers will be the most effective and parking restrictions will not be needed.

- Sites need to be located in arterial roadway sections of nearly identical land use, slope, size, road surface type and condition, vegetation coverage, and similar traffic counts and type of vehicle usage.
- Sites need to have no paving or construction activities planned for the next four years.
- Site need to have parking strips and adjacent residences/businesses amendable to an above-ground sampling cabinet installation; and have inlets suitable for monitoring (large enough both vertically and horizontally, enough vertical drop to bottom or water surface, abut curb, be structurally sound, etc.).

Potential arterials to monitor were investigated using a Geographical Information System (GIS) review and field reconnaissance to locate roadways that contain a minimum of six locations meeting the above requirements. Based on the review and field reconnaissance, six locations on M.L. King Jr. Way S were selected for initial, project development-phase grab sample monitoring. The goal of this grab sampling was to select four locations to monitor during the full phase study.

Between November 2013 and March 2014, a total of six rounds of roadway runoff grab samples were collected from the six initial sites (identified as SS1 through SS6) during this development phase of the project (development phase data are not presented in this report). The original plan was to identify the four stations with the most similar water quality conditions to sample under the full phase study. Because of unresolved capacity/drainage issues observed at sites SS1 and SS6, those two sites were eliminated from future consideration. The final sites selection for the full-scale study, identified as SS2 through SS5, are shown on Figure 1and location details are provided in Table 1. Photos of the four site inlets are shown on Figure 2 through Figure 5.

Table 1. Monitoring station location information.

Station ID	Address	FEA_KEY	EQNUM_ID	X_COORD	Y_COORD
SS2	4051 M. L. King Way Jr S	7329200	978552	1279074.49	210314.26
SS3	2961 S Dakota (on M. L. King Way Jr. S)	4061938	929412	1279202.99	209938.85
SS4	4118 M. L. King Way Jr S	7331900	978926	1279257.93	209787.44
SS5	No address, approx. 4925 M. L. Jr Way S, 130' south of S Ferdinand St	7349489	983834	1280405.63	206774.28

SS2 and SS5 will serve as the Control sites during this study so will they will be swept on a weekly basis over both years of the study. SS3 and SS4 will be the Impact sites so they will be under swept conditions during Year 1 and unswept conditions during Year 2.

2.2.4 Parameters analyzed

Parameters were selected based upon their known presence in stormwater, their potential for adverse impacts, or their value in providing necessary supporting information. Parameters and corresponding sample collection methods are listed in Table 2.

Table 2. Parameters analyzed.

Group Type	Parameter	Sample Collection Method
Conventional parameters in stormwater	Total Suspended Solids (TSS)	Auto sampler, composite
	Total Organic Carbon (TOC)	Auto sampler, composite
	Chemical Oxygen Demand (COD)	Auto sampler, composite
	Suspended Solids Concentration (SSC)/Particle Size Distribution (PSD)	Auto sampler, composite
	pH	Grab sample, field meter
	Hardness	Auto sampler, composite
Metals (total and dissolved) in stormwater	Copper	Auto sampler, composite
	Zinc	Auto sampler, composite
Nutrients in stormwater	Total Phosphorus	Auto sampler, composite
	Nitrate-Nitrite (N03-N02)	Auto sampler, composite
	Total Kjeldahl Nitrogen (TKN)	Auto sampler, composite
Organics in stormwater	Polycyclic Aromatic Hydrocarbons (PAHs)	Grab sample, direct in bottle
Bacteria in stormwater	Fecal coliform	Grab sample, direct in bottle
Stormwater flow data	Level/flow at each inlet	Level sensor and weir/data logger
Precipitation data	Local rainfall in project area	Tipping bucket rain gage/data logger

Figure 1. Monitoring site location map.

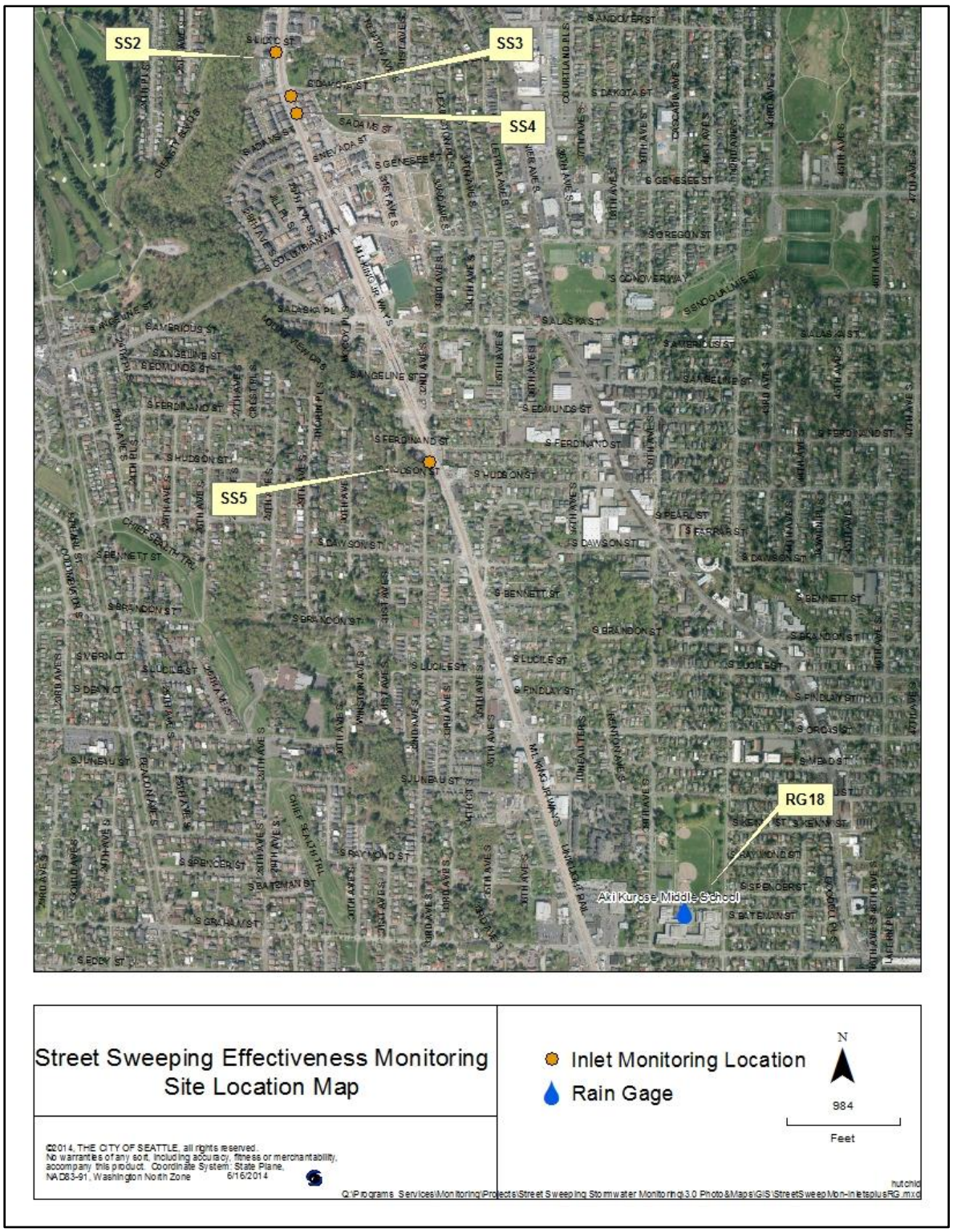
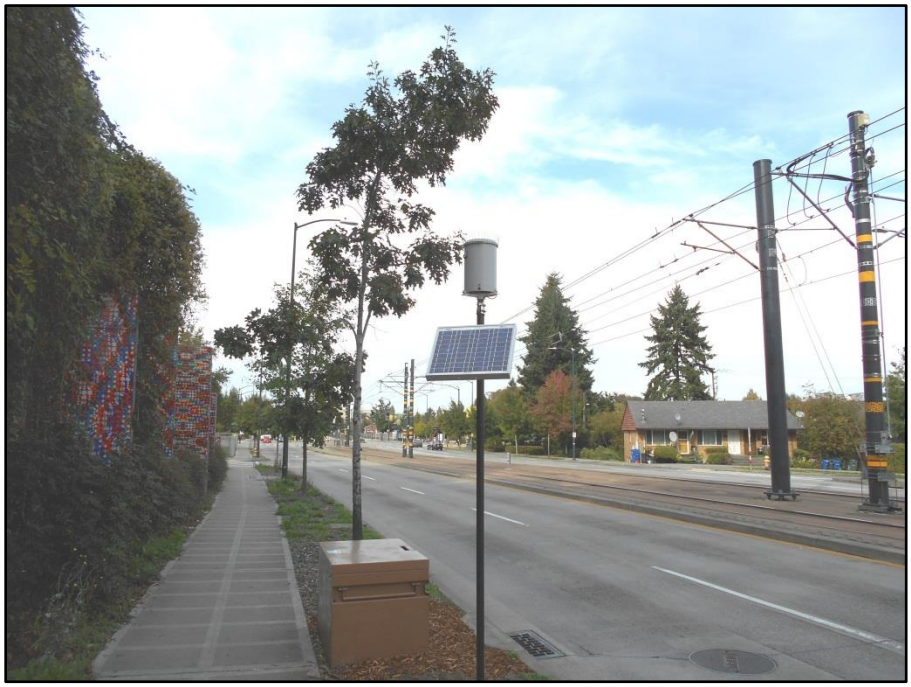


Figure 2. Photograph of monitoring station SS2 (looking south).

Figure 3. Photograph of monitoring station SS3 (looking south).

Figure 4. Photograph of monitoring station SS4 (looking south).

Figure 5. Photograph of monitoring station SS5 and project rain gage (looking north).



2.2.5 Monitoring Station Description

Each of the four monitoring stations are configured in a similar manner and consist of an aboveground metal equipment cabinet and solar panel installed in the parking strip with buried conduit connected to the adjacent storm drain inlet/catch basin structure. The one exception is there is a tipping bucket rain gage located at SS5 to measure rainfall for the localized project area. The elements of each monitoring station are shown on Figure 6 and Figure 7 and described below.

Figure 6. Monitoring station schematic detail (plan view).

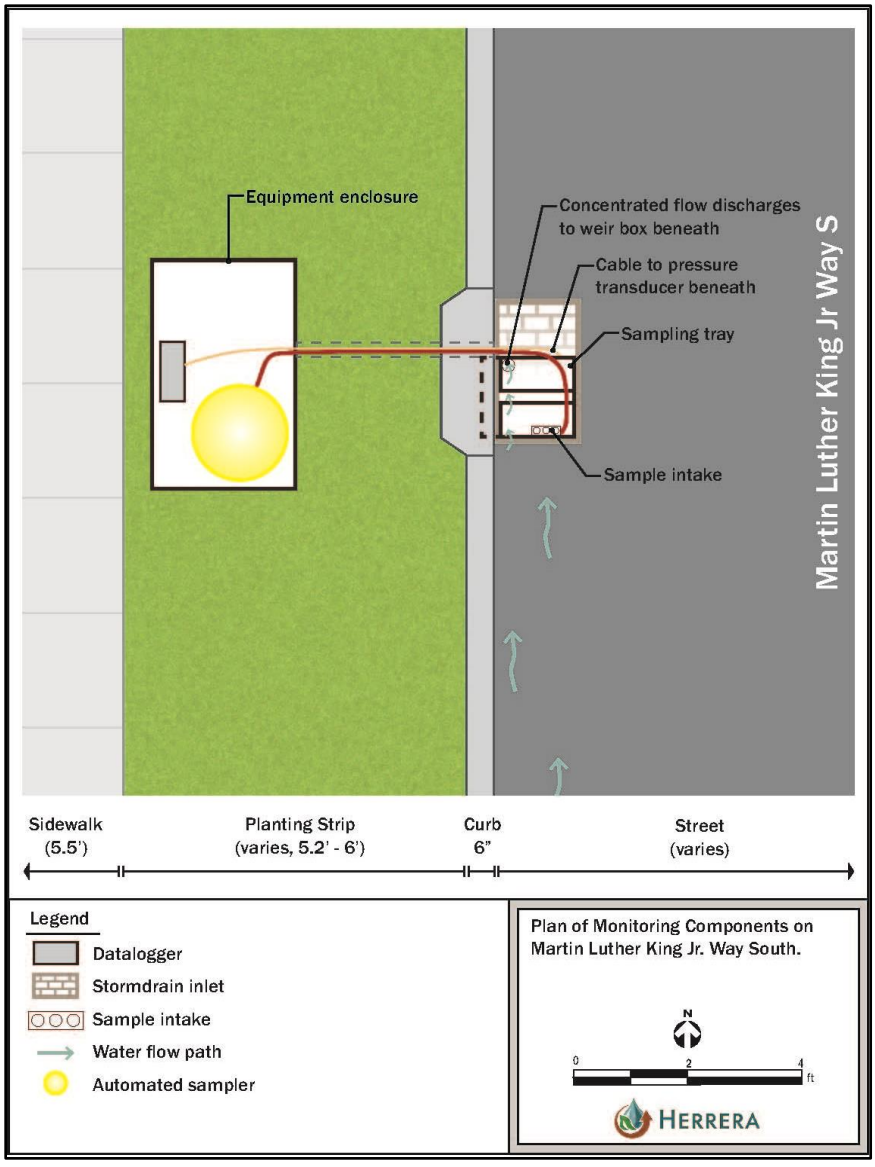
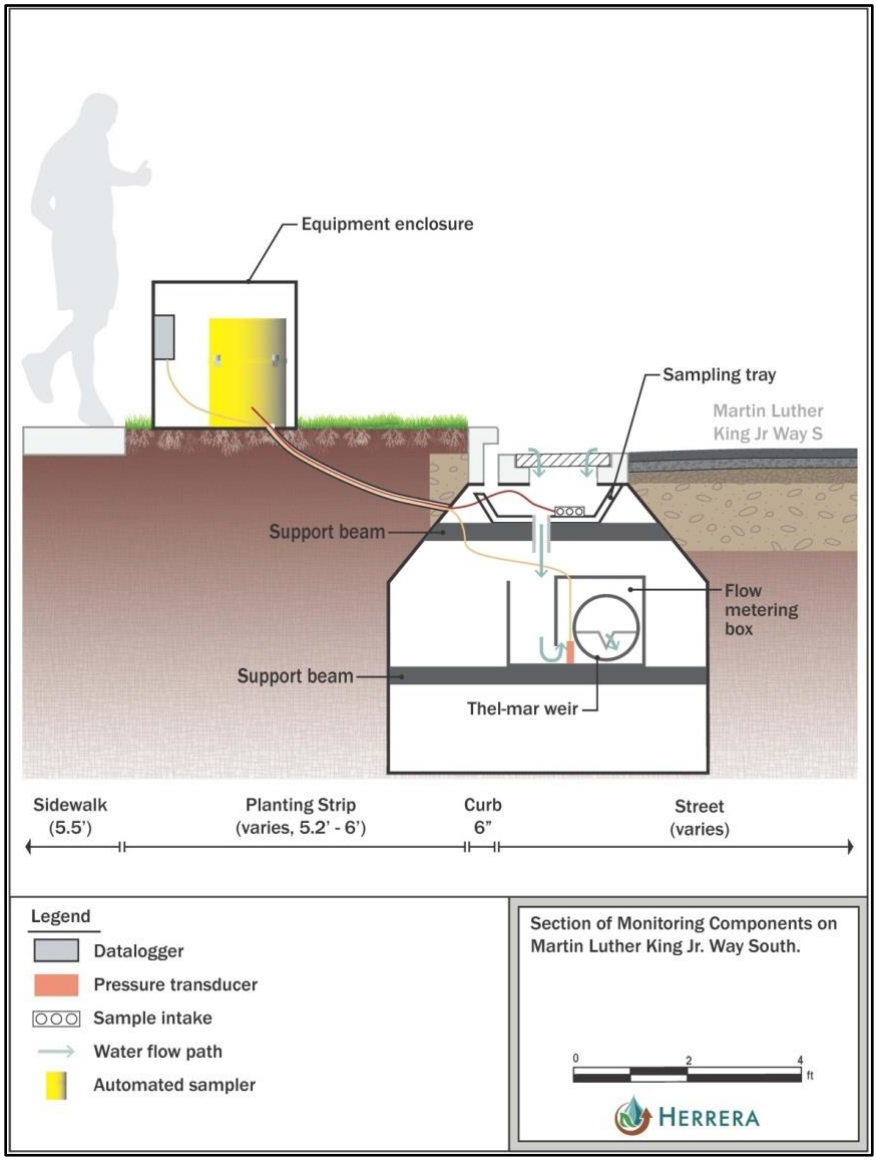


Figure 7. Monitoring station schematic detail (section view).



2.2.5.1 Flow Monitoring Equipment

Stormwater running off the roadway and entering each of the four inlets/catch basins is continuously monitored to calculate flow rate and volume. Accurate flow monitoring within catch basins is challenging since they are compact and not designed for flow monitoring. To facilitate flow monitoring, custom-made weir boxes were fabricated and installed in each monitored catch basin. A sampling tray positioned above each weir box directs all the flow entering each catch basin into the influent chamber of the weir box. An internal baffle calms the flow prior to it entering the outlet chamber where the flow exits the box through a Thel-Mar™

volumetric weir installed in the downstream wall of the outlet chamber. The weirs serve as the primary measurement devices which constrict and shape the flow, creating a relationship between hydraulic head and flow.

Figure 8. Sampling tray installed in inlet (inlet grate removed).

Figure 9. Weir box (prior to installation).

Pressure transducers (Campbell Scientific Inc. CS451-L) are installed in a stilling chamber to monitor water depth upstream of the weir in the outlet chamber.

The pressure transducers are connected to Campbell Scientific CR1000 data loggers which record water level measurements and control the automatic water sampling equipment. Loggers are programmed to record measurements every five (5) minutes. Level data are converted to flow based on an equation provided by the weir manufacturer. Each data logger is equipped with a digital cellular modem (Raven XTV) to provide remote access to flow data and adjust the pacing of the water quality sampler. Equipment is powered by rechargeable batteries augmented by solar panels. Aboveground monitoring equipment (data logger, modem, batteries and automatic samplers) are housed in Knaack Jobmaster Model 4830 storage cabinets.

2.2.5.2 Water Quality Sampling Equipment

The City purchased and is using vacuum-type automatic samplers (Manning Environmental Inc., VST3 sampler) for this project. Vacuum samplers were introduced to the market as an alternative to the more typically used (for stormwater sampling) peristaltic-pump type samplers. Vacuum samplers use an external vacuum pump to draw water samples instead of the peristaltic pumps that induce flow by compressing flexible tubing. Advantages of the vacuum pumps are reported to include higher transport velocities (5.1 feet per second [fps] at 5 feet of head for the VST3 vs. ~3 fps for the standard peristaltic pump), greater vertical lift range, larger diameter tubing options (up to 5/8-inch internal diameter), and less disruption of the water because tubing is not being squeezed. Because of these attributes, vacuum samplers are reputed to better represent the solids concentration in stormwater, especially when larger particles are present. Since getting representative solids concentrations in urban stormwater is important when quantifying the effect of street sweeping, SPU invested in this new equipment to increase the representativeness of the water quality samples.

The sampler intake strainer (perforated stainless steel sample head attached to the sample tubing) is installed in the custom-made sampling tray positioned below the inlet grate in each catch basin (see Figure 6 through Figure 8) and pump water to a 20 liter square (L) polyethylene (poly) composite bottle in the sampler base.

The data loggers (discussed in Section 2.2.5.1) are programmed to trigger the samplers every time a specified volume (referred to as the "trigger volume") is measured at the weir at each location, creating a volume-weighted composite to generate storm event mean concentrations (EMCs). Each trigger will result in the collection of one stormwater aliquot (or subsample) collected by the sampler. Each aliquot will measure approximately 200 milliliters (mL) so the composite bottle could receive approximately 100 aliquots before filling.

Figure 10. Cabinet containing sampler (yellow) and data logger enclosure (white).

2.2.5.3 Precipitation Monitoring Equipment

A temporary, project-specific tipping bucket rain gage (Hydrological Services model TB03) is installed at monitoring station SS5 and identified as RG-SS5 (shown on Figure 5). This rain gage provides localized rain data for the four project monitoring sites and enables controlling the water sampling equipment by ending sampling activities when rainfall has ceased for a six hour period. This rain gage is maintained by Herrera Environmental Consultants (Herrera).

In addition to the temporary rain gage, SPU collects precipitation data from a network of 17 tipping bucket rain gages located throughout Seattle. Precipitation data are collected over one-minute intervals and transmitted via wireless telemetry to a centralized server. The rain gage network is operated and maintained by a combination of SPU and ADS Environmental Services, Inc. (ADS) staff.

The backup project rain gage is RG18, one of the City's 17 permanent gages, located at Aki Kurose Middle School at 3928 S. Graham Street which is located about 0.8 miles southeast of SS5 (shown on Figure 1). RG18 will be used if problems are encountered with RG-SS5.

3 SAMPLING AND MONITORING PROCEDURES

Herrera Environmental Consultants (Herrera) of Seattle, WA, under contract with the City, performed all weather tracking, flow and precipitation monitoring, and stormwater sampling activities for this project. Analytical Resources Inc. (ARI) of Tukwila, WA performed all the sampling processing and laboratory analysis.

3.1.1 Qualifying Event Criteria

This study was designed to mimic the 2011 Technology Assessment Protocol – Ecology (TAPE) procedures as much as possible with the understanding that TAPE was established to test/approve structural best management practices (BMPs) which have an inlet and outlet, have design flow rates, internal bypasses, etc.; not activities such as street sweeping. Thus, the sampling procedures and criteria followed TAPE but the future data analysis methods will not follow TAPE.

The TAPE protocol defines "representative" storms that must be monitored when ascertaining performance of structural BMPs. Storm event criteria are established to: 1) ensure that adequate flow will be discharged; 2) allow some build-up of pollutants during the dry weather intervals; and 3) ensure that the storm will be "representative" (i.e., typical for the area in terms of intensity, depth, and duration).

Collection of samples during a storm event meeting these criteria ensures that the resulting data will portray the most common conditions for each site. Ensuring a representative sample requires two considerations: 1) the storm event must be representative of typical regional rainfall, and 2) the sample collected must represent the runoff of that storm event.

Table 3 lists the qualifying storm event criteria to ensure the storm event sampled is representative.

Table 3. Qualifying storm event criteria.

Criteria	Requirements
Minimum storm depth	A minimum of 0.15 inches of precipitation over a 24-hour period
Minimum storm duration	Target storms must have a duration of at least one hour
Antecedent dry period	A period of at least 6 hours preceding the event with less than 0.04 inches of precipitation.
Post-storm dry period	A continuous 6-hour period with less than 0.04 inches of precipitation.

Table 4 lists the criteria to ensure that the composite sample collected is representative of the storm event sampled.

Table 4. Qualifying composite sample collection criteria.

Storm event duration	<24 hours	>24 hours
Minimum storm volume sampled	75 percent of the storm event hydrograph	75 percent of the hydrograph of the first 24 hours of the storm
Minimum aliquot number	At least 10 flow-weighted sub-samples (aliquots) must be collected during the duration of the event. If fewer than 10, but 7 or more aliquots are collected, then the sample will be considered valid only if all other sampling criteria have been met.	
Maximum time period for sample collection (hours)	36	

Weather and rainfall data are continuously monitored using multiple forecasting, radar and satellite sources to target storms that meet the criteria for a qualifying event, listed above.

3.1.2 Flow Monitoring Procedures

Flow monitoring equipment type and configuration per each station are described in Section 2.2.5.1. The level sensors are calibrated prior to each sampled storm event. During periods without routine stormwater sampling (e.g., summer), flow monitor maintenance visits will be performed monthly or as-needed based on remote real-time monitor checks or data reviews. Each maintenance visit includes cleaning debris out of the weir box and calibration of the level sensor.

Level, flow, and rain data are automatically downloaded daily for maintenance purposes and on an as-needed basis around storm events. Data are inspected prior to each sampled storm event for any significant trends in reliability and/or accuracy (i.e., substantial level jump, spikes, flat-line data, or missing data). If anomalies are observed, a maintenance team is sent to the monitoring site to test and troubleshoot any issues observed.

After each maintenance visit, a review of the data was completed for the preceding period between maintenance visits. Because each maintenance visit included an actual measurement of the water level, level data were corrected for level drift if the difference between the actual and measured level was greater than 0.01 ft. The adjusted level data were then used to calculate the flow using the level-flow relationship provided by the weir manufacturer.

Both raw and edited/finalized flow data are stored in the Herrera's time-series database (AQUARIUS). Only finalized data are presented in this report.

3.1.3 Stormwater Grab Sampling Procedures

Grab samples were collected by removing the inlet grate and filling bottles directly from stormwater runoff entering the catch basin structure (see Figure 11). Ideally, all grab samples were collected between the first and last volume-proportional composite sample aliquot at each site. However, if the rain/runoff ended before the field crew could be present to collect the grab sample; a makeup grab sample was collected for the missed event during another event that met the storm criteria.

Figure 11. Collecting stormwater grab samples.

3.1.4 Stormwater Composite Sampling Procedures

Volume-proportioned stormwater composite samples were collected using Manning Environmental VST3 automatic samplers. The samplers utilize a vacuum pump to draw stormwater from the strainer (a perforated stainless steel sample head affixed to the end of the sampler tube) installed in the sampling tray and distribute it to a 20 L polyethylene (poly) composite bottle in the sampler base.

The data loggers were programmed to trigger the samplers every time a specified volume (referred to as the "trigger volume") was measured passing through the weir box, creating a volume-weighted composite. The trigger volume is determined by past rainfall to runoff relationships and the predicted rainfall amount for each storm. Each trigger results in the collection of one stormwater aliquot (or subsample) collected by each sampler which deposited into the 20L composite bottle. Each aliquot is 200 mL so the composite bottle can receive 100 aliquots before becoming full.

Flows and sample collection times were monitored remotely using the telemetry systems associated with each data logger. Field crews were mobilized to each site during the event if it appeared that the composite bottle was at risk of filling, and bottles were removed and replaced as needed.

3.1.5 Precipitation Monitoring Procedures

The project rain gage was tested and calibrated before deployment. The rain gage was or will be inspected and maintained quarterly. Maintenance included: checking the levelness of the gage and re-leveling, if necessary; and cleaning of filter screens, drain holes, and siphons. Gages will be verified and calibrated semi-annually by sending a known volume of water through the gage a minimum of two times, averaging the gage's measurement and comparing the average to the known volume. If the measurement is greater than +/- 2 percent of the actual volume, the gage will be adjusted in the field until it reads within 2 percent; or replaced with another gage, with the inaccurate gage sent back to the manufacturer for calibration.

3.1.6 Sample Processing Procedures

Since stormwater samples, specifically stormwater solids concentrations and related contaminants, can be readily biased without proper processing procedures; all composite samples were composited and split in the project analytical laboratory (ARI) using 22 liter (L) polyethylene churn splitters for all events. The churn splitter keeps solids suspended and the sample mixed as the composite sample is split and deposited into analyte-specific containers.

Figure 12. Compositing/splitting samples with churn splitter.

3.1.7 Decontamination Procedures

All water quality sampling equipment was initially decontaminated with the following procedure:

1. Wash in a solution of laboratory-grade, non-phosphate soap and tap (city) water.
2. Rinse in tap water.
3. Wash in a 10 percent nitric acid/deionized water solution.
4. Rinse in deionized water.
5. Final rinse in deionized water.

Sampling and sample processing equipment was decontaminated prior to every use with the exception of sampler tubing. Following the initial wash, sampler tubing and the sampling tray was rinsed with deionized water immediately prior to each sampling event. This is consistent with Ecology's *Standard Operating Procedure for Automatic Sampling for Stormwater Monitoring – ECY002*, dated September 16, 2009.

3.1.8 Field Quality Control (QC) Sample Collection Procedures

During 2014, which included only 3 months of monitoring from October to December, a limited number of field QC samples were collected to evaluate the sampling operation and to quantify and document bias that can occur in the field since sampling began in October. QC samples provided the ability to assess the quality of the data produced by field sampling and a means for quantifying sampling bias.

The following table lists the types of QC samples collected, description of how the QC samples were collected, the purpose and information provided by each sample, and the number of QC samples collected during 2014.

Table 5. QC sample summary.

QC Sample Type	Code	Description	Purpose/Info Provided	Number Collected WY2014	Collected on
Field Equipment Blank Sample	FEB	Blank water passed through decontaminated or new equipment	Tests cleaning procedures or cleanliness of sampling and processing equipment	6	Sampler tubing (at each station) and composite bottle/splitting equipment (churn splitters)

The field equipment blanks were made by field staff passing reagent grade deionized (DI) water over or through decontaminated sample equipment and capturing the blank water in analyte-specific bottles.

The sampler tubing was not fully decontaminated but rinsed with deionized water (consistent with Ecology's *Standard Operating Procedure for Automatic Sampling for Stormwater Monitoring – ECY002*, dated September 16, 2009) prior to sample or blank collection.

A combination composite bottle and churn splitter blank was made by filling a 20L poly bottle with reagent grade DI water, letting it sit for 30 minutes and then pouring the DI water into the churn splitter. Analyte-specific bottles were filled while churning following the same process used for compositing/splitting stormwater samples.

3.2 Analytical QA/QC Procedures, Methods and Reporting Limits

3.2.1 Analytical Data QA/QC Procedures

A laboratory data package was received for each sample delivery group (SDG) including a hard copy report and electronic data deliverable (EDD). The laboratory data packages were reviewed for completeness, analytical methods, quality control issues and corrective action taken, and adherence to EDD formatting requirements.

The data in each SDG were evaluated by analytical method for reporting limits (RLs), sample preservation and holding time, blank contamination, accuracy, and precision per the measurement quality objectives (MQOs) stated in the project QAPP. A data validation report (DVR) detailing the data evaluation and summarizing data qualification flags by analytical parameter, sample, and MQO quality control check was prepared for each SDG.

Data qualifiers from the DVRs were added to the EDDs and each validated EDD was loaded into the EQuIS™ project database. In EQuIS, a final assessment of the data was performed by reviewing validator and laboratory data qualifiers (populating the interpreted qualifiers field), populating the remarks field related to the MQO quality control checks, and adding a signature indicating final approval for each sample from each SDG.

3.2.2 Analytical Methods and Reporting Limits

The following table presents the methods and reporting limits (RL) used by the project analytical laboratory (ARI). Reporting limits represent the minimum concentration of an analyte in a specific matrix that can be identified and quantified above the method detection limit and within specified limits of precision and bias during routine analytical operating conditions. Reporting limits can vary by individual samples, particularly for sediments where the quantity and dilution analyzed affect the minimum detectable value.

Table 6. Stormwater Analytes, Methods and Reporting Limits (RL)

Group Type	Parameter	Reporting Limit	Units	Lab Method
Conventional parameters	Total Suspended Solids (TSS)	1	mg/L	SM2540D
	Total Organic Carbon (TOC)	1.5	mg/L	SM 5310B
	Chemical Oxygen Demand (COD)	10	mg/L	EPA 410.4
	Modified Suspended Solids Concentration (SSC)	0.01	mg/L	ASTM D3977-97
	pH	0.2	standard units	EPA 150.2
	Hardness as CaCO3	330	µg/L CaCO3	SM2340B
Metals - total/dissolved	Copper	0.5/(0.5)	µg/L	EPA 200.8
	Zinc	4/(4)	µg/L	EPA 200.8
Nutrients	Total Phosphorus	0.008	mg/L	SM4500-PE
	Nitrate-Nitrite (N03-N02)	0.01	mg-N/L	EPA 353.2
	Total Kjeldahl Nitrogen (TKN)	1	mg-N/L	EPA 351.2
Bacteria	Fecal Coliform	1	cfu/100mL	SM9222D
Organics	Polycyclic Aromatic Hydrocarbons (PAHs)	0.1	µg/L	8270D-SIM

4 SAMPLING EVENTS AND RESULTS

The following sections present a summary of storm events sampled and the stormwater analytical data for calendar year 2014.

4.1 Sampling Summary

4.1.1 Stormwater Events

Monitoring and sample collection for this project began in October 2014. Four storm events (SE) were sampled prior to the end of 2014. The events are identified as SE-01 through SE-04. The goal is to sample 12 events annually beginning in October and ending the following September. Precipitation, flow, and sample information for each event sampled in 2014 are presented in Table 7. All event criteria and goals were met without exception.

No grab samples were collected during the SE-03 event composite sample period on December 6, 2014 because rainfall ceased before a field crew could collect grabs. The grab samples designated for SE-03 were collected earlier on October 22, 2014 from an event that met all storm criteria but equipment problems resulted in no composite samples being submitted.

Table 7. Event Hydrologic Data - Storm Events (SE) 01-04

Analyte Name	Goal	SE-01	SE-02	SE-03	SE-04
RG-SS5 Precipitation Summary					
Precipitation Start		10/25/14 8:20	11/21/14 3:35	12/6/14 0:25	12/9/14 21:10
Precipitation Stop		10/25/14 19:45	11/21/14 19:10	12/6/14 6:50	12/10/14 7:50
Storm Event Duration (hrs)	NA	11.4	15.6	6.4	10.7
Event Rainfall (in)	≥ 0.15	0.38	0.66	0.22	0.41
Event Rainfall Mean (in/hr)	NA	0.03	0.04	0.03	0.04
Event Rainfall Max (in/hr)	NA	4.32	2.88	2.88	2.88
Antecedent Dry Period (hrs)	>6	10.2	26.1	13.9	10
SS2 Flow and Sampling Summary					
Event Total Flow Mean (gpm)	NA	1.4	3.3	2.3	3.8
Flow Duration (hrs)	>1	11.3	16.3	9.0	12.2
First Sample Time	NA	10/25/14 15:07	11/21/14 3:40	12/6/14 0:25	12/9/14 21:20
Last Sample Time	NA	10/25/14 19:17	11/21/14 17:32	12/6/14 4:27	12/10/14 3:37
Event Total Flow Max (gpm)	NA	21.8	20.4	23.5	22.9
No. Composite Sample Aliquots	≥ 10	10	100	12	24

Analyte Name	Goal	SE-01	SE-02	SE-03	SE-04
Event Flow Volume Sampled (%)	≥75	84.3	97.5	98.5	98.4
Sample Duration (hours)	<36	4.2	13.9	4.0	6.3
Flow Start	NA	10/25/14 8:25	11/21/14 3:40	12/6/14 0:20	12/9/14 21:10
Flow Stop	NA	10/25/14 22:10	11/21/14 20:55	12/6/14 13:10	12/10/14 12:40
Event Total Flow Volume (gal)	NA	949.3	3233.2	1223.8	2793.5
SS3 Flow and Sampling Summary					
Event Total Flow Mean (gpm)	NA	0.9	1.2	1.1	2.0
Flow Duration (hours)	>1	18.2	17.5	14.6	15.6
First Sample Time	NA	10/25/14 14:00	11/21/14 3:47	12/6/14 0:25	12/9/14 21:20
Last Sample Time	NA	10/25/14 21:57	11/21/14 18:32	12/6/14 11:27	12/10/14 7:52
Event Total Flow Max (gpm)	NA	12.1	7.7	13.0	13.2
No. Composite Sample Aliquots	≥ 10	27	84	33	39
Event Flow Volume Sampled (%)	≥75	87.4	98.5	95.1	96.9
Sample Duration (hours)	<36	8.0	14.8	11.0	10.5
Flow Start	NA	10/25/14 8:25	11/21/14 3:35	12/6/14 0:20	12/9/14 21:10
Flow Stop	NA	10/26/14 3:40	11/21/14 21:00	12/6/14 14:50	12/10/14 12:40
Event Total Flow Volume (gal)	NA	955.6	1268.3	980.0	1909.9
SS4 Flow and Sampling Summary					
Event Total Flow Mean (gpm)	NA	1.7	0.9	0.8	1.3
Flow Duration (hours)	>1	8.5	16.0	11.0	9.2
First Sample Time	NA	10/25/14 14:27	11/21/14 3:40	12/6/14 0:25	12/9/14 21:25
Last Sample Time	NA	10/25/14 19:22	11/21/14 17:17	12/6/14 12:12	12/10/14 7:42
Event Total Flow Max (gpm)	NA	13.7	3.4	7.8	5.8
No. Composite Sample Aliquots	≥ 10	36	100	36	24
Event Flow Volume Sampled (%)	≥75	87.3	95.3	98.8	99.0
Sample Duration (hours)	<36	4.9	13.6	11.8	10.3
Flow Start	NA	10/25/14 8:25	11/21/14 3:40	12/6/14 0:20	12/9/2014 21:15
Flow Stop	NA	10/25/14 21:40	11/21/2014 20:30	12/6/14 14:30	12/10/14 12:40
Event Total Flow Volume (gal)	NA	874.1	832.2	497.5	692.9
SS5 Flow and Sampling Summary					
Event Total Flow Mean (gpm)	NA	1.8	1.1	0.9	1.5
Flow Duration (hours)	>1	10.5	13.25	6.0833	15.5
First Sample Time	NA	10/25/14 8:27	11/21/14 8:05	12/6/14 0:30	12/9/14 21:25
Last Sample Time	NA	10/25/14 19:47	11/21/14 17:32	12/6/14 3:22	12/10/14 8:27
Event Total Flow Max (gpm)	NA	16.7	7.4	5.5	9.7
No. Composite Sample Aliquots	≥ 10	25	22	23	46
Event Flow Volume Sampled (%)	≥75	98.0	95.2	96.6	95.8
Sample Duration (hours)	<36	11.3	9.5	2.9	11.0

Analyte Name	Goal	SE-01	SE-02	SE-03	SE-04
Flow Start	NA	10/25/14 8:25	11/21/14 3:45	12/6/14 0:25	12/9/14 21:10
Flow Stop	NA	10/25/14 21:30	11/21/14 19:25	12/6/14 12:30	12/10/14 12:40
Event Total Flow Volume (gal)	NA	1133.2	880.4	316.8	1401.3

Appendix A presents an Individual Storm Report (ISR) for each event sampled in the 2014. The ISRs contain a hydrograph for each event which presents flow, rain, and aliquot information graphically in addition to repeating the tabular information presented above.

4.1.2 Field QC Sample Events

A limited number of QC samples were collected in 2014 as summarized in Table 5. A tubing blank was collected on each of the four automatic sampler tubes on November 5, 2014. A sampling processing blank was taken on the combination of composite bottle and churn splitter on November 17, 2014. Based the results of this sample, corrective actions were initiated by the laboratory and a second sample processing blank was taken on December 17, 2014. See Section 4.1.4 for a discussion of Field QC results.

4.1.3 Stormwater Analytical Data Summary

All stormwater sample analytical results including qualifiers collected during 2014 are presented in Table 8 to 11. The qualifiers are a combination of laboratory applied qualifiers and those applied during SPU's internal data validation.

Qualifiers are defined as follows:

U – Analyte was not detected above the reported result.
J – Analyte was positively identified and the reported resulted is an estimate.
UJ – Analyte was not detected above the reported estimate.

Since this is an interim report, and based on the design of the study, no conclusions about the effectiveness of street sweeping will be able to be made until the monitoring is completed in 2016. Thus, no sample result discussion or statistical testing is included in this report.

Table 8. Analytical Summary – SS2.

	Event ID	SE-01	SE-02	SE-03	SE-04
	Event Date	25 Oct 2014	21 Nov 2014	06 Dec 2014*	10 Dec 2014
Analyte	Units				
Conventionals					
Total Suspended Solids	mg/l	273	54.3	91	64.7
Total Organic Carbon	mg/l	13.3	13.5	18.8	15.1
Chemical Oxygen Demand	mg/l	55.8	65.6	13	47.7
pH	pH	6.6	6	6.8	7.6
Hardness	ug/l	37000	35000	37000	33000
Metals					
Copper, Dissolved	ug/l	6.3	6.8	4.3	2.8
Copper, Total	ug/l	44.4	28.7	40.7	26.2
Zinc, Dissolved	ug/l	14	15	15	11
Zinc, Total	ug/l	103	65 J	132	81
Nutrients					
Phosphorus, Total	mg/l	0.255	0.132	0.223	0.15
Nitrate + Nitrite	mg/l	0.129 J	0.171 J	0.144 J	0.083 J
Nitrogen, Total Kjeldahl	mg/l	1.3	1 U	1.2	1.1
Bacteria					
Fecal Coliform	cfu/100ml	195 J	260	88	1520
Polycylic Aromatic Hydrocarbons (PAHs)					
1-Methylnaphthalene	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
2-Methylnaphthalene	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
Acenaphthene	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
Acenaphthylene	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
Anthracene	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
Benzo(A)Anthracene	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
Benzo(A)Pyrene	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
Benzo(G,H,I)Perylene	ug/l	0.1 UJ	0.1 U	0.1 U	0.1 U
Benzofluoranthenes, Total	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
Chrysene	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
d10-2-Methylnaphthalene	ug/l	2.15	2.19	2.07	1.91
d10-Fluoranthene	ug/l	2.56	2.27	2.84	1.81
d14-Dibenzo(a,h)anthracene	ug/l	1.79	1.68	1.95	1.49
Dibenzo(A,H)Anthracene	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
Dibenzofuran	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
Fluoranthene	ug/l	0.1	0.1 U	0.12	0.13
Fluorene	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
Indeno(1,2,3-Cd)Pyrene	ug/l	0.1 UJ	0.1 U	0.1 U	0.1 U
Naphthalene	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
Phenanthrene	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
Pyrene	ug/l	0.11	0.1 U	0.12	0.2
Sediment Concentration					
Sediment Conc. > 500 um	mg/l	56.2	0.99	26.4	12.25
Sediment Conc. 500 to 250 um	mg/l	18.91	2.43	71.13	21.36
Sediment Conc. 250 to 62.5 um	mg/l	44	6.41	106.11	42.16
Sediment Conc. 62.5 to 3.9 um	mg/l	0.01 U	0.01 U	0.36	0.01 U
Sediment Conc. < 3.9 um	mg/l	65.29	36.66	65.45	50.53
Sediment Conc. Total	mg/l	184.4	46.49	269.45	126.3

Note:
* - The grab sample for SE-03 was collected on 10/22/2014, not during the SE-03 composite sample period on 12/6/2014.

Table 9. Analytical Summary – SS3.

	Event ID	SE-01	SE-02	SE-03	SE-04
	Event Date	25 Oct 2014	21 Nov 2014	06 Dec 2014	10 Dec 2014
Analyte	Units				
Conventionals					
Total Suspended Solids	mg/l	102	47.4	77	44.5
Total Organic Carbon	mg/l	10.6	12.4	7.57	7.49
Chemical Oxygen Demand	mg/l	112	59.6	11.1	23.3
pH	pH	6.8	6.9	6.7	7.4
Hardness	ug/l	45000	33000	36000	34000
Metals					
Copper, Dissolved	ug/l	5.6	5.5	4.1	3
Copper, Total	ug/l	48.1	26.5	27.7	20.4
Zinc, Dissolved	ug/l	15	17	13	11
Zinc, Total	ug/l	142	69	86	63
Nutrients					
Phosphorus, Total	mg/l	0.282	0.142	0.157	0.112
Nitrate + Nitrite	mg/l	0.076 J	0.159 J	0.159 J	0.081 J
Nitrogen, Total Kjeldahl	mg/l	1.2	1 U	1.1	1 U
Bacteria					
Fecal Coliform	cfu/100ml	445 J	1380	72	205
Polycylic Aromatic Hydrocarbons (PAHs)					
1-Methylnaphthalene	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
2-Methylnaphthalene	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
Acenaphthene	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
Acenaphthylene	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
Anthracene	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
Benzo(A)Anthracene	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
Benzo(A)Pyrene	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
Benzo(G,H,I)Perylene	ug/l	0.1 UJ	0.1 U	0.1 U	0.1
Benzofluoranthenes, Total	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
Chrysene	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
d10-2-Methylnaphthalene	ug/l	2.19	2.38	1.95	1.66
d10-Fluoranthene	ug/l	2.7	2.63	2.73	1.68
d14-Dibenzo(a,h)anthracene	ug/l	1.74	2.23	2.09	1.03
Dibenzo(A,H)Anthracene	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
Dibenzofuran	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
Fluoranthene	ug/l	0.1 U	0.1 U	0.1 U	0.11
Fluorene	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
Indeno(1,2,3-Cd)Pyrene	ug/l	0.1 UJ	0.1 U	0.1 U	0.1 U
Naphthalene	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
Phenanthrene	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
Pyrene	ug/l	0.1	0.1 U	0.1 U	0.18
Sediment Concentration					
Sediment Conc. > 500 um	mg/l	17.87	4.17	107.06	21.01
Sediment Conc. 500 to 250 um	mg/l	14.86	4.28	61.34	14.87
Sediment Conc. 250 to 62.5 um	mg/l	51.33	15.31	73.31	30.7
Sediment Conc. 62.5 to 3.9 um	mg/l	0.01 U	0.01 U	0.01 U	0.01 U
Sediment Conc. < 3.9 um	mg/l	75.98	46.65	74.73	32.66
Sediment Conc. Total	mg/l	160.04	70.41	316.44	99.24

Note
* - The grab sample for SE-03 was collected on 10/22/2014, not during the SE-03 composite sample period on 12/6/2014.

Table 10. Analytical Summary – SS4.

	Event ID	SE-01	SE-02	SE-03	SE-04
	Event Date	25 Oct 2014	21 Nov 2014	06 Dec 2014*	10 Dec 2014
Analyte	Units				
Conventionals					
Total Suspended Solids	mg/l	63.6	40.5	62.4	51.1
Total Organic Carbon	mg/l	5.77	10.2	9.58	4.79
Chemical Oxygen Demand	mg/l	69.6	40.1	12.7	10 U
pH	pH	6.8	6.7	6.7	7.5
Hardness	ug/l	32000	30000	35000	28000
Metals					
Copper, Dissolved	ug/l	3.5	4.8	3.5	2.3
Copper, Total	ug/l	30.9	21.2	22.8	13.4
Zinc, Dissolved	ug/l	10	14	11	10
Zinc, Total	ug/l	79	55	85	43
Nutrients					
Phosphorus, Total	mg/l	0.14	0.109	0.135	0.074
Nitrate + Nitrite	mg/l	0.057 J	0.121 J	0.143 J	0.052 J
Nitrogen, Total Kjeldahl	mg/l	1	1 U	1 U	1 U
Bacteria					
Fecal Coliform	cfu/100ml	110 J	160	64	135
Polycylic Aromatic Hydrocarbons (PAHs)					
1-Methylnaphthalene	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
2-Methylnaphthalene	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
Acenaphthene	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
Acenaphthylene	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
Anthracene	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
Benzo(A)Anthracene	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
Benzo(A)Pyrene	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
Benzo(G,H,I)Perylene	ug/l	0.1 UJ	0.1 U	0.1 U	0.1 U
Benzofluoranthenes, Total	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
Chrysene	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
d10-2-Methylnaphthalene	ug/l	2.04	2.37	2.14	1.9
d10-Fluoranthene	ug/l	2.72	2.56	2.78	2.22
d14-Dibenzo(a,h)anthracene	ug/l	2.1	2.04	2.36	1.68
Dibenzo(A,H)Anthracene	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
Dibenzofuran	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
Fluoranthene	ug/l	0.1 U	0.1 U	0.1 U	0.15
Fluorene	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
Indeno(1,2,3-Cd)Pyrene	ug/l	0.1 UJ	0.1 U	0.1 U	0.1 U
Naphthalene	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
Phenanthrene	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
Pyrene	ug/l	0.1 U	0.1 U	0.1 U	0.19
Sediment Concentration					
Sediment Conc. > 500 um	mg/l	15.7	1.08	78.83	7.26
Sediment Conc. 500 to 250 um	mg/l	7.38	1.84	10.45	9.21
Sediment Conc. 250 to 62.5 um	mg/l	24.66	7.14	44.4	38.16
Sediment Conc. 62.5 to 3.9 um	mg/l	0.01 U	0.01 U	0.01 U	0.01 U
Sediment Conc. < 3.9 um	mg/l	43.78	35.96	42.71	31.71
Sediment Conc. Total	mg/l	91.52	46.02	176.39	86.34

Note:
* - The grab sample for SE-03 was collected on 10/22/2014, not during the SE-03 composite sample period on 12/6/2014.

Table 11. Analytical Summary – SS5.

	Event ID	SE-01	SE-02	SE-03	SE-04
	Event Date	25 Oct 2014	21 Nov 2014	06 Dec 2014*	10 Dec 2014
Analyte	Units				
Conventionals					
Total Suspended Solids	mg/l	64.5	97.6	85.8	75
Total Organic Carbon	mg/l	8.83	12.4	19.4	14.7
Chemical Oxygen Demand	mg/l	75.7	48.9	12.7	10.5
pH	pH	6.9	6.7	6.5	7.2
Hardness	ug/l	32000	30000	31000	36000
Metals					
Copper, Dissolved	ug/l	5.1	6.5	4.2	2.7
Copper, Total	ug/l	33.5	31.2	37.7	24.3
Zinc, Dissolved	ug/l	15	29	16	12
Zinc, Total	ug/l	86	79	128	87
Nutrients					
Phosphorus, Total	mg/l	0.267	0.188	0.205	0.176
Nitrate + Nitrite	mg/l	0.121 J	0.108 J	0.114 J	0.088 J
Nitrogen, Total Kjeldahl	mg/l	1.1	1.2	1.1	1.3
Bacteria					
Fecal Coliform	cfu/100ml	260 J	80	420	260
Polycylic Aromatic Hydrocarbons (PAHs)					
1-Methylnaphthalene	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
2-Methylnaphthalene	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
Acenaphthene	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
Acenaphthylene	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
Anthracene	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
Benzo(A)Anthracene	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
Benzo(A)Pyrene	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
Benzo(G,H,I)Perylene	ug/l	0.1 UJ	0.1 U	0.1 U	0.13
Benzofluoranthenes, Total	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
Chrysene	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
d10-2-Methylnaphthalene	ug/l	2	2.18	2.22	0.97
d10-Fluoranthene	ug/l	2.12	2.37	3.18	1.83
d14-Dibenzo(a,h)anthracene	ug/l	1.05	1.51	2.13	1.65
Dibenzo(A,H)Anthracene	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
Dibenzofuran	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
Fluoranthene	ug/l	0.1 U	0.1 U	0.1 U	0.15
Fluorene	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
Indeno(1,2,3-Cd)Pyrene	ug/l	0.1 UJ	0.1 U	0.1 U	0.1 U
Naphthalene	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
Phenanthrene	ug/l	0.1 U	0.1 U	0.1 U	0.1 U
Pyrene	ug/l	0.12	0.1 U	0.1 U	0.22
Sediment Concentration					
Sediment Conc. > 500 um	mg/l	33.6	52.8	64	10.14
Sediment Conc. 500 to 250 um	mg/l	10.12	9.92	6.65	4.36
Sediment Conc. 250 to 62.5 um	mg/l	20.87	27.01	19.94	16.03
Sediment Conc. 62.5 to 3.9 um	mg/l	0.01 U	0.01 U	0.01 U	0.01 U
Sediment Conc. < 3.9 um	mg/l	41.58	72.58	59.82	60.89
Sediment Conc. Total	mg/l	106.17	162.31	150.41	91.42

Note:
* - The grab sample for SE-03 was collected on 10/22/2014, not during the SE-03 composite sample period on 12/6/2014.

4.1.4 Field QC Data Analytical Data Summary and Discussion

All field QC samples collected during 2014 are presented in Table 12 .

Table 12. Analytical Summary – Field QC samples.

Sample ID		SS2_Tubing Blank	SS3_Tubing Blank	SS4_Tubing Blank	SS5_Tubing Blank	Churn_Bottle Blank	Churn_Bottle Blank
Date		05 Nov 2014	05 Nov 2014	05 Nov 2014	05 Nov 2014	17 Dec 2014	17 Dec 2014
Analyte	Units						
Metals							
Copper, Total	ug/l	0.6	0.8	0.8	0.5	0.5 U	NA
Zinc, Total	ug/l	4 U	4 U	4 U	4 U	4 U	NA
Nutrients							
Nitrate + Nitrite	mg/l	0.01 U	0.01 U	0.01 U	0.01 U	0.04	0.01 U
Phosphorus, Total	mg/l	0.008 U	0.008 U	0.008 U	0.008 U	0.008 U	NA

NA – not analyzed.

Tubing blanks were non-detect for all analytes except for minor detections of total copper ranging from 0.5 to 0.8 micrograms per liter (µg/L). The detected range of the total copper in the associated stormwater samples was greater than ten (10) times the amount detected in the highest blank so no corrective action or sample qualification were needed.

The first composite bottle/churn splitter blank collected on November 17, 2014 was non-detect for all analytes except for 0.04 milligrams nitrogen per liter (mg-N/L) of nitrate-nitrite. Although this result was just above the reporting limit of 0.01 mg-N/L, it was within ten (10) times some of the initial stormwater sample results so correction action was required. SPU observed the nitrate-nitrite contamination during early data screening and requested that the field and laboratory staff investigate. After extensive testing, the source of contamination was determined to be a sodium hydroxide (NaOH) solution used by the lab to preserve samples immediately prior to analysis. Corrective action was taken by the lab and another composite bottle/churn splitter blank was taken on December 17, 2014 which was non-detect for nitrate-nitrite and the lab has since observed no recurrence of the contamination.

The corrective actions were put in place by December 15, 2014. Sample results within 10 times the blank concentrations and collected prior to December 15, 2014 have been qualified as discussed in the following section.

4.2 Analytical Data QA/QC Results

All analytical data presented in this report have been validated and flagged accordingly. No major QA/QC deficiencies were found. A complete QA/QC narrative report will be included in the final project report scheduled for late 2016.

Nitrate-nitrite results for stormwater samples collected using the same field collection and laboratory preservation procedures as the composite bottle/churn splitter ("Churn_Bottle") blank collected on November 17, 2014 and before corrective action was taken on December 15, 2014 were qualified based on the following criteria:

- No additional qualification was made to sample results reported as non-detect ("U-" qualified) at the method reporting limit (RL).
- Sample results reported as detected above the RL but less than the concentration of the churn bottle blank were qualified as non-detect at the reported concentration of the sample.
- Sample results reported as detected at or above the churn bottle blank concentration but less than ten (10) times the churn bottle blank concentration were qualified as estimated ("J-" qualified).
- No qualification was made to sample results reported as detected at or above ten (10) times the concentration of the churn bottle blank.

4.3 Summary of 2014 Street Sweeping Effectiveness Monitoring

During calendar year 2014, the City was successful in implementing a study to evaluate the effectiveness of street sweeping on stormwater quality. Street use permits were obtained, monitoring equipment was installed and tested, the collection of continuous flow and rain data was initiated, and four storm events were sampled and analyzed.

The City is on schedule to meet the project sampling goals and no major problems with the study design or implementation have been encountered.

Data collected during 2015 will be presented in next year's annual report, and all project data will be analyzed and the effectiveness of street sweeping will be presented in the 2016 report.

5 ACKNOWLEDGEMENTS

Stormwater sampling is very challenging environmental field work due to, among other factors: the difficulties of forecasting weather and targeting storms; operating and maintaining automatic sampling equipment continuously within elements of a drainage system; working in traffic and confined spaces at irregular hours in inclement weather, etc. Data in reports such as this are presented in a matter-of-fact style which typically does not acknowledge that sampling and laboratory personnel are constantly required to rearrange their work and personal schedules to prioritize capturing and analyzing stormwater samples.

During 2014, the project team successfully permitted and constructed the monitoring stations, initiated collection of hydrologic data and stormwater samples, and analyzed all samples received. Many dedicated scientists collaborated effectively to get this project started successfully.

The City of Seattle would like to acknowledge the dedication and hard work of the following staff:

Herrera Environmental Consultants – field sampling and monitoring staff
John Lenth (field project manager)
Dylan Ahearn (field supervisor)
Dan Bennett, Jeremy Bunn, Alex Svendsen, George Iftner (field sampling staff)

Analytical Resources, Inc. – primary project analytical laboratory
Mark Harris (project manager) and staff

Seattle Public Utilities
Doug Hutchinson (principal investigator, study manager, report author)
Jennifer Arthur (data validator)

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Appendix A: Individual Storm Reports and Event Hydrographs

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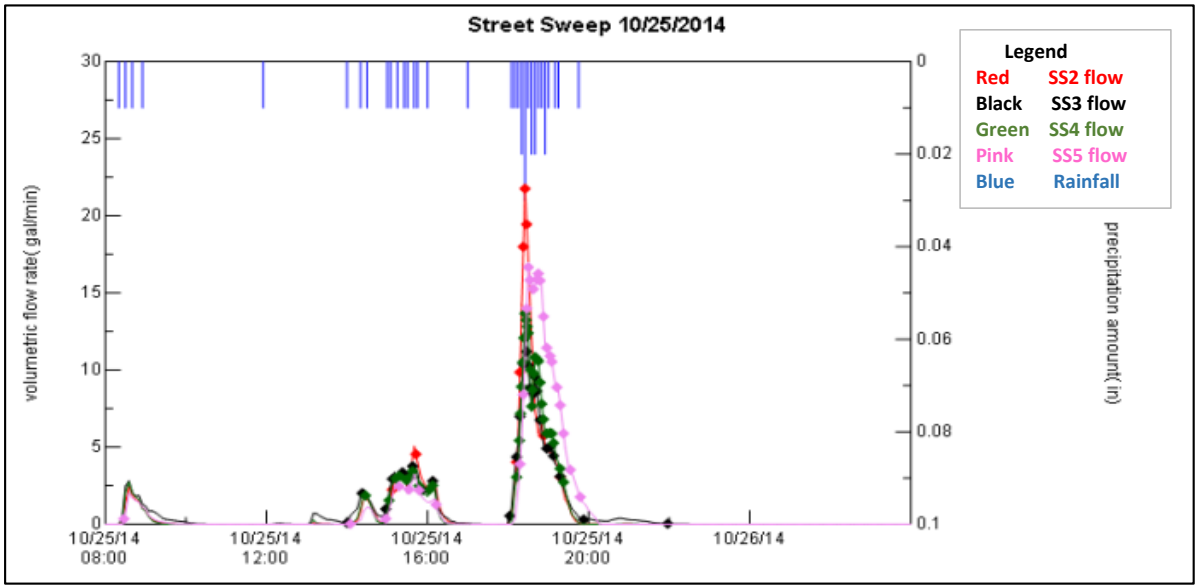
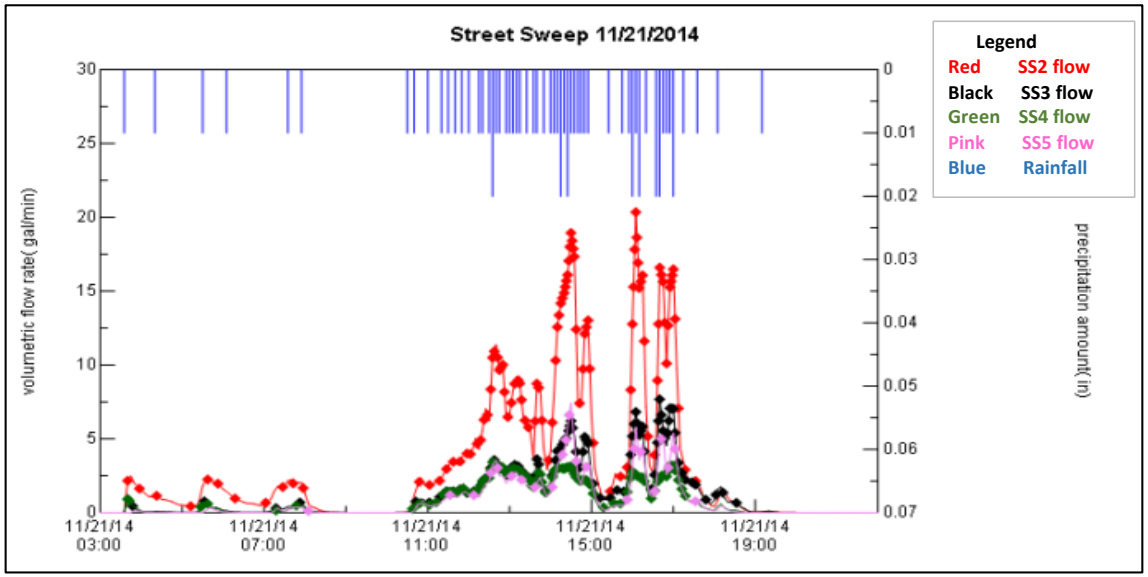
Street Sweeping Effectiveness Study
Individual Storm Report
SE-01: October 25, 2014



Flow and Sample Statistics	
Precip Start	10/25/2014 8:20
Precip Stop	10/25/2014 19:45
Storm Event Duration (hrs)	11.4
Event Rainfall (in)	0.38
Storm Event Rainfall Mean (in/hr)	0.0333
Event Rainfall Max (in/hr)	4.32
Antecedent Dry Period (hr)	10.2

Flow and Sample Statistics	SS2	SS3	SS4	SS5
Start	10/25/2014 8:25	10/25/2014 8:25	10/25/2014 8:25	10/25/2014 8:25
Stop	10/25/2014 22:10	10/26/2014 3:40	10/25/2014 21:40	10/25/2014 21:30
Flow Duration (hrs)	11.3	18.2	8.5	10.5
Event Total Flow Mean (gpm)	1.4	0.9	1.7	1.8
Event Total Flow Max (gpm)	21.8	12.1	13.7	16.7
Event Total Flow Volume (gal)	949.3	955.6	874.1	1133.2
No. Composite Sample Aliquots	10	27	36	25
First Sample Time	10/25/2014 15:07	10/25/2014 14:00	10/25/2014 14:27	10/25/2014 8:27
Last Sample Time	10/25/2014 19:17	10/25/2014 21:57	10/25/2014 19:22	10/25/2014 19:47
Sample Duration (hrs)	4.2	8.0	4.9	11.3
Event Flow Volume Sampled (%)	84.3	87.4	87.3	98.0

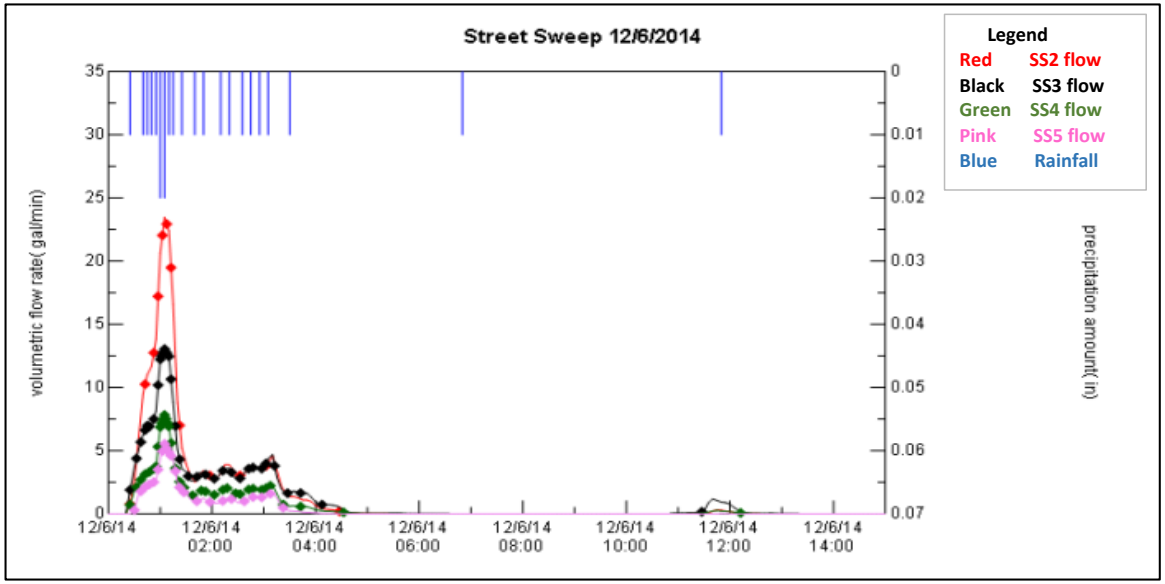
Street Sweeping Effectiveness Study
Individual Storm Report
SE-02: November 21, 2014



Flow and Sample Statistics	
Precip Start	11/21/2014 3:35
Precip Stop	11/21/2014 19:10
Storm Event Duration (hrs)	15.6
Event Rainfall (in)	0.66
Storm Event Rainfall Mean (in/hr)	0.04
Event Rainfall Max (in/hr)	2.88
Antecedent Dry Period (hr)	26.1

Flow and Sample Statistics	SS2	SS3	SS4	SS5
Start	11/21/2014 3:40	11/21/2014 3:35	11/21/2014 3:40	11/21/2014 3:45
Stop	11/21/2014 20:55	11/21/2014 21:00	11/21/2014 20:30	11/21/2014 19:25
Flow Duration (hrs)	16.3	17.5	16.0	13.3
Event Total Flow Mean (gpm)	3.3	1.2	0.9	1.1
Event Total Flow Max (gpm)	20.4	7.7	3.4	7.4
Event Total Flow Volume (gal)	3233.2	1268.3	832.2	880.4
No. Composite Sample Aliquots	100	84	100	22
First Sample Time	11/21/2014 3:40	11/21/2014 3:47	11/21/2014 3:40	11/21/2014 8:05
Last Sample Time	11/21/2014 17:32	11/21/2014 18:32	11/21/2014 17:17	11/21/2014 17:32
Sample Duration (hrs)	13.9	14.8	13.6	9.5
Event Flow Volume Sampled (%)	97.5	98.5	95.3	95.2

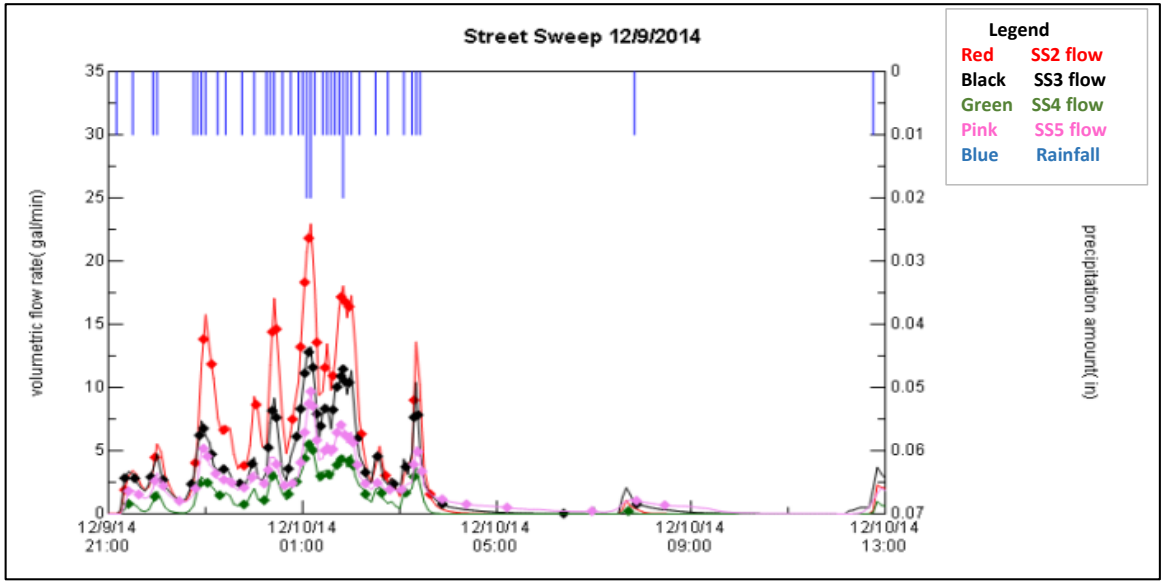
Street Sweeping Effectiveness Study
Individual Storm Report
SE-03: December 6, 2014



Flow and Sample Statistics	
Precip Start	12/6/2014 0:25
Precip Stop	12/6/2014 6:50
Storm Event Duration (hrs)	6.4
Event Rainfall (in)	0.22
Storm Event Rainfall Mean (in/hr)	0.03
Event Rainfall Max (in/hr)	2.88
Antecedent Dry Period (hr)	13.9

Flow and Sample Statistics	SS2	SS3	SS4	SS5
Start	12/6/2014 0:20	12/6/2014 0:20	12/6/2014 0:20	12/6/2014 0:25
Stop	12/6/2014 13:10	12/6/2014 14:50	12/6/2014 14:30	12/6/2014 12:30
Flow Duration (hrs)	9.0	14.6	11.0	6.1
Event Total Flow Mean (gpm)	2.3	1.1	0.8	0.9
Event Total Flow Max (gpm)	23.5	13.0	7.8	5.5
Event Total Flow Volume (gal)	1223.8	980.0	497.5	316.8
No. Composite Sample Aliquots	12	33	36	23
First Sample Time	12/6/2014 0:25	12/6/2014 0:25	12/6/2014 0:25	12/6/2014 0:30
Last Sample Time	12/6/2014 4:27	12/6/2014 11:27	12/6/2014 12:12	12/6/2014 3:22
Sample Duration (hrs)	4.0	11.0	11.8	2.9
Event Flow Volume Sampled (%)	98.5	95.1	98.8	96.6

Street Sweeping Effectiveness Study
Individual Storm Report
SE-04: December 9-10, 2014



Flow and Sample Statistics	
Precip Start	12/9/2014 21:10
Precip Stop	12/10/2014 7:50
Storm Event Duration (hrs)	10.7
Event Rainfall (in)	0.41
Storm Event Rainfall Mean (in/hr)	0.04
Event Rainfall Max (in/hr)	2.88
Antecedent Dry Period (hr)	10.0

Flow and Sample Statistics	SS2	SS3	SS4	SS5
Start	12/9/2014 21:10	12/9/2014 21:10	12/9/2014 21:15	12/9/2014 21:10
Stop	12/10/2014 12:40	12/10/2014 12:40	12/10/2014 12:40	12/10/2014 12:40
Flow Duration (hrs)	12.2	15.6	9.2	15.5
Event Total Flow Mean (gpm)	3.8	2.0	1.3	1.5
Event Total Flow Max (gpm)	22.9	13.2	5.8	9.7
Event Total Flow Volume (gal)	2793.5	1909.9	692.9	1401.3
No. Composite Sample Aliquots	24	39	24	46
First Sample Time	12/9/2014 21:20	12/9/2014 21:20	12/9/2014 21:25	12/9/2014 21:25
Last Sample Time	12/10/2014 3:37	12/10/2014 7:52	12/10/2014 7:42	12/10/2014 8:27
Sample Duration (hrs)	6.3	10.5	10.3	11.0
Event Flow Volume Sampled (%)	98.4	96.9	99.0	95.8

90b - Actions Taken Pursuant to S4F

The City, through Seattle Public Utilities (SPU), provided notifications to the Department of Ecology under S4.F of potential water quality problems that may be related to discharges from the City of Seattle's (City) municipal separate storm sewer system (MS4). The City continues to apply and implement its programs for stormwater management and to seek improvement to those programs through increased understanding of stormwater impacts and mitigation tools. Per the requirement of S4.F.3.d, Seattle is providing the status of implementation and the results of any monitoring, assessment or evaluation efforts conducted during 2014 related to the Seattle Iron and Metals S4F notification and the Lower Duwamish Waterway S4F notification..

Starting with the Annual Report submitted in March 2016, the source control activities and information related to these Adaptive Management Response Plans will be incorporated and submitted with the Annual Report that is required as a result of SPU's S4F notification for Lower Duwamish Waterway (LDW) Sediments(December 2, 2013). Ecology's response in June 2014 to the LDW Sediments S4.F notification noted that an adaptive management response under S4.F.3 is warranted "for all the City's MS4 Discharge to the LDW, include City MS4 discharges to outfalls not owned or operated by the City." Ecology's response went on to direct SPU to incorporate future adaptive management in the S. Myrtle Street drainage basin into the adaptive management plan for source control in the City-owned MS4 portions of the LDW. The plan is known as "Seattle's Source Control Plan for the Lower Duwamish Waterway." SPU has done this as a draft and looks forward to working with Ecology as they implement a broader source control strategy for controlling sources of pollutants to prevent or minimize the likelihood that in-waterway sediments will be recontaminated.

Seattle Iron & Metals S4F Report for 2014

Background

SPU has been engaged with Ecology in inspection and enforcement of City code and a state issued NPDES permit, respectively, regarding a private business, Seattle Iron & Metals Corp, 601 S. Myrtle St. Evidence indicated that the source control BMPs implemented by the business have failed to contain and eliminate the discharge of pollutants from the work site of the business into the City's MS4. The City's MS4 discharges into the Duwamish Waterway, which is part of the Lower Duwamish Waterway (LDW) Superfund site. SPU has been engaged in storm drain solid sampling from private and public catch basins in the City's MS4 as part of the LDW source control program. Results from storm drain samples collected by SPU in 2008-2009 indicated elevated PCBs in the MS4 on S. Myrtle St. that could be associated with operations at Seattle Iron & Metals. SPU conducted a business inspection at Seattle Iron & Metals on January 30, 2009 and after sampling both the MS4 in the vicinity of the property and onsite catch basins, sent a corrective action letter on July 10, 2009, requiring the following improvements:

- Eliminate trackout of sediment and dirt onto adjacent City streets.
- Cover all outside materials that have a potential to leach or spill to the Duwamish River, including scrap piles adjacent to the dock where gaps in the dock permit material and stormwater to discharge directly to the river.
- Remove scrap metal storage bins from the City right-of-way.
- Prepare a written spill response plan for the site and post at an appropriate location onsite.
- Improve onsite housekeeping by regularly 1) sweeping the lot, 2) checking catch basins for sediment accumulation and maintaining as needed, and 3) cleaning up leaks/spills when they occur and employing the spill plan when necessary.

As a result of the business inspection and source tracing sampling of the MS4, SPU jetted and cleaned all the MS4 and associated MS4 structures (inlets, catch basins and maintenance holes) to remove sediment from the City's MS4 that discharges to the LDW at S. Myrtle St.

Following the jetting and cleaning of the MS4, SPU conducted a joint inspection of Seattle Iron & Metals with EPA. During the inspection, SPU and EPA collected sediment samples from the roofs of the main office and maintenance buildings, as well as the catch basins in the Seattle Iron & Metals employee parking lot and from a City-owned catch basin in the right-of-way adjacent to Seattle Iron & Metals' property. The data collected by SPU indicated that contaminants in the City's MS4, that had accumulated after jetting and cleaning, continued to exceed source control screening levels and these contaminants might be associated with stormwater discharges from Seattle Iron & Metals. Because of this, SPU issued a Notice of Violation (NOV) to Seattle Iron & Metals on July 8th, 2010. Upon receipt of the NOV, Seattle Iron & Metals requested, and SPU agreed to a, Voluntary Compliance Agreement (VCA) on September 29th, 2010. The VCA requires Seattle Iron & Metals to implement the following source control measures:

A. Roof Drains:
   SIM agreed to survey roofs and drains for solid buildup and provide a report on this survey to SPU for review

   SIM agreed to clean roof and drains per the roof survey results. Wash water associated with this cleaning will be routed to the onsite treatment system.

   SIM agreed to design a roof drain treatment system and provide the design to SPU by November 15, 2010.

   SIM submitted the engineering plans for the roof drain treatment system to SPU on November 15, 2010. In their submittal, SIM noted that Ecology had indicated that the roof drain system as planned may not satisfy the requirements of SIM's NPDES Industrial Wastewater Discharge permit requirements. SIM requested that SPU and Ecology meet and determine which standard the roof drain system must meet; Seattle Stormwater Code (SMC 22.800-22.808) or Ecology NPDES Industrial Wastewater Discharge permit requirements.

SPU and Ecology met to discuss this issue and determined that SIM should design the roof drain system to meet the Ecology NPDES Industrial Wastewater Discharge permit requirements.

SPU referred enforcement of this provision of the VCA to Ecology on June 10, 2011 under Special Condition S5.C.7.b of the 2007 NPDES Phase I Municipal Stormwater Permit.

B. Track Out:
   - SIM will continue to implement a sweeping regiment that includes: sweeping at least once per day at the end of shift, moving employee vehicles to the employee parking lot onsite, rather than in the street, and more frequent sweeping as needed.
   -

C. Storm Drain Cleaning
   - SIM agreed to clean the catch basins located on the south side of S. Myrtle Street from the end of Myrtle St. to 7th Ave. South by November 15, 2010.
   SIM cleaned the catch basins located on the south side of S. Myrtle Street by November 15, 2010.

On April 4, 2013 SPU informed SIM via letter that the VCA had been completed.

<u>SPU Adaptive Management Response Report</u>
Ecology responded to the S4.F Notification on September 20th, 2010 that improved source control efforts by Seattle Iron & Metals will address their contribution to pollutant discharges, but Ecology expressed concern that Seattle Iron & Metals efforts by themselves may not eliminate the problem because there may be contribution to MS4 from an unpaved right-of-way on S. Myrtle St. Because of the potential for contribution to the MS4 from the unpaved right-of-way, Ecology determined that an Adaptive Management Response under condition S4.F.3 was necessary.

SPU submitted the Adaptive Management Response report to Ecology on November 22, 2010. The Adaptive Management Response report addressed the requirements detailed in S4.F.3.a and the required elements requested by Ecology in their September 20, 2010, response to the S4.F notification. Ecology acknowledged receipt of the Adaptive Management Response report on November 29, 2010. However, Ecology required additional actions and information prior to Approval. On April 4, 2011 SPU submitted a revised Adaptive Management report, which was approved on April 20, 2011 by Ecology.

Per the requirements of Special Condition S4.F.3.d, SPU is providing a summary of the status of the Adaptive Management Response report for 2014.

<u>Quarterly Inspections of Catch Basins on S. Myrtle Street</u>
During 2014, SPU monitored solids accumulation in catch basins in the vicinity of SIM. The table below details the results of this monitoring effort.

EQNUM	576148	576126	576140	576158	576162	576145	576165	943593
Location	S Myrtle St cul-de-sac, west	S Myrtle St cul-de-sac, north	north side S Myrtle St, west of SIM	south side S Myrtle St, west of SIM	south side S Myrtle St, east of SIM	S Myrtle St and Fox Ave S	south side S Myrtle St at 7th Ave S	north side S Myrtle St, east of SIM
Type	CBL	CBL	CBL	CBL	CBL	CBL	CBL	CBL
March, 2014								
% Full	4%	13%	30%	68%	19%	38%	49%	26%
June, 2014								
% Full	5%	15%	38%	73%	22%	29%	55%	36%
September, 2014								
% Full	6%	13%	42%	72%	22%	29%	55%	36%
December, 2014								
% Full	6%	15%	16%	81%	30%	28%	50%	36%

The Large Catch Basin (CBL) numbered 576158 is above the City of Seattle's maintenance standard (60% full). Maintenance of the catch basin is scheduled.

Historically CBL 576162 has accumulated solids and required cleaning more frequently than the other catch basins on S. Myrtle Street. In 2013 Seattle Iron and Metals installed two Filtera units adjacent to their driveway on S. Myrtle Street

Quarterly Inspections of Maintenance holes on S. Myrtle St.

During 2014, SPU monitored solids accumulation in the main-line of the MS4 on S. Myrtle St. The table below details the results of this monitoring effort.

EQNUM	599350	599353	599354
Location	S Myrtle St cul-de-sac	S Myrtle St at SIM	S Myrtle St at 7th Ave S
Type	MH	MH	MH
March, 2014			
% Full	0%	0%	0%
June, 2014			
% Full	0%	0%	0%
September, 2014			
% Full	0%	0%	0%
December, 2014			
% Full	0%	0%	0%

Based upon these quarterly inspections, line cleaning on S. Myrtle Street is not needed at this time.

Street Sweeping for Water Quality on S. Myrtle Street

S. Myrtle St. was swept by SDOT 37 times in 2014 as part the Street Sweeping for Water Quality Program (SS4WQ). The SS4WQ is currently focused on bi-weekly sweeping arterial streets that drain into the Municipal Storm Sewer System (MS4). S. Myrtle St. is included in

two sweeping routes (8 & 10) so that it is scheduled to be swept every week during the sweeping season[1]. The SS4WQ program will continue to sweep S. Myrtle Street during 2015.

Unpaved ROW feasibility Study

SPU and SDOT completed and submitted a feasibility study focused on controlling discharges from the unpaved right-of-way on S. Myrtle St to Ecology in 2011. The study concluded that continuation of the actions outlined in the Adaptive Management Response plan (sweeping and MS4 infrastructure inspections) was the best option given evaluation of PCB data from catch basins in the unpaved right-of-way.

SPU included two structural stormwater control projects for S. Myrtle Street in its study for development of an Integrated Plan as part of the activities for compliance with a Consent Decree for CSO control. (The Consent Decree allows SPU to delay construction of CSO projects if SPU can demonstrate that construction of stormwater projects would result in greater environmental benefit.) SPU rated and ranked stormwater projects based upon their effectiveness at providing greater environmental benefits and meeting SPU's triple bottom line (environmental, economic and social benefits). The projects on S. Myrtle Street projects did not rank high enough in the process to be proposed as a stormwater project in the Draft Integrated Plan that was submitted to Ecology in May of 2014.

Other Activities

In November 2014, SPU received a request from SPU's Source Control Specialist about illegal dumping, improper material storage and abandoned vehicles in the vicinity of SIM. A SPU Source Control inspector visited the site, reported the abandoned vehicles to the Seattle Department of Transportation and contacted Ecology to discuss SIM activities and potential non-compliance with SIM's Ecology NPDES Industrial Wastewater Discharge permit requirements. At that time SPU requested coordination on a joint inspection of the SIM site. The Ecology inspector informed SPU that he would contact SPU when Ecology was ready to inspect SIM.

In December 2014, Ecology informed SPU that Ecology had conducted an inspection of the SIM site during the last week of November and requested that SPU delay an inspection of SIM given that Ecology had just visited the site. Given this information, SPU has placed SIM on the list of businesses for inspection per the requirements of the 2013 NPDES Phase I Permit and will most likely inspect SIM during Summer 2015. SPU will coordinate with Ecology when SIM is to be inspected, so that the two agencies can conduct a joint inspection of the site.

Lower Duwamish River Water Quality and Sediments S4F Report for 2014

An S4.F notification was submitted in 2007 to notify Ecology of potential water quality problems that may be related to discharges from the City's MS4 for the Lower Duwamish

[1] Due to holidays, mechanical issues, weather and funding, the sweeping program is currently not sweeping all 52 weeks of the year.

River. Ecology determined that a report under S4.F.2.a was not necessary, with that determination conditioned on certain City actions. Ecology required the City, beginning with its Phase I Permit Annual Report for 2008, to include a summary of its stormwater management efforts in basins that discharge to the Lower Duwamish River. The City must notify Ecology if Seattle's involvement in Federal Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and associated Source Control Strategy processes changes or new information becomes available regarding phthalate recontamination in the Lower Duwamish Waterway.

An S4F notification was submitted on December 5, 2013 to notify Ecology of potential sediment quality problems that may be related to discharges from the City's MS4 for the Lower Duwamish Waterway (LDW). Ecology accepted the notification (June 4, 2014) as a general notification for all MS4 discharges to the LDW for all LDW sediment chemicals of concern (COC). The City's draft Source Control Implementation Plan (SCIP; November 2013) fulfills the City's requirement for submittal under S4.F.3.a of an expanded adaptive management response. The City is revising the SCIP, and a final draft of the SCIP is expected to be completed by March 31, 2015.

An S4F notification was submitted on September 5, 2014 to notify Ecology of potential sediment quality problems that may be related to discharges from the City's MS4 for the East Waterway (EWW) of the Duwamish Waterway The City believes that S4.F.2 applies and that the collective efforts in the LDW, including business inspections, source tracing, line cleaning, and other programs, and ongoing source control efforts to support the EWW CERCLA cleanup satisfy the Permit requirements.

The Lower Duwamish River extends from approximately the north end of Harbor Island in the City of Seattle to the upper turning basin in the City of Tukwila. This area is subject to, and is undergoing, contaminated sediment studies and cleanup actions governed by CERCLA and State Model Toxics Control Act (MTCA) cleanup laws. This area includes the East and West Waterway operable units of the Harbor Island Superfund site and the Lower Duwamish Waterway (LDW) Superfund site. The City of Seattle and others are conducting source tracing and source control activities on adjacent upland public and private properties. Source Control activities are organized and prioritized across drainage areas to minimize the possibility for recontamination of the waterway.

Regarding City stormwater management efforts in basins that discharge to the Lower Duwamish River, the City implements several source tracing programs with specific emphasis to the Lower Duwamish Waterway. These programs include:

- Business Inspections: In support of the clean-up effort, multi-media inspections are conducted, which cover stormwater pollution prevention, hazardous waste management and industrial waste management. In 2014, 166 inspections were conducted with the Lower Duwamish Waterway (LDW) and East Waterway Basins (EWW). Each business is inspected for compliance with the City's Stormwater Code and required to be brought into compliance with all relevant best management practices (BMP) for source control. The inspections resulted in 145 Corrective

Action Letters, and none of these sites were referred to Ecology for potential NPDES Industrial Stormwater permit coverage. Sixteen facilities were issued NOV's for non-compliance with the City's Stormwater Code, and no facility entered into a Voluntary Compliance Agreement.

- Stormwater Facility Inspections: While inspecting a business for source control BMPs, the flow control and/or treatment facility is also inspected. Within the LDW and EWW basins, 81 facilities were inspected for Code compliance with regard to flow control and treatment system code requirements during 2014.

- Illicit Discharge Detection and Elimination (IDDE): SPU conducts sediment sampling of onsite catch basins, right of way catch basins and drainage system mainlines to identify sources of contamination and potential illicit discharges and illicit connections. Sampling is conducted in tandem with business inspections to identify and terminate sources of pollution. Samples are analyzed for the LDW contaminants of concern, including TOC, SVOC's, TPH-Dx, select Metals, PCB's, Grain Size and occasionally site specific parameters, such as pH, additional metals, VOCs.

  The IDDE Summary Report: Duwamish Basin 2014 is attached (Attachment 1). Also included are maps, one identifying the basins screened and what remains and the other showing the illicit connections discovered in the individual basins.

- Water Quality Complaints: Inspectors respond to complaints as they are received through the water quality hotline, webpage or from agency referrals. In 2014, 82 water quality complaints were reported in the LDW and EWW basins, which include 33 IDDE trigger investigations and 9 complaints that resulted in business inspections. When a complaint is reported at a business, a full business inspection is completed. Spill Response: Spills are dispatched through the SPU Operations Response Center to on-call Spill Coordinators as they are received. In 2014, SPU responded to 41 spills within the LDW and EWW basins.

- Education and Outreach: SPU funds the Resource Venture, a conservation service for Seattle businesses. Resource Venture implements the City's Spill Kit Incentive Program, which provides free spill kits, assistance in developing spill plan and site specific technical assistance to Seattle businesses. Approximately 78 businesses in the LDW and EWW basins received spill kits, either stemming from a business inspection or through targeted outreach. Surveys conducted of spill kit recipients statistically show that businesses who participate in this program show an improved understanding of stormwater pollution prevention.

- Line Cleaning: In 2014, 57,736 linear feet on storm drainage lines were cleaned in the East Waterway and South Lander Street basin.

- Source Tracing: As part of the Lower Duwamish Waterway source control efforts, Seattle Public Utilities conducts periodic sampling of drainage infrastructure sediments across the basin. A sediment sample collected in July 2012 from a

maintenance hole sump located at the intersection of 6th Ave S and S Snoqualmie St was found to have contain high levels of PCB (45.9 ppm). A work order was created to clean the drainage system in an effort to remove the contaminant. The system was cleaned shortly after the initial sample was taken, and the location was flagged for ongoing monitoring. The station location is identified as MH18. In May 2013, another sample was taken and found to have reduced but still high PCB contamination (6.5 ppm). The drainage sub-area involved covers approximately ten blocks, and includes approximately twenty businesses. The businesses within the basin were prioritized for inspection based upon prior inspection history and site activity and risk potential.

Thirteen businesses were inspected as part of the source tracing efforts. The inspections conducted included a routine assessment of stormwater BMP compliance with a specific focus on potential PCB sources. Several locations had potential as PCB sources, due to the age of the buildings, electrical equipment on site, and site activities dealing with potentially PCB containing materials. SPU collected sample(s) at each site where feasible. The sediment samples collected were tested using the standard Duwamish parameters of PCBs, Metals, SVOCs, TOC, TPHDX, and Grain Size. Several businesses in the basin were not inspected during the source tracing, as they had been inspected within the prior year; however, samples were collected from their drainage infrastructure. Several locations were unable to be sampled due to lack of sediment in their infrastructure. In total, thirty-eight samples were collected within the sub-area (see Table 1).

The location for sample CB246-050714 is an Asian food goods distributor named Sun Foods. While business activities on the site did not appear to have a potential PCB impact, the property historically had several large concrete grain silos located in the parking area. These silos were removed years ago, but a large quantity of debris (paint chips, concrete, etc.) from their removal was scattered across the paved parking lot. Sample results from around the silo site varied greatly, with levels of PCB up to 45 ppm. A sample taken where the private drainage at the site entered the SPU system showed PCB level at “background levels”, far lower than the samples taken on the property. This business was required, using progressive enforcement, to clean their drainage infrastructure and to remove all remnant debris from the grain silos that remained on site. Upon completion, subsequent sampling found levels of PCBs in the site’s drainage system similar to background for the area.

Table 1. Sample Results

Sample Station	Sample Name	Sample Date	Result	Unit	Exceedance	Location
CB251	CB251-041614	4/16/2014	145	mg/kg	Yes	Western Waterproofing Catch Basin
CB261	CB261-051414	5/14/2014	39	mg/kg	Yes	Western Waterproofing Catch Basin
CB246	CB246-050714	5/17/2014	32	mg/kg	Yes	Sun Foods Catch Basin
CB260	CB260-051414	5/14/2014	28.9	mg/kg	Yes	Western Waterproofing Catch Basin
CB251	CB251-051414	5/14/2014	16.1	mg/kg	Yes	Western Waterproofing Catch Basin
CB247	CB247-050714	5/17/2014	14	mg/kg	Yes	Sun Foods Catch Basin
CB241	CB241-040414	4/4/2014	10	mg/kg	Yes	Sun Foods Catch Basin
CB242	CB242-040414	4/4/2014	6.2	mg/kg	Yes	Sun Foods Catch Basin
MH18	MH18-051414	5/14/2014	3.06	mg/kg	Yes	Inline Initiating Sample
CB248	CB248-050714	5/17/2014	2.9	mg/kg	Yes	Sun Foods Catch Basin
CB177	CB177-022614	2/26/2014	1.57	mg/kg	Yes	Catch Basin
CB2	CB2-031314	3/13/2014	0.97	mg/kg	No	Catch Basin
CB250	CB250-041614	4/16/2014	0.77	mg/kg	No	Catch Basin
RCB58	RCB58-040214	4/2/2014	0.68	mg/kg	No	ROW Catch Basin
RCB36	RCB36-041614	4/16/2014	0.55	mg/kg	No	ROW Catch Basin
RCB51	RCB51-051414	5/14/2014	0.5	mg/kg	No	ROW Catch Basin
CB180	CB180-022714	2/27/2014	0.45	mg/kg	No	Catch Basin
CB176	CB176-022614	2/26/2014	0.377	mg/kg	No	Catch Basin
CB231	CB231-032114	3/21/2014	0.29	mg/kg	No	Catch Basin
CB178	CB178-022614	2/26/2014	0.27	mg/kg	No	Catch Basin
CB240	CB240-040414	4/4/2014	0.27	mg/kg	No	Catch Basin
CB223	CB223-030714	3/7/2014	0.26	mg/kg	No	Catch Basin
CB226	CB226-030714	3/7/2014	0.218	mg/kg	No	Catch Basin
CB222	CB222-030714	3/7/2014	0.208	mg/kg	No	Catch Basin
CB221	CB221-030714	3/7/2014	0.191	mg/kg	No	Catch Basin
CB243	CB243-041014	4/10/2014	0.183	mg/kg	No	Catch Basin
RCB57	RCB57-040214	4/2/2014	0.167	mg/kg	No	ROW Catch Basin
CB179	CB179-022714	2/27/2014	0.166	mg/kg	No	Catch Basin
CB245	CB245-041014	4/10/2014	0.133	mg/kg	No	Catch Basin
CB224	CB224-030714	3/7/2014	0.123	mg/kg	No	Catch Basin
CB244	CB244-041014	4/10/2014	0.123	mg/kg	No	Catch Basin
RCB233	RCB233-041614	4/16/2014	0.104	mg/kg	No	ROW Catch Basin
CB220	CB220-030714	3/7/2014	0.099	mg/kg	No	Catch Basin
RCB294	RCB294-050714	5/17/2014	0.094	mg/kg	No	ROW Catch Basin
CB225	CB225-030714	3/7/2014	0.077	mg/kg	No	Catch Basin
RCB59	RCB59-040214	4/2/2014	0.076	mg/kg	No	ROW Catch Basin
CB230	CB230-032114	3/21/2014	0.038	mg/kg	No	Catch Basin
CB232	CB232-041614	4/16/2014	0.025	mg/kg	No	Catch Basin
CB227	CB227-030714	3/7/2014	0.019	mg/kg	No	Inline

The second PCB hotspot discovered during the sampling sweep was a structural waterproofing and restoration company called Western Waterproofing. A sediment sample taken from a storage yard drain at this site contained 145 ppm PCBs. The business and the property owner were contacted and informed of the contamination, and SPU staff began progressive enforcement with the site. Several samples were taken to determine the locations on site with contamination. Samples taken in the public MS4 infrastructure downstream had elevated PCB levels as well. The Toxics Clean-up Program (TCP) at Ecology was notified of the contamination and a formal request for the site to be listed was made. SPU Source Control required the business to sweep their lot, clean all catch basins, and to jet and clean the private and public drainage infrastructure from the business to MH18. The property owner hired a contractor and conducted a full cleaning of the drainage system as requested. Over 1,000 feet of MS4 was cleaned as a part of the enforcement process. Samples taken after the cleaning showed greatly reduced PCB levels, but levels still above the sediment management levels. The exact source of the PCBs at this site is unknown. The property owner is known to have conducted a PCB cleanup of the property five years prior to the discovery of PCBs in MH18, but he believes that the current PCBs are not related to this.

SPU Source Control is actively monitoring this sub-area and will be conducting follow up sampling of MH18 as sediment accumulates in the system. The basin will continue to be regularly inspected per the SPU Source Control compliance inspection frequencies, and if additional PCB contamination is found, SPU will continue source tracing efforts.