WSDOT NPDES Municipal Stormwater Permit
BMP Effectiveness Monitoring Status Report (S7.C and S7.D)
Water Years 2012-2014

October 2015

Prepared by

Stormwater and Watersheds Program
Washington State Department of Transportation

Washington State
Department of Transportation

Author and Contact Information

Washington State Department of Transportation
Stormwater and Watersheds Program
P.O. Box 47332
Olympia, WA 98504-7332
🖰 www.wsdot.wa.gov/environment/waterquality/default.htm

Stormwater Monitoring Report

BMP Effectiveness Evaluation
Water Years 2012-2014

Approved by:

I certify, under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to ensure qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for willful violations.

Signature: ______________________________ Date: ______________

Megan White, Director, WSDOT Environmental Services Office

Signatures are not available on the Internet version.
WSDOT = Washington State Department of Transportation

Acknowledgements

WSDOT would like to express special thanks to the following individuals and organizations for their comments, insights, and contributions, which were invaluable in the development of this annual monitoring report.

- AmTest Laboratories, Kirkland, WA
- Heidi Wachter, Cardno TEC, Inc., Seattle, WA
- Bryan Berkompas, Cardno TEC, Inc., Seattle, WA
- Mingta Lin, Pyron Environmental, Inc., Olympia, WA
- Laboratory Data Consultants, Carlsbad, CA

WSDOT would also like to extend special thanks and appreciation to staff in the department's region maintenance offices that assisted monitoring efforts in the field.

WSDOT Stormwater and Watersheds Program field and data management teams deserve special acknowledgement for the long hours and extra effort they devoted to data collection and developing information for this report.

Contents

List of Tables

List of Figures

1 Introduction

1.1 Permit Overview

On March 6, 2014, the Washington State Department of Ecology (Ecology) reissued a *National Pollutant Discharge Elimination System (NPDES) and State Waste Discharge Municipal Stormwater General Permit* (permit) (Ecology 2014) to the Washington State Department of Transportation (WSDOT), effective April 5, 2014 to April 5, 2019. Under Special Condition S7 of the permit, WSDOT must continue a monitoring program to evaluate the effectiveness of highway vegetated filter strip (VFS) and modified VFS best management practices (BMPs), and develop a monitoring program to evaluate BMP effectiveness at three facilities (rest areas, maintenance facilities, or ferry terminals). In addition, WSDOT must continue a monitoring program to establish baseline stormwater discharge information from its existing highway runoff characterization sites.

Under Special Conditions S7.B–D of the permit, monitoring reports are required for information collected at the department's stormwater BMP effectiveness and highway runoff monitoring sites. The following report helps satisfy these requirements and provides a summary of monitoring activities completed at VFS and modified VFS BMP effectiveness monitoring sites from October 1, 2011, through September 30, 2014 (water years 2012-2014). This report also provides status on preparations to develop BMP effectiveness monitoring programs at future facility sites. A separate report covers monitoring activities completed at WSDOT highway runoff characterization sites.

1.2 Monitoring Requirements (S7.C and S7.D)

In accordance with the permit, WSDOT must continue to evaluate the effectiveness of its highway VFS and modified VFS stormwater treatment and hydrologic management BMPs. Monitoring must continue until statistical goals in the *Technical Guidance Manual for Evaluating Emerging Stormwater Treatment Technologies: Technology Assessment Protocol – Ecology (TAPE)* (Ecology 2011) are met. If the statistical goals in TAPE cannot be met, the 2014 permit requires a maximum sampling effort of 35 sampling events.

In addition, WSDOT is developing a monitoring program to evaluate the effectiveness of stormwater treatment and hydrologic management BMPs at three maintenance facilities.

Under the previous 2009 WSDOT NPDES municipal stormwater permit (Ecology 2009a); seasonal first flush toxicity sampling was required from three BMP effluent locations in water years 2012 and 2013 (WY12 and WY13). Although toxicity testing is not a requirement under the current 2014 permit, this report includes a description of toxicity sampling requirements under the 2009-issued permit.

In accordance with the 2009-issued permit, toxicity samples were collected from the effluent of VFS and modified VFS BMPs based on the following annul average daily traffic (AADT):

- One highly urbanized site (≥ 100,000 AADT)
- One urbanized site (≤ 100,000 and ≥ 30,000 AADT)
- One rural site (≤ 30,000 AADT)

Toxicity sampling results are summarized in the *WSDOT NPDES Municipal Stormwater Permit Final Highway Runoff Characterization Report (S7.B) Water Years 2012-14* (WSDOT 2015a).

1.3 Monitoring Schedule

WSDOT submitted a *Quality Assurance Project Plan (QAPP) for WSDOT Roadway Stormwater Treatment Evaluation: Best Management Practices* (WSDOT 2011a) to Ecology for approval on September 2, 2011. Ecology sent WSDOT a QAPP approval letter on September 16, 2011. This QAPP describes the objectives of the VFS and modified VFS effectiveness monitoring programs and the procedures used to assure the quality and integrity of collected data. The QAPP also identifies project timelines and schedule.

Under the 2009 permit, WSDOT was required to fully implement the stormwater BMP effectiveness monitoring program no later than September 6, 2011. However, unanticipated challenges, including government hiring and equipment purchase freezes in effect through early summer 2011, delayed implementation of the monitoring program.

On October 20, 2011, as required under the 2009 permit, WSDOT notified Ecology that it would be unable to fully comply with monitoring program implementation timelines and that toxicity sampling would be deferred until August 2012.

In a letter to Ecology on January 13, 2012, WSDOT proposed a revised schedule and phased approach for initiating the BMP effectiveness monitoring component of its program. The phased approach provided time for the iterative learning and adaptation necessary to fully and successfully implement the program. The letter proposed sampling at one BMP monitoring site beginning May 1, 2012, with the remainder of the sites operational by June 15, 2012. Ecology concurred, and WSDOT successfully met the revised timelines and schedule.

In October 2013 and March 2014, WSDOT submitted its first BMP effectiveness monitoring reports (WSDOT 2013a and 2014a). Those reports describe the development and status of the program through the first two years of monitoring. This report updates information from the previous reports. Appendix A summarizes BMP stormwater sampling data from WY12 through WY14.

2 Monitoring Program Implementation

2.1 Site Selection Strategy

The first step in selecting BMP effectiveness evaluation sites was a thorough review of the monitoring program's objectives and permit requirements. WSDOT used the program's objectives and permit requirements to establish the number and types of sites needed for monitoring.

Guidance from the California Department of Transportation (Caltrans 2003) and the following evaluation criteria helped ensure WSDOT selected the most appropriate sites:

- Property ownership
- Site representativeness
- Personnel safety
- Site accessibility
- Equipment security
- Discharge measurement capability
- Site design limitations

2.1.1 Property Ownership

Only properties owned and operated by WSDOT were considered during the site evaluation and selection process.

2.1.2 Site Representativeness

Monitoring was required from two treatment BMPs, at no less than two sites per BMP. Screening criteria for representativeness meant study sites had to be minimally influenced by unique contributing sources of pollution. The following factors were important in assessing BMP effectiveness site locations:

- Long-Term Location – Based on information available during the site selection process, sites that had the potential to be developed or redeveloped in the near future were avoided.

- Uniform Flow – Runoff flows need to be well mixed, but not turbulent. Sites with slopes greater than 33 percent or slopes with abrupt grade changes were not selected.

- Erosion Potential – Extremely steep slopes or cut and fill areas where the land surface had not been stabilized were avoided.

- Tidal and Backwater Influences – Backwater or tidally-influenced sites were not selected.
- High Groundwater Table – A high groundwater table sometimes influences stormwater runoff if the groundwater reaches the surface and mixes with runoff. Therefore, sites where groundwater influence was suspected or confirmed were avoided.
- Illegal Discharges – Sites where there were signs of illegal discharges or dumping of wastes were not considered.
- Surrounding Land Uses – Sites where the surrounding land use heavily influenced the quality of runoff through aerial deposition were avoided.

2.1.3 Personnel Safety

For any WSDOT highway project, staff safety is a high priority. Hazards from traffic, explosive or toxic gasses, poor footing on slopes, slippery conditions, and poor visibility due to adverse weather or night work were minimized or avoided whenever possible.

The following site attributes expose monitoring field teams to potentially unsafe conditions:

- Sites located along a highway shoulder
- Sites that require traffic diversions
- Sites with poor access
- Sites close to waterways

To minimize the effect(s) of these hazards, members of the field team had to be capable of performing all tasks required for sample collection and be familiar with WSDOT's *Safety Procedures and Guidelines Manual* (WSDOT 2015b) and *Work Zone Traffic Control Guidelines* (WSDOT 2014b). Site-specific Pre-Activity Safety Plans were developed for each monitoring site to further minimize the effect of these hazards.

2.1.4 Site Accessibility

Monitoring sites were selected to provide safe and feasible access. Highway shoulder width and site visibility from the roadway had to be sufficient to allow safe access for vehicles leaving and reentering the highway.

Due to the nature of highway BMP effectiveness monitoring, locating sites away from the highway shoulder was not an option. To improve fieldwork safety, staff sought access to freeway sites from frontage roads or other off-site locations. When sample timing or site retrofit needs made off-site access impracticable, field teams followed WSDOT safety guidelines and minimized time spent working along the highway.

To make sure personnel could quickly locate and access monitoring sites, site-specific Health and Safety Plans were developed to include a description of parking and work zone safety procedures. Information in the Health and Safety Plans included lists of physical and biological hazards, standard emergency procedures, site maps, and directions.

2.1.5 Equipment Security

Selected sites had to provide adequate level space for monitoring station installation in areas that did not stand out visually. Data collection equipment was installed in locked metal enclosures on level ground or concrete platforms to reduce the risk of tampering.

Locked metal enclosures provided a secure location as well as protection from wind, rain, and snowfall. Signs applied to the outside of the enclosures identified the monitoring stations as WSDOT property, and they appear to have deterred site vandalism.

2.1.6 Discharge Measurement Capability

Monitoring sites were selected in locations that allowed discharge measurement and automatic sample collection. In order to monitor sheet flow runoff from WSDOT highways, conveyance systems were constructed to collect, direct, and measure stormwater runoff from sections of the roadway. Stormwater monitoring conveyance systems provided suitable water depth for measuring discharge and collecting stormwater samples during storm events.

2.1.7 Site Design Limitations

To meet permit requirements, BMP monitoring stations had to be established to enable collection of water quality and quantity data from influent and effluent sampling locations. The following site design limitations were considered when establishing monitoring stations for BMP effectiveness evaluation:

- The physical space needed for monitoring infrastructure and data collection platform (DCP) establishment.
- The monitoring site design needs that would provide easy access for BMP influent and effluent sampling.
- Monitoring equipment and site infrastructure that would need to be installed to enable accurate flow measurements, and reduce the amount of maintenance required.

2.2 Addressing Resource and Logistical Constraints

To maximize resources and address logistical challenges in implementing the stormwater BMP effectiveness monitoring program, WSDOT staff developed a strategy to optimize the number of monitoring locations needed to meet permit requirements. To address logistical challenges and reduce mobilization costs, monitoring study sites were localized to reduce travel time and associated costs. Whenever possible, BMP effectiveness and highway runoff characterization sites were co-located to further reduce the number of locations and total number of sites required for monitoring.

Figure 1 shows the location of the highway runoff characterization and BMP effectiveness monitoring sites across the state.

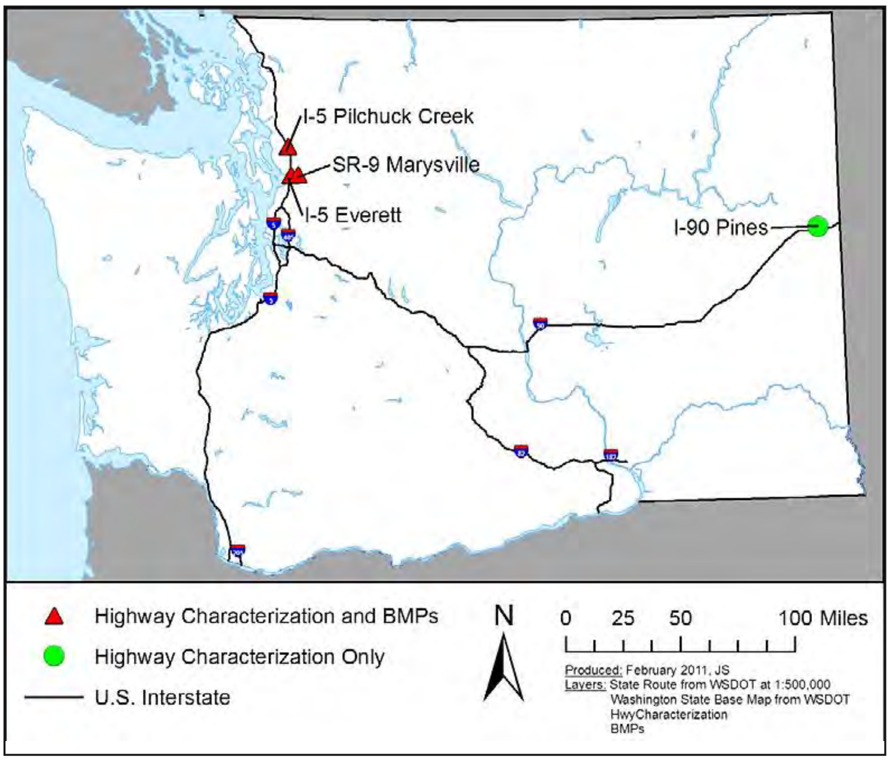


Figure 1 Highway runoff and BMP effectiveness monitoring sites.

2.3 BMP Effectiveness Monitoring Sites

WSDOT combined permit-required highway runoff characterization and BMP effectiveness monitoring sites at two locations along Interstate 5 (I-5). The following types of biofiltration BMPs were selected for monitoring:

- Vegetated filter strips (VFS)
- A compost-amended vegetated filter strip (CAVFS)
- Experimental or modified vegetated filter strips (modified VFS)

Vegetated filter strips (VFS) are sloping land areas with planted vegetation and amended soils used to treat stormwater sheet flow from roads and highways. These BMPs function by slowing runoff velocities, filtering sediment and other pollutants, and providing some biologic uptake and infiltration into underlying soils (WSDOT 2014c).

A *basic vegetated filter strip (VFS)* is a compacted roadside embankment that is hydroseeded with an established grass seed mix. A *compost-amended vegetated filter strip* (CAVFS) is a variation of the basic VFS that incorporates soil amendments (compost) into the top 12 inches of soil to enhance infiltration characteristics, increase surface roughness, and improve plant growth and cover (WSDOT 2014c). Basic VFSs and CAVFSs are preferred filter strip designs. Both BMPs are also approved for use by the Washington State Department of Ecology (Ecology) and described in detail in the *Highway Runoff Manual* (WSDOT 2014c).

The *modified vegetated filter strip* (modified *VFS*) is an experimental BMP that has not yet received approval from Ecology. The modified VFS includes a 3-inch compost blanket that is applied to the surface of the soil. In comparison to CAVFS, the modified VFS does not require heavy equipment to till compost into the top 12 inches of the soil, making the cost of installation less expensive.

Modified VFS designs reduce costs for construction because compost blanket applications require minimal ground disturbance, fewer traffic impacts, and less traffic control. In addition, compost blankets may be applied on steeper slopes, over broader areas, and as erosion control earlier in the construction process. Modified VFSs can also be applied in confined spaces, such as urban areas, where CAVFS installations are usually not possible.

The department's VFS effectiveness study sites were established along roadside embankments adjacent to the northbound lanes of I-5 (MPs 197.27 and 197.35) and southbound lanes of I-5 (MPs 210.71 and 210.85). These sites provide a paired study for comparison of a low-impact development (LID) treatment approach, as required by the permit. A CAVFS was installed along the southbound lanes of I-5 at MP 210.78 for additional comparison.

The SR 9 study site is different in that it addresses only one permit requirement—it provides a "rural" sampling location for BMP effluent toxicity testing. Highway runoff characterization is also collected from the edge of pavement at the SR 9 study site, but this data is not included in the VFS effectiveness evaluation.

Table 1 provides a list of the BMPs, with their locations, average slopes, and average grades. Figure 2 shows the BMP effectiveness study site locations.

Table 1 Highway characterization monitoring sites.

BMP Study	Location	BMP Type	Traffic Designation[1]	Average Slope (H:V)[2]	Average % Grade
I-5 VFS Study	I-5, Everett MP197.27	Basic VFS	Highly urbanized 126,000 AADT	3.70:1	27
	I-5, Everett MP 197.35[3]	Modified VFS		3.85:1	26
	I-5 Pilchuck MP 210.71	Basic VFS	Urbanized 76,000 AADT	4.00:1	25
	1-5 Pilchuck MP 210.78	CAVFS		3.85:1[4]	26
	I-5 Pilchuck MP 210.85[3]	Modified VFS		3.70:1	26
SR 9 Rural VFS Study	SR9 Marysville MP 17.92[3]	VFS	Rural 20,000 AADT	4.00:1	25

[1] Annual average daily traffic (AADT). AADT values were obtained from the WSDOT "Annual Traffic Report" (WSDOT 2014d).

[2] Horizontal: Vertical (H:V)

[3] Toxicity samples collected from influent and effluent sampling points.

[4] Estimated slope.

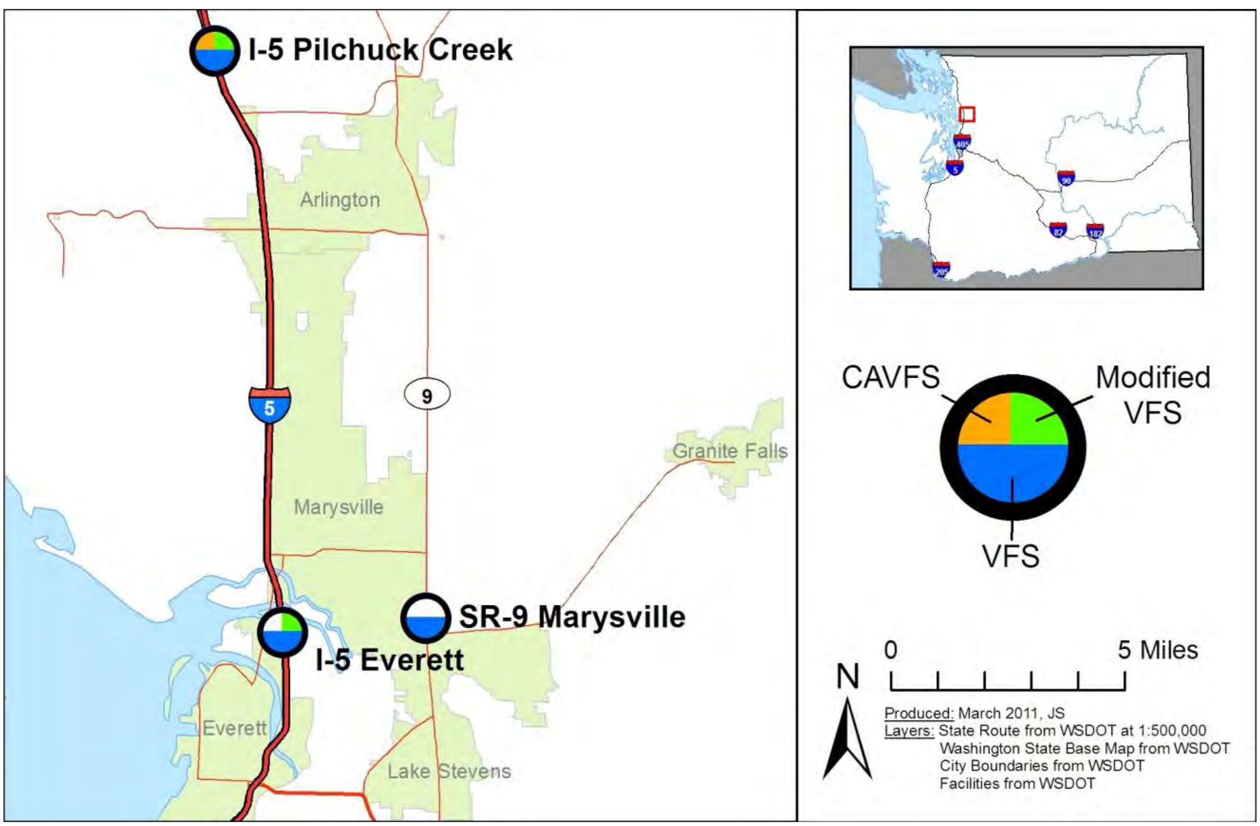


Figure 2 BMP locations and types for stormwater monitoring.

2.4 Highway Runoff Characterization and BMP Effectiveness Study Design

The I-5 BMP effectiveness studies evaluate and compare highway treatment performance of basic VFS, modified compost-blanket VFS, and CAVFS designs. Stormwater collectors (4-inch-diameter high-density polyethylene pipes) are positioned along each VFS at the edge of pavement, and at 6.6 feet (2 meters) and 13.1 feet (4 meters) downslope from the pavement edge. Each collector is notched along its length to allow free flow of surface water into the pipes, but prevent rainfall from contributing to discharge volumes. WSDOT staff will evaluate and compare treatment performance from the pavement edge (influent samples) and downslope collection points (effluent samples).

As part of the study's sampling design, WSDOT staff established effluent sample collection points 6.6 feet downslope, because highways in highly urbanized areas often have limited space to locate stormwater treatment along the road shoulder. Some studies suggest much of the flow reduction and water quality treatment performance of VFSs may occur close to the edge of pavement (Ebihara et al., 2009; Kaighn and Yu 1996).

The effluent collection points located 13.1 feet downslope are included in this study to further evaluate the treatment performance of the BMPs on the road shoulder embankment. Sampling from the 6.6- and 13.1-foot locations provides an opportunity to assess to what extent, if any, performance is enhanced by increasing the distance.

Aerial views of the I-5 Everett and I-5 Pilchuck Creek BMP effectiveness monitoring study sites are shown in Figures 3 and 4.

Figure 5 shows an aerial view of the SR 9 Marysville monitoring study site. This site provides a monitoring location for rural highway runoff and BMP effluent toxicity sampling. Thus, this site is not part of the BMP effectiveness evaluation.

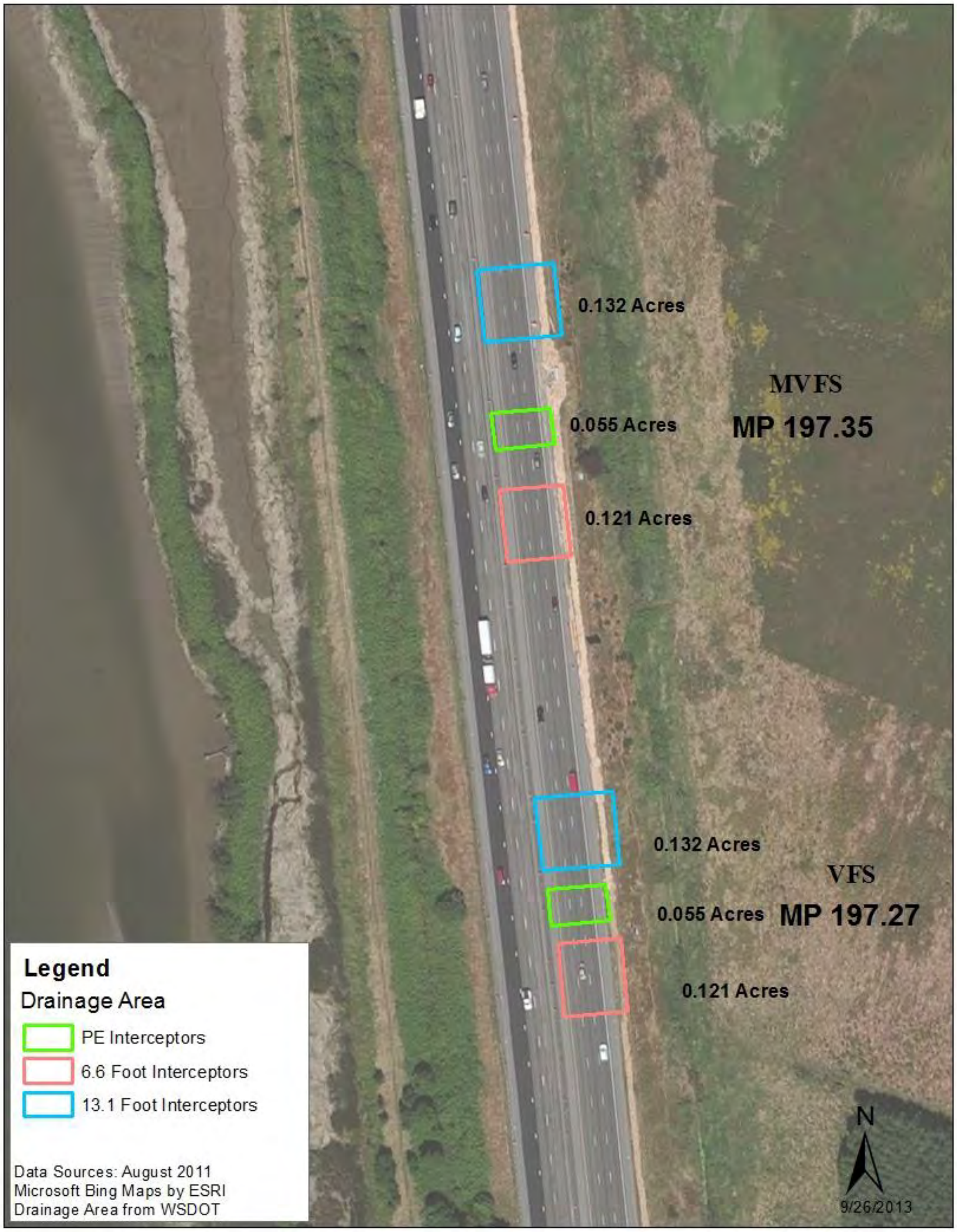


Figure 3 I-5 Everett BMP effectiveness monitoring study sites.

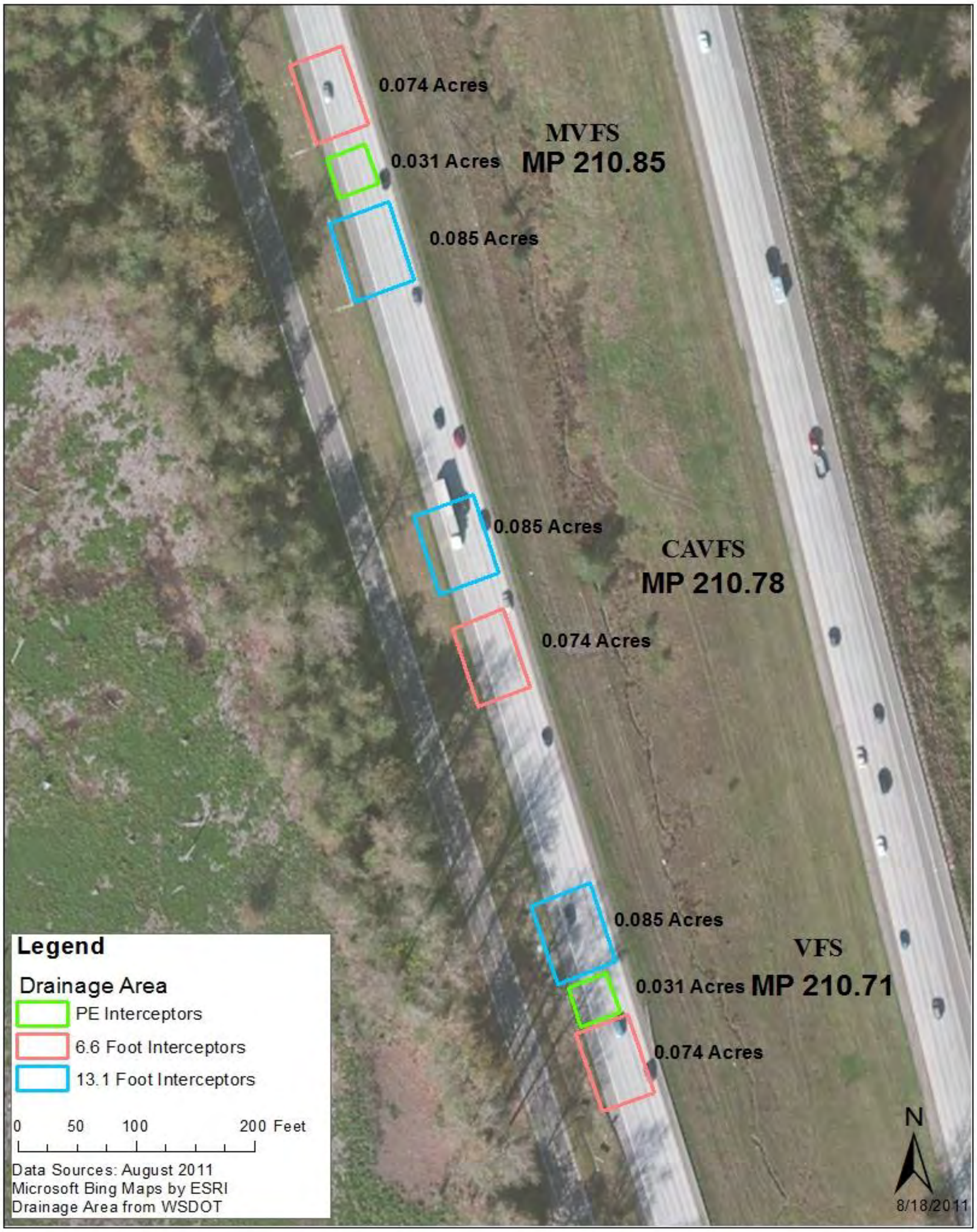


Figure 4 I-5 Pilchuck Creek BMP effectiveness monitoring study sites.

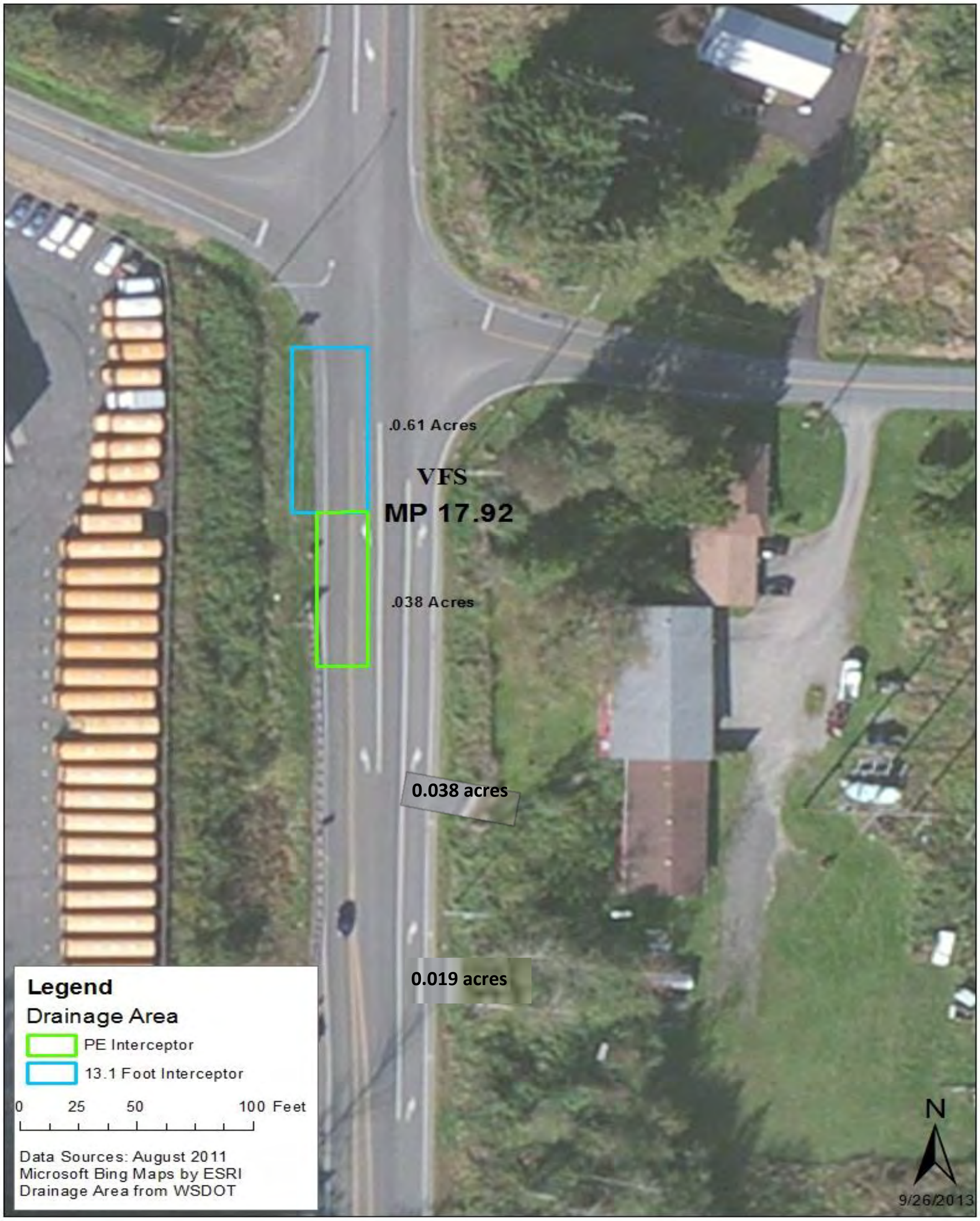


Figure 5 SR 9 Marysville highway and BMP effluent monitoring site.

2.4.1 Time of Concentration

WSDOT staff programmed automatic flow-weighted composite samplers to begin sampling as early in a storm runoff event as feasible, and to continue sampling past the longest estimated time of concentration. For highway runoff characterization and BMP effectiveness monitoring sites, time of concentration is the time necessary for surface runoff to reach the edge of pavement collector from the hydraulically most distant point of each drainage area. Time of concentration estimates provide a baseline to ensure pacing of the monitoring equipment is set to obtain a representative sample and to evaluate whether contributions from the entire basin are represented.

Each monitoring site's times of concentration were based on a range of rainfall depths typical in Washington State. Flow lengths were estimated from hydraulics reports, field estimates, as-built drawings, aerial photography, or WSDOT's GIS Workbench (WSDOT 2011b). Drainage areas were calculated by multiplying the flow length by the length of the pavement edge collectors.

For further information regarding each site's time of concentration, refer to the *Quality Assurance Project Plan for WSDOT Roadway Stormwater Treatment Evaluation: Best Management Practices* (WSDOT 2011a).

2.4.2 Monitoring Site Set-Up and Sampling Design Details

WSDOT staff installed high-density polyethylene (HDPE) pipe collectors along the pavement at the I-5 Everett, I-5 Pilchuck Creek, and SR 9 Marysville highway runoff characterization and BMP effectiveness monitoring sites. Each collector is notched along its length to allow free flow of surface water into the pipes, but prevent rainfall from contributing to discharge volumes.

Staff buried pipes and mortared them to the edge of the pavement. Collector pipes slope slightly downhill to promote directional flow for measurement. Figure 6 shows the pavement edge collector pipe and highway shoulder in cross section.

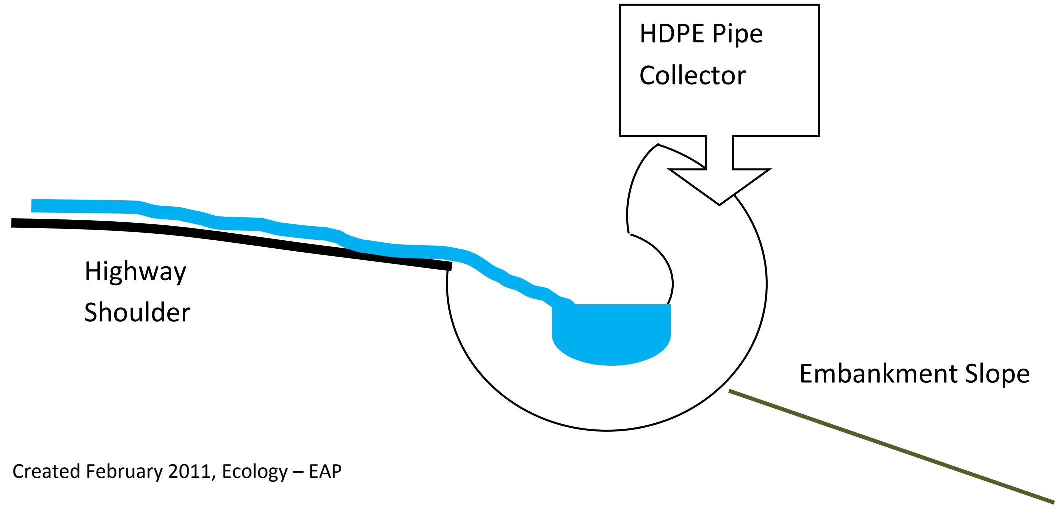


Figure 6 Cross section of the pavement edge collector.

Collector pipes installed at 6.6 feet and 13.1 feet along the VFS embankments were recessed into the surface of the soil and positioned to collect surface runoff flowing through the BMP from the edge of pavement. Similar to the pavement edge collector, the 6.6- and 13.1-foot collectors were sloped slightly to promote directional flow for measurement. Figure 7 shows the downslope collector in cross section.

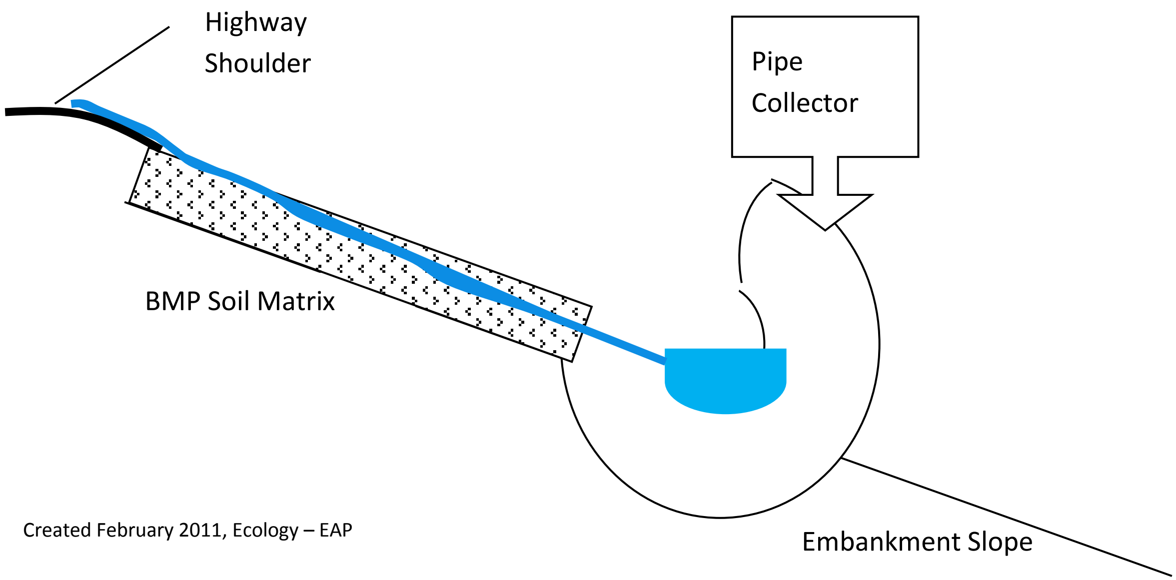


Figure 7 Cross section of the downslope collector.

Figure 8 shows a generalized drawing of a combined highway runoff and BMP effectiveness monitoring site. The diagram illustrates how collectors were positioned to collect sheet flow runoff from the surface of the highway and downslope through the VFS. The data collection platform (DCP) with rain gage, solar panel, transmitting antennae, and enclosures was installed at the lower end of the roadside embankment.

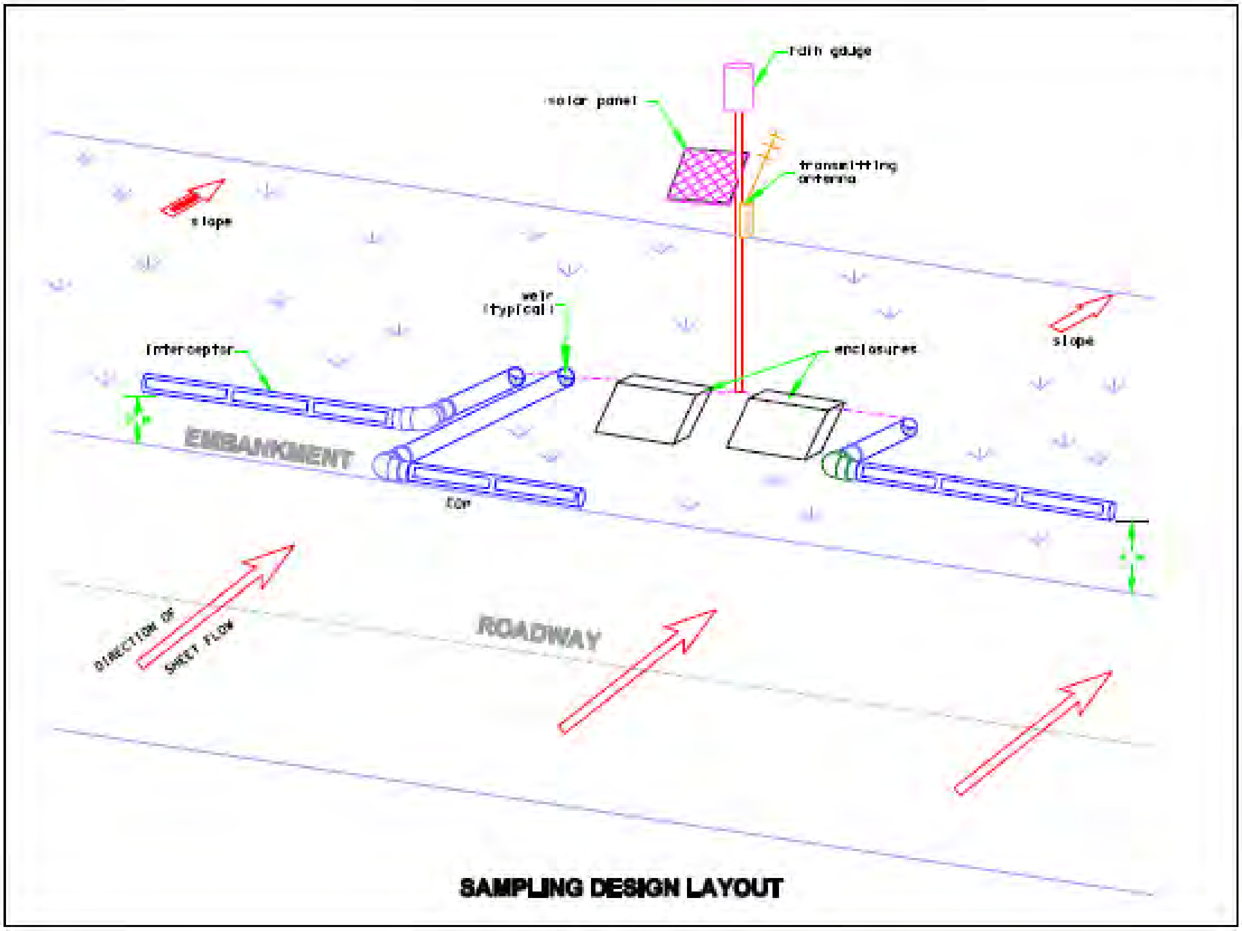


Figure 8 Generalized sampling design.

Figures 9, 10, and 11 depict the I-5 Everett, I-5 Pilchuck Creek, and SR 9 Marysville monitoring sites. Since the SR 9 Marysville monitoring site is not part of the BMP effectiveness evaluation, only one collector was installed along the slope of the VFS embankment.

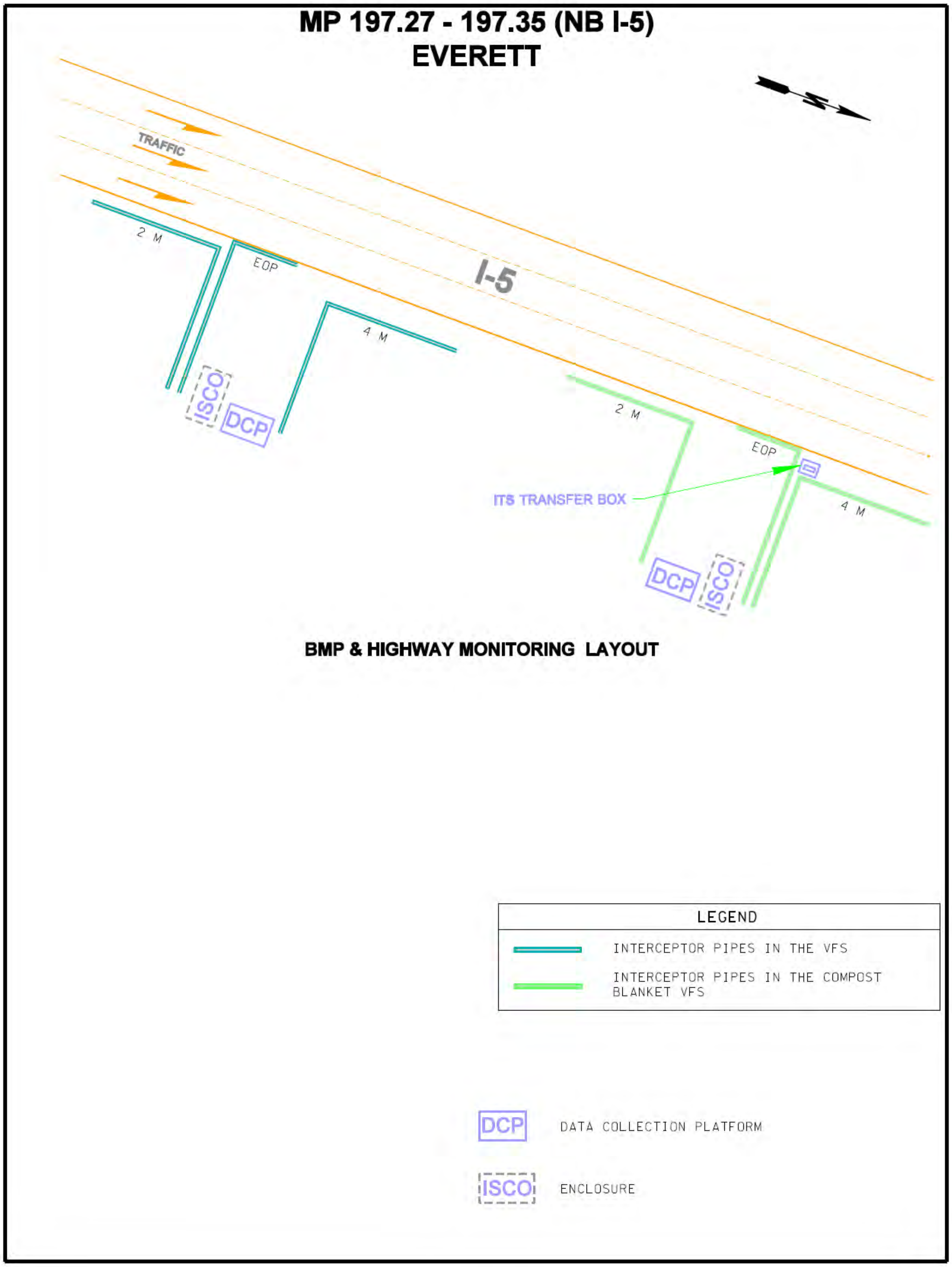


Figure 9 I-5 Everett Highway and BMP effectiveness monitoring site.

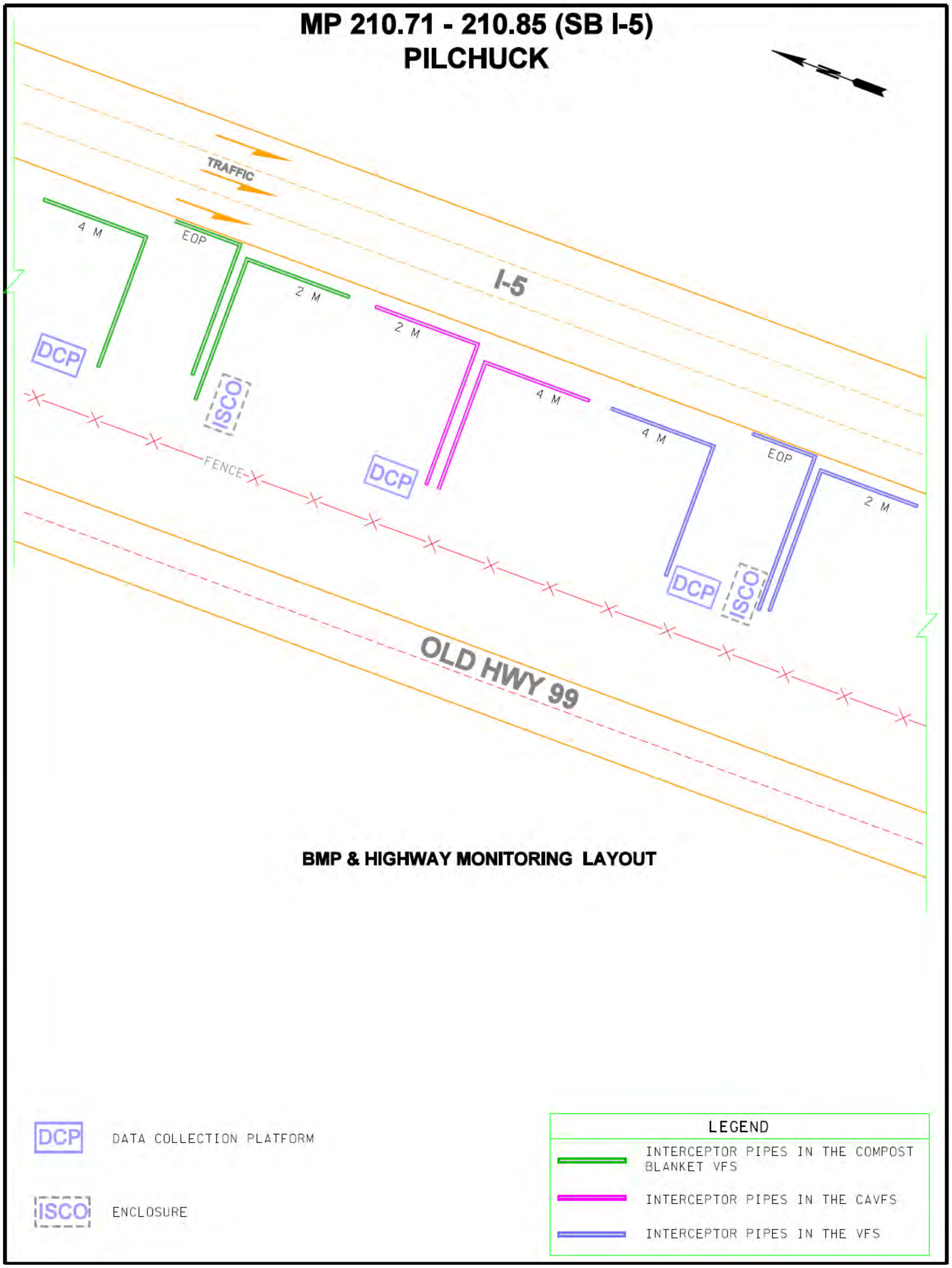


Figure 10 I-5 Pilchuck Creek Highway and BMP effectiveness monitoring site.

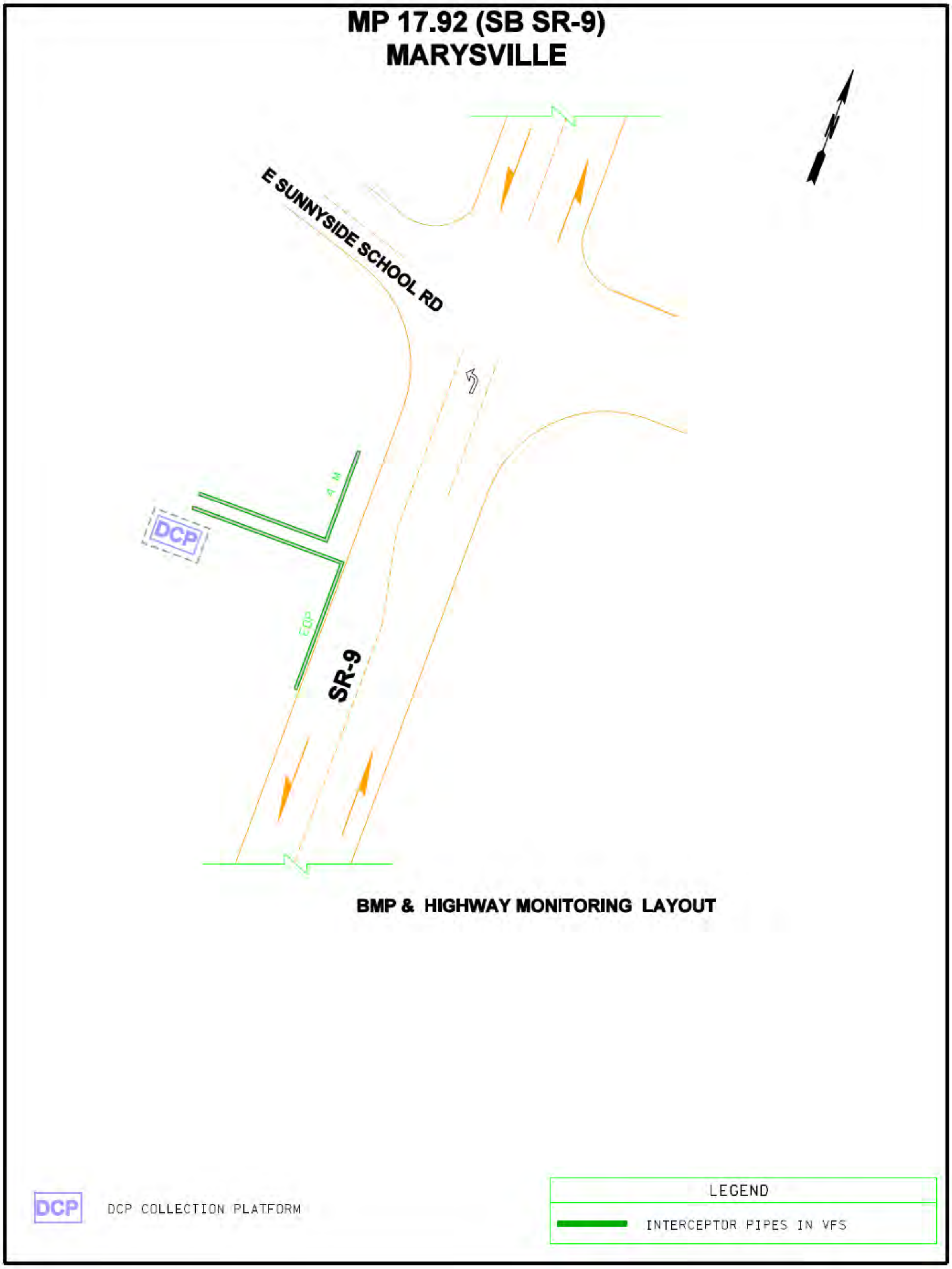


Figure 11 SR 9 Marysville monitoring site.

3 Sampling and Monitoring Procedures

3.1 Monitoring Stations

Monitoring stations at best management practice (BMP) effectiveness monitoring sites typically include an equipment enclosure with lock, Global Positioning System (GPS), antenna, solar panel, and rain gage. The antenna, solar panel, and rain gage are attached to a mounting pole that is installed along the side of the equipment enclosure.

The equipment enclosure houses a data logger; refrigerated automatic sampler; sample tubing; an analog module to run a thermistor (temperature sensor); stage measuring devices, including a depth pressure transducer (PT) and compact bubble sensor (CBS); and a 12-volt battery. Sample tubing runs from the automatic sampler through protective conduit located outside the enclosure to the designated sampling point. The thermistor and PT wires as well as the CBS line run through conduit to a stilling well where stage and temperature are recorded. The locked enclosure provides a secure location for equipment as well as protection from wind, rain, and snowfall.

3.1.1 Precipitation Measurement

At each monitoring station, WSDOT installed a pole-mounted tipping bucket rain gage to accurately capture on-site rainfall measurements. Rain gages were leveled and installed in a secure location where no trees, buildings, overpasses, or other objects obstructed or diverted precipitation prior to entering the rain gage. WSDOT used National Weather Service criteria as guidance for rain gage installation (NWS 2010).

WSDOT collected rain gage data every 15 minutes and stored it in the data logger's memory. WSDOT used these data, transmitted telemetrically to a WSDOT database, to track and record site-specific precipitation measurements.

3.1.2 Temperature Measurement

Water temperature measurements are recorded to fulfill permit requirements and monitor freezing conditions at each of the BMP effectiveness monitoring sites. Sensors were installed at each of the sampling points for every station to record temperature measurements continuously. These data are recorded by the data logger every 15 minutes and transmitted hourly to WSDOT's database. If temperatures approach freezing, the data logger discontinues sample collection.

Sample event tables in Appendix B provide minimum and maximum temperature values recorded during sampling events.

3.2 Weather Tracking

WSDOT uses weather information—from satellite imagery, prediction models, the National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS), and private forecasters—to forecast potentially qualifying storm events on a daily basis. As candidate storms approach, radar observations and hourly reports from land-based weather stations help track and evaluate storm potential. Staff use telemetered data transmitted from individual monitoring stations to track the progress of a storm event and the beginning of runoff. The stormwater monitoring team uses this information to direct field team deployments for sample collection.

To qualify, storms have to meet rainfall depth and antecedent dry period criteria. Table 2 lists storm event criteria in effect for BMP effectiveness monitoring sites through WY14.

Table 2 Storm event criteria for BMP effectiveness monitoring.

Criteria	BMP Effectiveness Monitoring	BMP Effluent First-Flush Toxicity Monitoring
Monitoring Period	Year round	Annual (Aug 1 – Oct 31)
Rainfall Depth	0.15" minimum; no fixed maximum	Not specified
Rainfall Duration	1-hour minimum; no fixed maximum	Not specified
Antecedent Dry Period	< 0.04" rain in the previous 6 hours	< 0.04" rain in the previous week (168 hours)
Inter-Event Dry Period	Not specified	Not specified
Minimum Intensity	Lowest intensity that qualifies as a rainfall event[1]	Not specified

[1] Average intensities should exceed 0.03 inches per hour for at least half the sampled storms.

A one-week antecedent dry period was required prior to seasonal first flush toxicity sampling at the three BMP effluent monitoring locations in western Washington. The first flush sampling event had to occur in August or September. If unsuccessful in August or September, a first flush toxicity sample was collected in October, irrespective of the antecedent dry period.

To make the best use of limited resources, WSDOT combined western Washington highway runoff characterization and BMP effectiveness monitoring sites. Where storm criteria for highway characterization and BMP effectiveness monitoring differed, the most inclusive storm criteria were followed. For example, the antecedent dry period criteria for highway monitoring required more time between storms. In this case, antecedent dry period criteria for highways were followed for both highway runoff characterization and BMP effectiveness monitoring sites.

3.3 Sampling Parameters

Sampling requirements listed in S7.C.4 and S7.E.5 of the 2009 permit specify parameters for seasonal first flush toxicity testing and BMP effectiveness monitoring, respectively. These parameters are listed in Table 3, in the priority order of analysis. If insufficient sample volume existed, the department processed samples for the highest priority pollutants in accordance with laboratory volume requirements.

Table 3 Sampling water quality parameters listed in order of priority.

BMPs	Toxicity
TSS	Cu, Zn, Cd, Pb (total)
PSD	Cu, Zn, Cd, Pb (dissolved)
pH	triclopyr (not applied)[1]
total phosphorus	2, 4-D (not applied)
orthophosphate	clopyralid (not applied)
hardness	diuron (not applied)
Cu, Zn (total)	dichlobenil (not applied)
Cu, Zn (dissolved)	picloram (not applied)
	glyphosate
	TSS
	chlorides
	Hardness[2]
	MBAS
	PAHs
	phthalates
	TPH-Dx and TPH-Gx

[1] Herbicides were only required for monitoring if applied in the site drainage area.

[2] Hardness was not a permit-required parameter. It is included in this list by Ecology recommendation and because of the effect of hardness on the bioavailability of metals in solution.

WSDOT was required to sample and analyze herbicides at toxicity monitoring sites where listed herbicides were applied in the monitoring site vicinity. The stormwater monitoring team annually checked herbicide applications for all monitoring site drainage areas.

WSDOT staff used these annual reviews to update the list of herbicides monitored at each site. On the west side of the state, only glyphosate was applied in or near the monitoring study sites.

The permit also required sediment sampling for BMP effectiveness monitoring sites. However, the BMPs the department selected for monitoring (i.e., basic VFS, CAVFS, and modified VFS) are infiltration-type BMPs that use grass and soil, or compost, grass, and soil, as filtration media. Sediment samples from these BMPs were not collected since there is no technique to ensure collected sediment would represent only stormwater-carried sediments and not components of the soil or compost. Ecology approved this deviation from permit requirements during the QAPP approval process.

3.4 Sampling Methods

BMP effectiveness monitoring sites were established to measure stormwater quality and quantity. Table 4 lists parameter categories, sampling frequency, and methods.

Table 4 Sampling methods overview.

Parameter Category	Sampling Frequency	Sampling Method	Telemetered Data?
Rainfall	Continuous, year round	Rain gage	yes
Stage (flow)	Continuous, year round	Stage measuring device	yes
Temperature	Continuous, year round	In situ probe	yes
Chemical, except TPH	Discrete storm events	Autosampler	no
TPH	Discrete storm events	Grab sample	no

For further information regarding field work activities, sample processing details, and analytical requirements for BMP effectiveness evaluation and toxicity water quality sampling, see the *Quality Assurance Project Plan for WSDOT Roadway Stormwater Treatment Evaluation: Best Management Practices* (WSDOT 2011a).

3.5 Station Maintenance

WSDOT staff provided regular station maintenance every six to eight weeks or after sampled storm events. Monitoring staff performed a visual inspection of the monitoring site to identify possible damage to equipment and any new or unsafe conditions. Staff checked equipment enclosures for signs of tampering or forced entry. Unusual odors and the presence of water or debris were noted for the record and addressed through further investigation and site retrofit or rehabilitation, when necessary.

Staff inspected and cleaned outlet pipes, sampling basins, and the conveyance system to ensure the monitoring station was in good condition prior to a sampled storm event. Field staff followed this inspection and cleaning procedure to ensure representative data collected from the system was unaffected by accumulated debris and sensor drift.

Following the *Standard Operating Procedure for Equipment Maintenance and Cleaning* (WSDOT 2011c), field staff conducted station checks that included equipment inventory, inspections, testing, and replacement of worn or missing parts. Monitoring staff inspected internal wires and cables to evaluate wear and ensure cable connections to the data logger were in good condition. Station antennae declinations and bearings were checked, and solar panels were cleaned to remove accumulated debris. When servicing or calibration of scientific equipment at monitoring stations was required, trained technicians followed manufacturers' specifications and conducted servicing and calibration of equipment on site or in a controlled environment, as appropriate.

3.6 Equipment Decontamination

Unless certified as precleaned from the equipment source, WSDOT staff or a contract lab decontaminated pump tubing, churners, sample containers, filters, or other materials that came into contact with sampled stormwater prior to each use. Intake tubing was cleaned prior to installation and changed once each year.

For more detailed descriptions of decontamination procedures, see the *Quality Assurance Project Plan for WSDOT Roadway Stormwater Treatment Evaluation: Best Management Practices* (WSDOT 2011a).

3.7 Staff Roles and Responsibilities

WSDOT used Stormwater and Watersheds Program staff in the Headquarters (HQ) Environmental Services Office (ESO) and staff from the department’s region offices to implement its monitoring program. Eight staff from the HQ ESO played key roles in the stormwater monitoring strategy. Staff from a field office in Mount Vernon supported ESO efforts on a part-time basis and participated in stormwater monitoring at different levels.

This page intentionally left blank

4 Quality Assurance and Quality Control

The *Quality Assurance Project Plan for WSDOT Roadway Stormwater Treatment Evaluation: Best Management Practices* (WSDOT 2011a) includes a comprehensive description of quality assurance and quality control activities.

WSDOT implemented quality control (QC) procedures through all phases of data collection and analyses. Quality control procedures included field collection and laboratory processing for all permit-required samples. Additionally, verification and validation of both field- and laboratory-generated data occurred as part of data management activities. The quality of raw, unprocessed, and processed data was subject to review and management, including the following areas of work:

1. Field quality control
   - Implementation of standard operating procedures
   - Field instrument inspection, calibration, and maintenance
   - Site water conveyance systems inspection and maintenance
   - Collection of field notes and maintenance documentation
   - Collection of composite field duplicate/grab field replicate samples
   - Collection of field equipment blanks
2. Laboratory quality control
   - Laboratory instrument maintenance and calibration
   - Analysis of laboratory duplicate/split samples
   - Analysis of laboratory matrix spike and matrix spike duplicate samples
   - Analysis of laboratory blanks and standards
3. Data management
   - Hydrology and precipitation data verification
   - Field data verification
   - Correction of data gaps, anomalies, and use qualification for precipitation and hydrology data
   - Laboratory data verification and validation
   - Self-assessment and audit of project processes

WSDOT used third-party data validators to perform validation on the analytical data as part of data management. Additionally, WSDOT's data quality consultant prepared an analytical data quality assessment report (Appendix C) for WSDOT. This report provides an overview of the analytical scheme, data verification and validation procedures, and the quality of analytical data collected. The quality of data was assessed and discussed in terms of measurement quality objectives (MQOs) (i.e., precision, accuracy, representativeness, comparability, sensitivity, and completeness). The analytical data quality assessment report includes data collected from all WSDOT monitoring sites, including the department's highway runoff characterization and best management practice (BMP) effectiveness monitoring sites.

5 Monitoring Results

5.1 BMP Monitoring

WSDOT collected water quality, hydrological, and meteorological data at vegetated filter strip (VFS) best management practice (BMP) effectiveness monitoring sites in water years 2012-2014. Appendix A summarizes BMP stormwater sampling data, and Appendix B presents monitoring storm reports. Appendix C provides a data quality assessment report.

5.2 Sampling Logistics and Challenges

WSDOT field staff used storm event criteria and guidelines detailed in WSDOT's NPDES municipal stormwater permit and Ecology's Technical Assessment Protocol (TAPE) (Ecology 2011) to deploy for forecast qualifying storm events. Collecting BMP stormwater data was challenging due to the dynamic and unpredictable nature of storm forecasts and rainfall. Section 3.2 details the storm event criteria used to determine team deployments.

Sample collection requirements included a minimum of 10 equal-volume samples (aliquots)[1] collected during each sampled storm event and combined to create a single composite sample. For storm events lasting less than 24 hours, samples had to be collected for 75 percent of the storm hydrograph (by volume). For storm events lasting more than 24 hours, samples had to be collected for at least 75 percent of the first 24 hours of the storm (Ecology 2011).

Frequently, storm event patterns that meet one permit requirement contribute to not meeting another requirement. For example:

- WSDOT uses industry standard remote autosamplers that collect sample aliquots based on the amount of stormwater volume flowing out of the respective BMPs. WSDOT autosamplers can only hold a certain amount of stormwater, 9.4 liters (2.5 gallons), which limits the number of aliquots that can be collected during a storm. Autosamplers are programmed based on forecast rainfall amounts and predicted volume of stormwater runoff. However, actual storm event rainfall and runoff volume often differ from forecast amounts. With an event that produces greater than predicted amounts of runoff, autosamplers may fill prematurely, limiting their ability to capture 75 percent of a storm. Conversely, events that produce less than the predicted amount may fail to meet the 10 aliquot requirement set by TAPE and the permit.

[1] Seven to nine aliquots may be accepted; however, the Technical Evaluation Report (TER) must include an explanation and justification as to why less than 10 aliquots were collected.

- Rain-to-runoff patterns often differ based on many contributing variables. A storm event that occurs in close proximity to another event may display different surface runoff characteristics than a storm event occurring after weeks of no precipitation. In addition, a high-intensity, short-duration rain event will display different stormwater runoff dynamics than a low-intensity storm occurring over a long duration.

Despite the challenges in collecting qualified storm event samples, WSDOT successfully collected multiple events at all of the BMP sites. Field observations and data regarding site hydrology and soils (e.g., soil saturation levels, structure, and composition) conducted during the year improved sampling success by improving the predictability of runoff occurring from a forecast storm event. WSDOT anticipates using these site feedback loops, paired with consistent improvements in the understanding of the science of stormwater, to further improve sampling efficacy.

5.3 Stormwater Sample Collection

WSDOT is in the process of collecting enough stormwater samples to meet the permit and Ecology's Technology Assessment Protocol (TAPE) requirements. TAPE guidelines specify the number of samples, sampling procedures, and type of data assessment needed to meet the required statistical goals for BMP approval. When sampling and statistical goals are met, a Technical Evaluation Report (TER) will be compiled and submitted to Ecology. The TER will present the results and discussion of WSDOT's VFS BMP performance.

Appendix A and B detail all storm event sampling dates and parameter sample values. The numbers of storm events sampled in WY12-WY14 at WSDOT's 14 BMP sample collection points are presented below:

I-5 Everett, MP 197.27, VFS:

- Fourteen events collected at site pavement edge (PE) (Everett 01)
- Eight events collected 6.6 feet (2 meters) from PE (Everett 02)
- Ten events collected 13.1 feet (4 meters) from PE (Everett 03)

I-5 Everett, MP 197.35, Modified VFS

- Sixteen events collected at site PE (Everett 04)
- Nine events collected 6.6 feet from PE (Everett 05)
- Five events collected 13.1 feet from PE (Everett 06)

I-5 Pilchuck, MP 210.71, VFS

- Seventeen events collected at site PE (Pilchuck 01)
- Five events collected 6.6 feet from PE (Pilchuck 02)
- Twelve events collected 13.1 feet from PE (Pilchuck 03)

I-5 Pilchuck, MP 210.78, Compost-Amended VFS (CAVFS)

- Four events collected 6.6 feet from PE (Pilchuck 04)
- Ten events collected 13.1 feet from PE (Pilchuck 05)

I-5 Pilchuck, MP 210.85, Modified VFS

- Fifteen events collected at site PE (Pilchuck 06)
- Seven events collected 6.6 feet from PE (Pilchuck 07)
- Seven events collected 13.1 feet from PE (Pilchuck 08)

5.4 Monitoring Trends

A primary goal of WSDOT's BMP effectiveness monitoring is to compare sample parameter and surface runoff values between influent and effluent points of each VFS BMP. TAPE currently requires a minimum of 12 paired influent and effluent samples. A minimum two years of monitoring is generally recommended. WSDOT is currently analyzing samples for statistical relevance to TAPE goals, though a general trend of flow reduction has been observed at most of WSDOT's VFS and modified VFS BMPs.

5.5 Toxicity Sampling

WSDOT field staff collected toxicity monitoring stormwater samples in September and October in WY12 and WY13. Toxicity monitoring requirements involved both highway runoff characterization and BMP effectiveness monitoring sites. Results from both years show no significant toxic effect and a high survival rate for *Hyalella azteca*, a small aquatic crustacean and the target species for toxicity testing. Data summaries are presented in the *WSDOT NPDES Municipal Stormwater Permit Highway Runoff Monitoring Reports* (WSDOT 2013a, 2014a, and 2015). Some VFS storm event data were collected during toxicity monitoring and will be added to the data presentation and analyses in the final VFS BMP effectiveness monitoring report.

5.6 Changes to the Monitoring Program

WSDOT staff evaluated the effectiveness of monitoring practices in WY13-WY14 and recorded their observations. These observations helped refine existing monitoring methods and procedures. These changes should improve the accuracy and efficiency of data collection, and make more effective use of limited staff time and resources.

The following changes were made in WY13 and WY14:

1. **Frequency of site storm event preparation:** Staff originally prepared sites for sampling immediately before storm events, with the intention of calibrating the systems as close to the start of the sampling events as possible. Unfortunately, short notice prior to many sampled storm events created rushed and potentially inadequate site preparations, occasionally resulting in missed or rejected storm data. Switching storm preparation to a two-week cycle allowed for more thorough sampling conveyance system cleanout and equipment calibration, and better data quality.
2. **Monitoring station maintenance staff:** In WY12 and WY13, the field team lacked sufficient staff to manage the significant site maintenance workload. Most field team time was devoted to obtaining samples, with little time left for maintaining and improving the structural components of the sampling conveyance systems and equipment. Late in WY13, WSDOT hired a staff member whose primary duty was site maintenance. This staff member was able to implement many infrastructure efficiencies in addition to maintaining system operations on a tighter schedule.
3. **WSDOT region staff support:** Staff support from region maintenance and environmental offices was critically important during the initial phase of monitoring. However, with recent reductions in work force, most region staff had limited availability for stormwater monitoring due to other work priorities. Shifting the majority of region staff responsibilities to stormwater monitoring staff at WSDOT headquarters helped focus team efforts, eliminated reliance on region staff with limited availability, and improved consistency of work.
4. **Sample naming and labeling:** The original naming and labeling conventions for laboratory samples were complex and non-intuitive, creating problems in often-chaotic field conditions. These sample names were replaced by a simple date-based naming convention that staff could easily generate and follow in the field. This change drastically reduced time in the field and improved sample labeling accuracy.
5. **New forecasting tool:** In WY13, staff deployed a WSDOT Storm Event Reporting and Forecasting (SERF) tool. This tool provided a direct link to NOAA regional forecasts and created a communication email chain to alert staff when a qualifying storm approached.

The SERF tool significantly shortened the time needed to generate a daily forecast, making faster and more efficient deployments for storm event sampling possible.

6. **New laboratory contract:** On June 1, 2014, the Washington State Department of Transportation (WSDOT) established AmTest, Inc., in Kirkland, Washington as the primary analytical laboratory for the department's stormwater monitoring program. AmTest is an accredited analytical laboratory with the Washington State Department of Ecology (Ecology), and has the ability to achieve acceptable limits of detection for the parameters measured as part of the highway runoff monitoring project.

   The AmTest contract replaces the analytical services agreement with Ecology's Manchester Environmental Laboratory. Establishing AmTest as WSDOT's primary analytical laboratory eliminated the need to communicate with multiple laboratories and streamlined the sample delivery process. Other benefits achieved under this contract include reduced costs for analytical services and availability of AmTest laboratory staff for off hours and weekend sample submittal.

5.7 Lessons Learned

WSDOT found that developing the VFS BMP effectiveness monitoring program was a complex endeavor. Following are some of the lessons learned from implementing the monitoring program:

Some specific lessons learned were:

1. **Establishment of standard operating procedures:** Standard operating procedures (SOPs) helped clarify the fundamentals of various monitoring activities allowing for efficient and consistent collection of the most reliable, representative data possible. SOPs document all steps in the monitoring process from sample collection in the field to data management and validation in the office.
2. **Reassessment of staff roles:** It was determined that with limited staff resources the program was hard-pressed to fulfill the maintenance requirements of the sampling infrastructure. In response, staff that specialized in infrastructure maintenance were hired. A more robust maintenance schedule was implemented that increased the reliability of the equipment and the accuracy of collected data.
3. **Changes to sampling deployment protocol**: It was found that using a 50 percent likelihood of a qualifying amount of precipitation to trigger sampling deployment resulted in many unsuccessful deployments. To increase sampling success, the minimum likelihood was raised to 75 percent to reduce the chance that deployments would be made for non-qualifying rain events.

4. **Reassessment of the sampling infrastructure and maintenance**: Infrastructure was assessed for improvements and it was found, for example, that the chambers utilized by the bubble pressure sensors were not only difficult to clean and maintain but were also providing inconsistent measurements. The monitoring program re-designed the bubble chambers and found that after installation, maintenance requirements were significantly reduced and measurements consistency improved.

   Additionally, the team developed new techniques for maintenance such as a custom sponge set-up that allowed for the cleaning of otherwise inaccessible pipe runs. Taking time to address shortcomings in procedures and infrastructure allowed for some dramatic improvements on both the practical and data-quality fronts.

5. **Cross-training of staff:** Cross training staff proved to be an important factor for the program considering limited personnel resources. Having team members able to respond to different aspects of the program was a key part of the program's approach. This was especially true considering the difficulty in predicting weather phenomena.

5.8 Projected Work and Future Monitoring Projects

WSDOT's VFS effectiveness monitoring continues, with the goal of obtaining enough samples to satisfy permit requirements and produce useful data for decision making. WSDOT will analyze WY14 and WY15 data to assess whether statistical goals in TAPE have been met. If statistical goals are met, WSDOT will produce a final BMP effectiveness report in October 2016.

Within one year following submittal of the VFS BMP effectiveness studies final report or no later than October 2017, WSDOT in consultation with Ecology must begin implementation of new highway BMP effectiveness study. The selection of a highway BMP effectiveness study must be based on WSDOT's stormwater research priorities and the stormwater treatment needs of the agencies, and must be at approximately the same level of monitoring effort and cost as the current VFS BMP effectiveness study.

The 2014 WSDOT NPDES municipal stormwater permit also requires implementation of a monitoring program to evaluate the effectiveness of stormwater treatment and hydrologic management BMPs at rest areas, maintenance facilities, or ferry terminals. The stormwater BMPs (operational or structural) selected for monitoring will address concerns identified from WY12 and WY13 baseline facilities monitoring data. WSDOT will evaluate BMPs at two facilities in western Washington, and one facility east of the Cascades. Monitoring staff are currently constructing BMPs at three maintenance facilities.

Glossary

analyte – An element, ion, compound, or chemical moiety (pH, alkalinity) that is to be determined. The definition can be expanded to include organisms, such as fecal coliform (Kammin 2010).

annual average daily traffic (AADT) – The average, over a year, of the number of vehicles passing a point on a highway in both directions each day (Mohamad et al., 1998). Counts are estimated using Trip Generation, published by the Institute of Transportation Engineers, or using a traffic study prepared by a professional engineer or transportation specialist with expertise in traffic volume estimation (WSDOT 2014c).

best management practices (BMPs) – The structural devices, maintenance procedures, managerial practices, prohibitions of practices, and schedules of activities that are used singly or in combination to prevent or reduce the detrimental impacts of stormwater, such as pollution of water, degradation of channels, damage to structures, and flooding (WSDOT 2014c).

Clean Water Act (CWA) – A federal act passed in 1972, formerly referred to as the Federal Water Pollution Control Act, which contains provisions to restore and maintain the quality of the nation's waters. Major amendments to the CWA in 1987 addressed stormwater pollution by extending the National Pollutant Discharge Elimination System (NPDES) permit program to include stormwater discharges. Section 402 of the CWA governs the NPDES permit program.

data collection platform (DCP) – A collection of instruments or sensors that operate and report to a central data logger. A DCP is collectively housed in a central location or "platform" at the monitoring site.

first flush – Typically, the first 30 to 60 minutes of runoff from a rainfall event (Caltrans 2003). A first-flush rain event for toxicity is defined in Special Condition S7.C.1 of the 2009 WSDOT NPDES municipal stormwater permit as the first qualifying rain event that occurs after July 31, with a one-week antecedent dry period (or October, irrespective of the antecedent dry period, if unsuccessful in August and September) (Ecology 2009a).

flow-weighted compositing – Samples of equal volume are taken at equal increments of flow volume and composited (Ecology 2009b)

Global Positioning System (GPS) – A satellite navigation system used to determine ground position and velocity (location, speed, and direction).

hydrograph – A graph of flow versus time for a given point (Caltrans 2003).

hyetograph – A graph of rainfall to a monitoring station versus time (Caltrans 2003).

Jersey barrier – A tapered concrete structure installed in the median or along the roadside shoulder to prevent vehicle crossovers.

low-impact development (LID) – An evolving approach to land development and stormwater management that uses a site's natural features and specially designed BMPs to manage stormwater; it involves assessing and understanding the site, protecting native vegetation and soils, and minimizing and managing stormwater at the source. Low-impact development practices are appropriate for a variety of development types (WSDOT 2014c).

National Pollutant Discharge and Elimination System (NPDES) – The national program for issuing, modifying, revoking and reissuing, terminating, monitoring, and enforcing permits, and imposing and enforcing pretreatment requirements, under sections 307, 402, 318, and 405 of the Federal Clean Water Act, for the discharge of pollutants to surface waters of the state from point sources. These permits are referred to as NPDES permits and, in Washington State, are administered by the Washington State Department of Ecology (Ecology 2014).

parameter – A specified characteristic of a population or sample. Also, an analyte or grouping of analytes. Benzene, nitrate+nitrite, and anions are all parameters (Kammin 2010; Ecology 2004).

pavement edge (PE) collector – A 6-inch high-density polyethylene pipe or similar device that is installed to collect runoff from an impervious roadway. PE collectors also act as conveyance systems for stormwater from the road surface to pass through a flow measurement device and allow for composite sample collection.

pH – A measure of the acidity or alkalinity of water. A low pH value (0 to 7) indicates that an acidic condition is present, while a high pH (7 to 14) indicates a basic or alkaline condition. A pH of 7 is considered to be neutral. Since the pH scale is logarithmic, a water sample with a pH of 8 is ten times more basic than one with a pH of 7.

Quality Assurance Project Plan (QAPP) – A document that describes the objectives of a monitoring project and the procedures necessary to ensure the quality and integrity of the collected data (Ecology 2004).

representativeness – The state or quality of being accurately representative of something. Expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at the sampling point, or an environmental condition (USEPA 2006).

stormwater – That portion of precipitation that does not naturally percolate into the ground or evaporate, but flows via overland flow, interflow, pipes, and other features of a stormwater drainage system into a defined surface water body or a constructed infiltration facility (WSDOT 2014c).

thermistor – A temperature-sensing probe that displays large changes in resistance in proportion to small changes in temperature.

stilling well – A well or chamber that is connected to the main flow channel by a small inlet.

time of concentration – The time necessary for surface runoff to reach the edge of pavement collector from the hydraulically most remote point of the drainage area (WSDOT 2014c). Time of concentration provides a measure to ensure time pacing of the monitoring equipment is set to obtain a representative sample and to evaluate whether contributions from the entire basin are represented.

water year (WY) – The 12-month period beginning October 1 for any given year through September 30 of the following year. The water year is designated by the calendar year in which it ends. For example, the water year ending September 30, 2012, is called the "2012" water year (USGS 2013).

This page intentionally left blank

Literature Cited

Caltrans. 2003. Caltrans Guidance Manual: Stormwater Monitoring Protocols, Third Edition. California Department of Transportation, Sacramento, CA. CTSW-RT-03-109.51.42.

Ebihara, T., C. Bryan Young, V. Tiwari, and L. Agee. 2009. Treatment of contaminated roadway runoff using vegetated filter strips. Department of Civil, Environmental, and Architectural Engineering, University of Kansas, Lawrence, Kansas.

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/0403030.html

______. 2009a. Washington State Department of Transportation National Pollutant Discharge and Elimination System and State Waste Discharge Permit for Municipal Stormwater. Washington State Department of Ecology, Olympia, WA. Permit No. WAR043000A. Issued February 4, 2009. Major Modifications May 5, 2010, and March 7, 2012.

______. 2009b. Standard Operating Procedure for Automatic Sampling for Stormwater Monitoring (ECY002). Washington State Department of Ecology, Olympia, WA.

______. 2011. Technical Guidance Manual for Evaluating Emerging Stormwater Treatment Technologies: Technology Assessment Protocol – Ecology (TAPE), 2011 revision. Washington State Department of Ecology, Olympia, WA. Publication No. 11-10-061. http://www.ecy.wa.gov/biblio/1110061.html

______. 2014. Washington State Department of Transportation National Pollutant Discharge and Elimination System and State Waste Discharge Municipal Stormwater General Permit. Washington State Department of Ecology, Olympia, WA. Permit No. WAR043000A. Issued March 6, 2014. http://www.ecy.wa.gov/programs/wq/stormwater/municipal/wsdot.html

Kaighn, R. and S. Yu. 1996. Testing of roadside vegetation for highway runoff pollutant removal. Journal of the Transportation Research Board. 1523: 116-123.

Kammin, W. 2010. Ecology Quality Assurance Glossary. Washington State Department of Ecology, Olympia, WA.

Mohamad, D., K. C. Sinha, and T. Kuczek. 1998. An annual average daily traffic prediction model for county roads. Transportation Research Record 1617, Paper No. 98-1115. Presented at the Transportation Research Board, 77th Annual Meeting, January 11-15, 1998, Washington D. C. http://trb.metapress.com/content/22j1822x818533mx/fulltext.pdf

NWS. 2010. National Weather Service Instruction. U. S. Department of Commerce, National Oceanic and Atmospheric Association, National Weather Service, Silver Spring, MD. NWSPD 10-13. http://www.weather.gov/om/coop/standard.htm

USEPA. 2006. Guidance on Systematic Planning Using the Data Quality Objectives Process. EPA QA/G-4. EPA/240/B-06/001. February 2006.

USGS. 2013. What is a water year? U.S. Department of the Interior, U.S. Geological Survey, Reston, VA. http://water.usgs.gov/nwc/explain_data.html

WSDOT. 2011a. Quality Assurance Project Plan for WSDOT Roadway Stormwater Treatment Evaluation: Best Management Practices. Washington State Department of Transportation, Environmental Services Office, Olympia, WA. Revised March 2014, and updated October 2015.

______. 2011b. GIS Workbench. Washington State Department of Transportation, Environmental Services Office, Olympia, WA.

______. 2011c. Standard Operating Procedure for Equipment Maintenance and Cleaning. Washington State Department of Transportation, Olympia, WA.

______. 2013a. WSDOT NPDES Municipal Stormwater Permit Highway Runoff and BMP Effectiveness Stormwater Monitoring Report (S7.B, S7.C, and S7.E) Water Year 2012. Washington State Department of Transportation, Olympia, WA.

______. 2014a. WSDOT NPDES Municipal Stormwater Permit BMP Effectiveness Monitoring Report (S7.C and S7.D). Washington State Department of Transportation, Environmental Services Office, Olympia, WA. October 2014.

______. 2014b. Work Zone Traffic Control Guidelines. Publication No. M 54-44.04. Washington State Department of Transportation, Olympia, WA. www.wsdot.wa.gov/publications/manuals/fulltext/m54-44/workzone.pdf

______. 2014c. Highway Runoff Manual. Washington State Department of Transportation, Environmental and Engineering Programs Design Office, Olympia, WA. Publication M 31-16.04. www.wsdot.wa.gov/environment/waterquality/runoff/highwayrunoffmanual.htm01

______. 2014d. Annual Traffic Report. Washington State Department of Transportation, Olympia, WA. www.wsdot.wa.gov/mapsdata/travel/annualtrafficreport.htm

______. 2015a. WSDOT NPDES Municipal Stormwater Permit Final Highway Runoff Characterization Report (S7.B) Water Years 2012-14. Washington State Department of Transportation, Olympia, WA.

______. 2015b. Safety Procedures and Guidelines Manual. Publication No. M 75-01.25. Washington State Department of Transportation, Olympia, WA. Available at: www.wsdot.wa.gov/publications/manuals/m75-01.htm

Acronyms, Abbreviations, and Units of Measurement

Acronyms and Abbreviations

AADT	annual average daily traffic
BMP	best management practice
CAVFS	compost-amended vegetated filter strip
Cd	cadmium
CBS	compact bubble sensor
COC	chain of custody
Cu	copper
CWA	Clean Water Act
DCP	data collection platform
Ecology	Washington State Department of Ecology
ESO	Environmental Services Office
GIS	geographical information system
GPS	Global Positioning System
HDPE	high-density polyethylene
HQ	WSDOT Headquarters
I-5	Interstate 5
LID	low-impact development
MBAS	methylene blue active substances
MEL	Manchester Environmental Laboratory
MP	milepost
MQO	measurement quality objective
NB	northbound
NPDES	National Pollutant Discharge Elimination System
NOAA	National Oceanic and Atmospheric Association
NWS	National Weather Service
OP	orthophosphate
PAH	polycyclic aromatic hydrocarbons
Pb	lead
PE	pavement edge
pH	measure of alkalinity or acidity
PSD	particle size distribution
PT	pressure transducer
QAPP	Quality Assurance Project Plan

QA	quality assurance
QC	quality control
SB	southbound
SERF	Storm Event Reporting and Forecasting tool
SOP	standard operating procedure
SR	state route
TAPE	Technology Assessment Protocol – Ecology (TAPE)
TC	time of concentration
TP	total phosphorus
TPH	total petroleum hydrocarbon
TSS	total suspended solids
USEPA	United States Environmental Protection Agency
VFS	vegetated filter strip
WSDOT	Washington State Department of Transportation
WY	water year
Zn	zinc

Units of Measurement

ac	acre
°C	degrees centigrade
°F	degrees Fahrenheit
ft	feet
g	gram, a unit of mass
in	inch
gal/min	gallons per minute
L/min	liters per minute
mg	milligrams
mg/Kg	milligrams per kilogram (parts per million)
mg/L	milligrams per liter (parts per million)
mL	milliliters
Qp	gallons/minute
Tc	time of concentration
µg/Kg	micrograms per kilogram (parts per billion)
µg/L	micrograms per liter (parts per billion)
µm	micrometer
oz	ounce

Appendix A:
Analytical Data

This page intentionally left blank

Everett VFS Pavement Edge (PE)		Storm Event					
PARAMETER	**UNITS**	**11/6/2012**		**3/2/2013**		**3/19/2013**	
Conventionals							
TSS	mg/L	29		132		--	
Hardness as $CaCO_3$	mg/L	11.5		--		16.5	
Nutrients							
Total Phosphorous	mg/L	0.0423		--		0.121	
Orthophosphate	mg/L	0.01	U	--		--	
Total Kjeldahl Nitrogen	mg/L	0.91	U	--		0.85	J
Nitrate-Nitrite	mg/L	0.335		--		0.224	
Metals							
Total Recoverable Copper	ug/L	21.7		--		--	
Dissolved Copper	ug/L	6.05	J	--		--	
Total Recoverable Zinc	ug/L	64.5		--		--	
Dissolved Zinc	ug/L	27.7	J	--		--	
Particle Size Distribution							
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	0.11		--		9.82	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	17.11		--		10.76	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	0.22		--		8.25	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	--		0.01	U
Particle/Grain Size, PhiScale 3 to 4 (62.5-125 um)	mg/L	0.01	U	--		0.01	U
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	4.94		--		57.94	
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	8.27		--		12.3	

Notes:

-- parameter not analyzed

U - Analyte not detected above reported result

J - estimated value

UJ - Analyte not detected above reported result, reported reporting limit may inaccurate

TPH-Diesel (NWTPH-Dx) values are calculated as the sum of the Diesel and Lube Oil concentrations

Everett VFS PE (cont.)		Storm Event					
PARAMETER	**UNITS**	**5/21/2013**		**1/7/2014**		**1/28/2014**	
Conventionals							
TSS	mg/L	67		97		92	
Hardness as $CaCO_3$	mg/L	18.3		43.3		--	
Nutrients							
Total Phosphorous	mg/L	0.157		0.149		0.113	
Orthophosphate	mg/L	0.0189		0.0102		0.0114	J
Total Kjeldahl Nitrogen	mg/L	1.2	J	1.6		1.2	
Nitrate-Nitrite	mg/L	0.74		0.328		0.202	
Metals							
Total Recoverable Copper	ug/L	40.1		51.4		38.6	
Dissolved Copper	ug/L	12.5		12.5		12.7	J
Total Recoverable Zinc	ug/L	131		215		177	
Dissolved Zinc	ug/L	40.5		65.1		62.9	J
Particle Size Distribution							
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	15.96		2.84		--	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	29.86		11.99		--	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	13.62		2.73		--	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.01	U	--	
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U	0.01	U	--	
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	8.11		70.65		--	
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	24.89		15.62		--	

Everett VFS PE (cont.)		Storm Event					
PARAMETER	**UNITS**	**3/19/2014**		**4/21/2014**		**6/12/2014**	
Conventionals							
TSS	mg/L	65		23		38	
Hardness as $CaCO_3$	mg/L	33.1		13.9		19	
Nutrients							
Total Phosphorous	mg/L	0.112		0.0689		0.098	
Orthophosphate	mg/L	--		0.0202		--	
Total Kjeldahl Nitrogen	mg/L	1.6		1.4		2.71	
Nitrate-Nitrite	mg/L	0.708		0.559		0.51	
Metals							
Total Recoverable Copper	ug/L	--		30.1		--	
Dissolved Copper	ug/L	--		16.1		--	
Total Recoverable Zinc	ug/L	--		72		--	
Dissolved Zinc	ug/L	--		28.1		--	
Particle Size Distribution							
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	1.83		2.31		7.55	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	8.41		4.2		24.45	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	1.03		0.1		2.31	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.01	U	0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.12		0.01	U	0.01	U
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	52.19		17.55		0.01	U
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	6.54		2.09		12.54	

Everett VFS 2m	Storm Event						
PARAMETER	**UNITS**	**3/2/2013**		**3/19/2013**		**5/21/2013**	
Conventionals							
TSS	mg/L	66		--		31	
Hardness as $CaCO_3$	mg/L	17.4		10.9		25.3	
Nutrients							
Total Phosphorous	mg/L	0.112		0.0971		0.309	
Orthophosphate	mg/L	--		--		0.146	
Total Kjeldahl Nitrogen	mg/L	0.9	J	--		2.4	J
Nitrate-Nitrite	mg/L	0.277		0.12		0.901	
Metals							
Total Recoverable Copper	ug/L	--		--		28.1	
Dissolved Copper	ug/L	--		--		14.8	
Total Recoverable Zinc	ug/L	--		--		76	
Dissolved Zinc	ug/L	--		--		32.8	
Particle Size Distribution							
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	1.67		19.91		9.72	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	16.05		8.89		24.85	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	0.01	U	8.61		8.63	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.01	U	0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U	0.01	U	0.01	U
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	30.36		36.37		0.01	U
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	20.18		11.74		10.25	

Everett VFS 2m (cont.)		Storm Event					
PARAMETER	**UNITS**	**1/7/2014**		**1/28/2014**		**3/19/2014**	
Conventionals							
TSS	mg/L	31		--		34	
Hardness as $CaCO_3$	mg/L	28.3		--		13.5	
Nutrients							
Total Phosphorous	mg/L	0.135		--		0.0914	
Orthophosphate	mg/L	0.0371		--		--	
Total Kjeldahl Nitrogen	mg/L	1.6		1.4		0.68	J
Nitrate-Nitrite	mg/L	0.401		--		0.353	
Metals							
Total Recoverable Copper	ug/L	22.7		--		--	
Dissolved Copper	ug/L	12.3		--		--	
Total Recoverable Zinc	ug/L	94.8		--		--	
Dissolved Zinc	ug/L	40.3		--		--	
Particle Size Distribution							
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	0.55		3.14		0.55	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	3.59		3.01		4.54	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	0.44		1.40		0.66	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.01	U	0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U	0.04		0.01	U
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	19.55		30.24		25.10	
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	5.32		2.76		5.03	

Everett VFS 2m (cont.)		Storm Event			
PARAMETER	**UNITS**	**4/21/2014**		**6/12/2014**	
Conventionals					
TSS	mg/L	9		14	
Hardness as $CaCO_3$	mg/L	25.2		34	
Nutrients					
Total Phosphorous	mg/L	0.259		0.424	
Orthophosphate	mg/L	0.196		--	
Total Kjeldahl Nitrogen	mg/L	2		5.39	
Nitrate-Nitrite	mg/L	2.01		1	J
Metals					
Total Recoverable Copper	ug/L	20.7		--	
Dissolved Copper	ug/L	16.1	J	--	
Total Recoverable Zinc	ug/L	82.1		--	
Dissolved Zinc	ug/L	72.7	J	--	
Particle Size Distribution					
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	0.11		0.62	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	0.89		1.2	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	0.22		0.21	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U	0.01	U
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	6.43		13.36	
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	0.45		3.66	

Everett VFS 4m		Storm Event					
PARAMETER	**UNITS**	**11/6/2012**		**12/11/2012**		**3/2/2013**	
Conventionals							
TSS	mg/L	49		10		11	
Hardness as $CaCO_3$	mg/L	39.6		26.5		24.9	
Nutrients							
Total Phosphorous	mg/L	2.1		0.189		0.197	
Orthophosphate	mg/L	1.69		0.107		--	
Total Kjeldahl Nitrogen	mg/L	1.9		1.2	J	1.4	
Nitrate-Nitrite	mg/L	--		0.472		0.472	
Metals							
Total Recoverable Copper	ug/L	12		6.8		--	
Dissolved Copper	ug/L	9.86	J	4.85		--	
Total Recoverable Zinc	ug/L	155		40.1		--	
Dissolved Zinc	ug/L	145	J	38.3		--	
Particle Size Distribution							
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	6.88		1.89		10.75	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	3.65		0.6		3.89	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	2.78		1.22		0.13	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	1.82		0.01	U	0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	23.49		0.01	U	0.01	U
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	28.74		9.47		0.01	U
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	1.29		1.28		2.18	

Everett VFS 4m (cont.)		Storm Event					
PARAMETER	**UNITS**	**3/19/2013**		**1/7/2014**		**1/28/2014**	
Conventionals							
TSS	mg/L	--		16		--	
Hardness as $CaCO_3$	mg/L	22.5		25.8		--	
Nutrients							
Total Phosphorous	mg/L	0.253		0.213		--	
Orthophosphate	mg/L	--		0.105		--	
Total Kjeldahl Nitrogen	mg/L	0.86	J	2.3		3.2	
Nitrate-Nitrite	mg/L	0.395		0.476		--	
Metals							
Total Recoverable Copper	ug/L	--		11.7		--	
Dissolved Copper	ug/L	--		7.87		--	
Total Recoverable Zinc	ug/L	--		53.1		--	
Dissolved Zinc	ug/L	--		37.8		--	
Particle Size Distribution							
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	8.83		1.83		4.02	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	9.09		1.84		0.82	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	5.38		0.75		9.86	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.01	U	0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U	0.01	U	0.03	
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	0.01	U	16.15		10.54	
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	5.16		1.44		0.56	

Everett VFS 4m (cont.)		Storm Event							
PARAMETER	**UNITS**	**3/15/2014**		**3/19/2014**		**4/21/2014**		**6/12/2014**	
Conventionals									
TSS	mg/L	22		41		28		22	
Hardness as $CaCO_3$	mg/L	10.2		15.2		24.9		33	
Nutrients									
Total Phosphorous	mg/L	0.114		0.228		1.65		0.896	
Orthophosphate	mg/L	0.0502		--		1.16		--	
Total Kjeldahl Nitrogen	mg/L	1.3		1.3		8		7.84	
Nitrate-Nitrite	mg/L	0.155		0.403		0.793		0.015	
Metals									
Total Recoverable Copper	ug/L	6.27		--		37.7		--	
Dissolved Copper	ug/L	3.33		--		23.3		--	
Total Recoverable Zinc	ug/L	22.1	J	--		50.5		--	
Dissolved Zinc	ug/L	13.3		--		24.8		--	
Particle Size Distribution									
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	9.03		6.01		9.77		4.39	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	1.28		3.52		3.62		0.82	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	2.2		3.16		9.55		1.25	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.01	U	0.01	U	0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	1.21		0.01	U	0.01	U	0.01	U
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	16.1		35.67		17.50		24.39	
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	0.87		2.94		1.49		1.42	

Everett MVFS PE		Storm Event					
PARAMETER	**UNITS**	**11/6/2012**		**3/2/2013**		**3/19/2013**	
Conventionals							
TSS	mg/L	51	J	100		88	
Hardness as $CaCO_3$	mg/L	13.5		17.3		14.1	
Nutrients							
Total Phosphorous	mg/L	0.0817		0.107		0.13	
Orthophosphate	mg/L	0.01	U	--		--	
Total Kjeldahl Nitrogen	mg/L	1.1		1.1		--	
Nitrate-Nitrite	mg/L	0.373		0.246		0.198	
Metals							
Total Recoverable Copper	ug/L	19.6		--		--	
Dissolved Copper	ug/L	5.93	J	--		--	
Total Recoverable Zinc	ug/L	109		--		--	
Dissolved Zinc	ug/L	73.5	J	--		--	
Particle Size Distribution							
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	1.96		--		--	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	4		--		--	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	2.82		--		--	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	--		--	
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U	--		--	
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	30.07		--		--	
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	4.78		--		--	

Everett MVFS PE (cont.)		Storm Event					
PARAMETER	UNITS	4/12/2013		5/21/2013		1/7/2014	
Conventionals							
TSS	mg/L	72		55		89	
Hardness as $CaCO_3$	mg/L	17.6		16.8		39.5	
Nutrients							
Total Phosphorous	mg/L	0.138	J	0.142		0.129	
Orthophosphate	mg/L	--		0.0183		0.01	U
Total Kjeldahl Nitrogen	mg/L	0.46	J	1.5	J	1.4	
Nitrate-Nitrite	mg/L	0.455		0.676		0.39	
Metals							
Total Recoverable Copper	ug/L	--		34.6		47.4	
Dissolved Copper	ug/L	--		13.8		13	
Total Recoverable Zinc	ug/L	--		157		224	
Dissolved Zinc	ug/L	--		74.2		83.3	
Particle Size Distribution							
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	9.04		12.76		1.57	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	17.83		32.66		11.86	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	8.74		10.98		1.46	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.01	U	0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U	0.01	U	0.01	U
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	18.71		0.01	U	64.73	
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	22.11		21.86		15.36	

Everett MVFS PE (cont.)		Storm Event							
PARAMETER	**UNITS**	**1/28/2014**		**4/8/2014**		**4/21/2014**		**6/12/2014**	
Conventionals									
TSS	mg/L	70		55		36		38	J
Hardness as $CaCO_3$	mg/L	50.2		20.8		12.4		15	
Nutrients									
Total Phosphorous	mg/L	0.0932		0.237		0.0671		0.114	
Orthophosphate	mg/L	0.01	UJ	0.018		0.01	U	--	
Total Kjeldahl Nitrogen	mg/L	1.5		--		1.3		2.95	
Nitrate-Nitrite	mg/L	0.202		--		0.572		0.33	
Metals									
Total Recoverable Copper	ug/L	31.6		61		21.8		--	
Dissolved Copper	ug/L	11	J	37.5		8.19		--	
Total Recoverable Zinc	ug/L	184		191		121		--	
Dissolved Zinc	ug/L	85.6	J	91.4		64.5		--	
Particle Size Distribution									
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	3.57		1.66		4.1		3.74	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	6.67		8.1		5.2		21.63	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	3.13		1.11		0.11		1.46	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.01	U	0.01	U	0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U	0.2		0.01	U	0.01	U
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	59.22		60.67		28.99		0.01	U
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	8.64		3.38		2.38		18.28	

Everett MVFS 2m		**Storm Event**					
PARAMETER	**UNITS**	**11/6/2012**		**3/2/2013**		**4/12/2013**	
Conventionals							
TSS	mg/L	51		8		33	
Hardness as $CaCO_3$	mg/L	41.8		24		34.9	
Nutrients							
Total Phosphorous	mg/L	0.464		0.512		2.13	J
Orthophosphate	mg/L	0.181		--		--	
Total Kjeldahl Nitrogen	mg/L	--		2.3		10	
Nitrate-Nitrite	mg/L	--		0.725		0.109	
Metals							
Total Recoverable Copper	ug/L	13.5		--		--	
Dissolved Copper	ug/L	10.5	J	--		--	
Total Recoverable Zinc	ug/L	55.7		--		--	
Dissolved Zinc	ug/L	49.1	J	--		--	
Particle Size Distribution							
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	--		1.34		0.6	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	--		0.46		3.49	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	--		0.01	U	1.11	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	--		0.01	U	0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	--		0.01	U	0.01	U
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	--		4.23		2.66	
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	--		0.67		11.14	

Everett MVFS 2m (cont.)		Storm Event					
PARAMETER	**UNITS**	**5/21/2013**		**1/7/2014**		**1/28/2014**	
Conventionals							
TSS	mg/L	19		27		--	
Hardness as $CaCO_3$	mg/L	75.3		22.6		--	
Nutrients							
Total Phosphorous	mg/L	9.01		1.13		--	
Orthophosphate	mg/L	8.91		0.827		--	
Total Kjeldahl Nitrogen	mg/L	20	J	5.8		9.9	
Nitrate-Nitrite	mg/L	1.11		0.773		0.01	
Metals							
Total Recoverable Copper	ug/L	32.6		13.7		--	
Dissolved Copper	ug/L	25		8.62		--	
Total Recoverable Zinc	ug/L	129		83.0		--	
Dissolved Zinc	ug/L	82.6		44.6		--	
Particle Size Distribution							
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	3.47		5.70		5.20	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	0.88		0.69		1.59	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	2.66		2.65		5.87	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.4		0.01	U	0.17	
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	14.16		0.61		22.91	
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	5.76		8.71		16.45	
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	0.22		0.49		0.53	

Everett MVFS 2m (cont.)		Storm Event					
PARAMETER	**UNITS**	**4/8/2014**		**4/21/2014**		**6/12/2014**	
Conventionals							
TSS	mg/L	24		49		30	
Hardness as $CaCO_3$	mg/L	34.1		32.1		62	
Nutrients							
Total Phosphorous	mg/L	4.87		3.46		5.61	
Orthophosphate	mg/L	4.43		3.09		0.01	
Total Kjeldahl Nitrogen	mg/L	21		14		17.5	
Nitrate-Nitrite	mg/L	0.736		0.978		2.9	
Metals							
Total Recoverable Copper	ug/L	19.4		28		--	
Dissolved Copper	ug/L	14.4		14.9		--	
Total Recoverable Zinc	ug/L	69.2		104		--	
Dissolved Zinc	ug/L	34.2		26.3		--	
Particle Size Distribution							
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	1.35		10.45		0.01	U
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	2.68		2.87		0.83	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	0.90		7.07		0.21	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.01	U	0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	2.02		2.52		0.04	
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	37.24		57.13		17.03	
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	1.47		3.08		1.95	

Everett MVFS 4m		Storm Event					
PARAMETER	**UNITS**	**12/11/2012**		**3/2/2013**		**3/19/2013**	
Conventionals							
TSS	mg/L	26		10		8	
Hardness as $CaCO_3$	mg/L	22.1		21.1		22.3	
Nutrients							
Total Phosphorous	mg/L	0.8		0.469		0.548	
Orthophosphate	mg/L	0.485		--		--	
Total Kjeldahl Nitrogen	mg/L	--		1.9		2.4	
Nitrate-Nitrite	mg/L	0.461		0.943		0.581	
Metals							
Total Recoverable Copper	ug/L	7.39		--		--	
Dissolved Copper	ug/L	3.6		--		--	
Total Recoverable Zinc	ug/L	34.2		--		--	
Dissolved Zinc	ug/L	13.6		--		--	
Particle Size Distribution							
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	--		0.01	U	5.66	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	--		3.75		0.41	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	--		0.01	U	1.52	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	--		0.01	U	0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	--		0.01	U	0.01	U
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	--		0.01	U	5.06	
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	--		2.28		0.84	

Everett MVFS 4m (cont.)		Storm Event			
PARAMETER	**UNITS**	**1/28/2014**		**6/12/2014**	
Conventionals					
TSS	mg/L	--		30	
Hardness as $CaCO_3$	mg/L	--		76	
Nutrients					
Total Phosphorous	mg/L	--		5.8	J
Orthophosphate	mg/L	--		--	
Total Kjeldahl Nitrogen	mg/L	31		19.2	
Nitrate-Nitrite	mg/L	--		4.1	
Metals					
Total Recoverable Copper	ug/L	--		--	
Dissolved Copper	ug/L	--		--	
Total Recoverable Zinc	ug/L	--		--	
Dissolved Zinc	ug/L	--		--	
Particle Size Distribution					
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	7.76		0.44	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	2.32		1.36	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	8.79		0.22	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	1.39		0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	34.09		0.09	
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	37.23		37.2	
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	1.41		3.89	

Pilchuck VFS PE		Storm Event							
PARAMETER	**UNITS**	**7/20/2012**		**10/18/2012**		**11/7/2012**		**2/21/2013**	
Conventionals									
TSS	mg/L	117		31		21		--	
Hardness as $CaCO_3$	mg/L	38		17		17.4		--	
Nutrients									
Total Phosphorous	mg/L	0.266		0.0687		0.0562		0.115	
Orthophosphate	mg/L	--		0.0163	J	0.0142		0.01	U
Total Kjeldahl Nitrogen	mg/L	1.4		--		--		0.99	U
Nitrate-Nitrite	mg/L	0.411		--		--		0.351	
Metals									
Total Recoverable Copper	ug/L	--		16		11.4		28.1	
Dissolved Copper	ug/L	--		3.99		4.51	J	9.9	
Total Recoverable Zinc	ug/L	--		62.8		56	J	128	
Dissolved Zinc	ug/L	--		16.8		26	J	32.1	
Particle Size Distribution									
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	0.20		0.01	U	--		--	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	11.54		4.04		--		--	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	1.43		0.01	U	--		--	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.02		0.01	U	--		--	
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	42.14		0.01	U	--		--	
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	65.40		21.85		--		--	
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	13.82		5.96		--		--	

Pilchuck VFS PE (cont.)		Storm Event					
PARAMETER	**UNITS**	**2/24/2013**		**2/28/2013**		**3/2/2013**	
Conventionals							
TSS	mg/L	32		66		77	
Hardness as $CaCO_3$	mg/L	46.5		29.7		22.8	
Nutrients							
Total Phosphorous	mg/L	0.0659		0.104		0.0947	
Orthophosphate	mg/L	--		0.01	U	--	
Total Kjeldahl Nitrogen	mg/L	--		1.1	J	0.57	J
Nitrate-Nitrite	mg/L	--		0.089		0.078	
Metals							
Total Recoverable Copper	ug/L	--		30.7		--	
Dissolved Copper	ug/L	--		6.3		--	
Total Recoverable Zinc	ug/L	--		130		--	
Dissolved Zinc	ug/L	--		15.6		--	
Particle Size Distribution							
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	--		0.7		--	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	--		12.3		--	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	--		0.56		--	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	--		0.01	U	--	
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	--		0.01	U	--	
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	--		30.69		--	
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	--		16.14		--	

Pilchuck VFS PE (cont.)		Storm Event					
PARAMETER	**UNITS**	**3/20/2013**		**1/7/2014**		**1/28/2014**	
Conventionals							
TSS	mg/L	53		62		54	
Hardness as $CaCO_3$	mg/L	36		30.4		36.6	
Nutrients							
Total Phosphorous	mg/L	--		0.0987		0.112	
Orthophosphate	mg/L	0.01	U	0.01	U	0.01	U
Total Kjeldahl Nitrogen	mg/L	0.66	J	1.1		0.93	J
Nitrate-Nitrite	mg/L	0.115		0.206		0.363	
Metals							
Total Recoverable Copper	ug/L	22.3		26.4		24.2	
Dissolved Copper	ug/L	6.75		4.66		5.91	J
Total Recoverable Zinc	ug/L	87.9		125		118	
Dissolved Zinc	ug/L	16.2		20.8		21.4	J
Particle Size Distribution							
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	1		1.31		4.31	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	8.21		7.59		6.76	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	6.68		0.92		2.65	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.01	U	0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U	0.01	U	0.01	U
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	36.06		29.47		45.33	
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	10.12		9.21		9.34	

Pilchuck VFS PE (cont.)		Storm Event					
PARAMETER	**UNITS**	**3/19/2014**		**4/8/2014**		**6/12/2014**	
Conventionals							
TSS	mg/L	57		34		80	
Hardness as $CaCO_3$	mg/L	24.1		24.6		39	
Nutrients							
Total Phosphorous	mg/L	0.09		0.0751		0.173	
Orthophosphate	mg/L	--		0.0125		--	
Total Kjeldahl Nitrogen	mg/L	--		--		1.66	
Nitrate-Nitrite	mg/L	--		--		0.21	
Metals							
Total Recoverable Copper	ug/L	--		17.8		--	
Dissolved Copper	ug/L	--		5.97		--	
Total Recoverable Zinc	ug/L	--		66.8		--	
Dissolved Zinc	ug/L	--		14.9		--	
Particle Size Distribution							
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	1.35		10.48		0.01	U
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	6.23		2.97		4.39	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	1.91		1.01		0.21	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.01	U	0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U	0.48		0.03	
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	47.7		28.01		71.06	
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	6.6		2.2		5.16	

Pilchuck VFS 2m		Storm Event					
PARAMETER	**UNITS**	**10/18/2012**		**2/28/2013**		**3/2/2013**	
Conventionals							
TSS	mg/L	35	J	--		11	
Hardness as $CaCO_3$	mg/L	13.6		25.2		22.2	
Nutrients							
Total Phosphorous	mg/L	0.181		0.0674		0.0952	
Orthophosphate	mg/L	0.0851	J	0.0199		--	
Total Kjeldahl Nitrogen	mg/L	--		0.94	U	0.64	J
Nitrate-Nitrite	mg/L	0.106		0.128		0.096	
Metals							
Total Recoverable Copper	ug/L	16.7		10.7		--	
Dissolved Copper	ug/L	8.94		6.37		--	
Total Recoverable Zinc	ug/L	50.8		28		--	
Dissolved Zinc	ug/L	10.3		11.6		--	
Particle Size Distribution							
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	2.68		--		0.01	U
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	2.6		--		7.03	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	0.38		--		0.01	U
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	--		0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U	--		0.01	U
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	25.63		--		0.01	U
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	3.6		--		3.87	

Pilchuck VFS 2m (cont.)	Storm Event				
PARAMETER	**UNITS**	**3/20/2013**		**1/7/2014**	
Conventionals					
TSS	mg/L	23		7	
Hardness as $CaCO_3$	mg/L	34.2		13.2	
Nutrients					
Total Phosphorous	mg/L	0.219		0.0844	
Orthophosphate	mg/L	0.0949		0.0533	
Total Kjeldahl Nitrogen	mg/L	0.95	J	0.76	
Nitrate-Nitrite	mg/L	0.133		0.076	
Metals					
Total Recoverable Copper	ug/L	10		9.98	
Dissolved Copper	ug/L	6.32		7.38	
Total Recoverable Zinc	ug/L	52.7		24.9	
Dissolved Zinc	ug/L	18.8		14.9	
Particle Size Distribution					
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	4.67		0.50	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	1.29		1.82	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	16.07		0.62	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U	0.01	U
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	18.11		2.79	
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	1.55		1.22	

Pilchuck VFS 4m		Storm Event							
PARAMETER	**UNITS**	**7/20/2012**		**10/18/2012**		**11/7/2012**		**12/11/2012**	
Conventionals									
TSS	mg/L	28		37		62	J	19	J
Hardness as $CaCO_3$	mg/L	83.9		13.7		42.8		22	
Nutrients									
Total Phosphorous	mg/L	0.657		0.27		0.583		0.111	
Orthophosphate	mg/L	--		0.158	J	--		0.0479	
Total Kjeldahl Nitrogen	mg/L	2.5		--		0.79	U	0.37	J
Nitrate-Nitrite	mg/L	2.51		0.079		0.314		0.147	
Metals									
Total Recoverable Copper	ug/L	--		18		12.5		8.18	
Dissolved Copper	ug/L	--		11.9		4.23	J	4.76	
Total Recoverable Zinc	ug/L	--		38.1		228		24.6	
Dissolved Zinc	ug/L	--		12.8		166	J	14	
Particle Size Distribution									
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	1.71		6.99		--		3.56	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	0.79		3.83		--		11.2	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	1.01		0.01	U	--		3.95	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.01	U	--		0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	2.60		2.88		--		0.01	U
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	20.59		26.38		--		0.01	U
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	0.54		0.81		--		7.31	

Pilchuck VFS 4m (cont.)		Storm Event					
PARAMETER	**UNITS**	**2/21/2013**		**2/24/2013**		**2/28/2013**	
Conventionals							
TSS	mg/L	8		2		--	
Hardness as $CaCO_3$	mg/L	--		30.8		20.5	
Nutrients							
Total Phosphorous	mg/L	--		0.175		0.0978	
Orthophosphate	mg/L	0.208		0.114		0.0694	
Total Kjeldahl Nitrogen	mg/L	--		1.5	J	0.56	U
Nitrate-Nitrite	mg/L	--		0.292		0.156	
Metals							
Total Recoverable Copper	ug/L	9.16		5.48		6.67	
Dissolved Copper	ug/L	7.1		5.03		6.22	
Total Recoverable Zinc	ug/L	64.3		30.9		20	
Dissolved Zinc	ug/L	54.2		30.9		15.9	
Particle Size Distribution							
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	--		--		0.8	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	--		--		0.42	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	--		--		0.13	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	--		--		0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	--		--		0.01	U
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	--		--		0.01	U
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	--		--		0.39	

Pilchuck VFS 4m (cont.)		Storm Event					
PARAMETER	**UNITS**	**3/20/2013**		**1/28/2014**		**3/19/2014**	
Conventionals							
TSS	mg/L	19		--		5	
Hardness as $CaCO_3$	mg/L	30		--		20.2	
Nutrients							
Total Phosphorous	mg/L	0.334		--		0.0950	
Orthophosphate	mg/L	0.162		--		--	
Total Kjeldahl Nitrogen	mg/L	1.6		1.5		1.2	
Nitrate-Nitrite	mg/L	0.262		--		0.208	
Metals							
Total Recoverable Copper	ug/L	9.45		--		--	
Dissolved Copper	ug/L	5.54		--		--	
Total Recoverable Zinc	ug/L	39.8		--		--	
Dissolved Zinc	ug/L	26.3		--		--	
Particle Size Distribution							
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	20.81		1.32		0.11	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	1.42		2.00		0.61	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	16.56		1.44		0.56	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.01	U	0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U	0.43		0.01	U
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	14.17		16.01		2.97	
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	1.57		0.43		0.10	

Pilchuck VFS 4m (cont.)		Storm Event					
PARAMETER	**UNITS**	**4/8/2014**		**4/22/2014**		**6/12/2014**	
Conventionals							
TSS	mg/L	7		4		5	
Hardness as $CaCO_3$	mg/L	--		22.8		25	
Nutrients							
Total Phosphorous	mg/L	3.43		0.182		0.584	
Orthophosphate	mg/L	0.219		--		--	
Total Kjeldahl Nitrogen	mg/L	--		1.4		3.6	
Nitrate-Nitrite	mg/L	--		0.2		0.17	
Metals							
Total Recoverable Copper	ug/L	8.77		--		--	
Dissolved Copper	ug/L	7.47		--		--	
Total Recoverable Zinc	ug/L	19		--		--	
Dissolved Zinc	ug/L	14.7		--		--	
Particle Size Distribution							
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	--		0.11		2.18	J
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	--		4.57		4.2	J
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	--		0.11		0.87	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	--		0.01	U	0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	--		0.01	U	0.01	U
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	--		0.01	U	0.01	U
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	--		0.15		5.45	

Pilchuck CAVFS 2m		Storm Event							
PARAMETER	**UNITS**	**2/21/2013**		**2/28/2013**		**4/8/2014**		**6/12/2014**	
Conventionals									
TSS	mg/L	27		16		28		12	J
Hardness as $CaCO_3$	mg/L	49.7		--		26.2		35	
Nutrients									
Total Phosphorous	mg/L	0.898		0.603		0.985		1.74	
Orthophosphate	mg/L	0.685		0.518		0.242		--	
Total Kjeldahl Nitrogen	mg/L	4.1		--		--		3.48	
Nitrate-Nitrite	mg/L	0.764		--		0.107		0.28	
Metals									
Total Recoverable Copper	ug/L	9.65		6.79		14.2		--	
Dissolved Copper	ug/L	6.64		3.43		4.72	J	--	
Total Recoverable Zinc	ug/L	35.8		28.7		33.6		--	
Dissolved Zinc	ug/L	19.2		14.9		11.6	J	--	
Particle Size Distribution									
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	0.01	U	1.02		5.34		7.14	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	0.8		8.1		1.66		0.82	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	1.02		0.38		1.11		2.94	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.01	U	0.36		0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U	0.01	U	10.01		0.01	U
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	21.59		0.01	U	18.35		18.26	
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	1.51		4.9		1.09		2.6	

Pilchuck CAVFS 4m	Storm Event						
PARAMETER	UNITS	10/18/2012		2/21/2013		2/25/2013	
Conventionals							
TSS	mg/L	28		6		11	
Hardness as $CaCO_3$	mg/L	35.7		34.6		42.7	
Nutrients							
Total Phosphorous	mg/L	1.06		0.836		0.518	
Orthophosphate	mg/L	0.887	J	0.765		0.438	
Total Kjeldahl Nitrogen	mg/L	2		2	J	1.9	J
Nitrate-Nitrite	mg/L	0.263		1.22		0.703	
Metals							
Total Recoverable Copper	ug/L	25.1		6.39		9.51	
Dissolved Copper	ug/L	21.7		4.07		7.54	
Total Recoverable Zinc	ug/L	29.6		61.9		21.1	
Dissolved Zinc	ug/L	27.5		49		12.2	
Particle Size Distribution							
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	14.51		0.01	U	0.11	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	2.16		3.4		9.36	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	0.65		0.01	U	0.01	U
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.01	U	0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U	0.01	U	0.01	U
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	24.15		0.01	U	0.01	U
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	2.79		1.56		4.74	

Pilchuck CAVFS 4m (cont.)		Storm Event					
PARAMETER	**UNITS**	**2/28/2013**		**3/12/2013**		**3/20/2013**	
Conventionals							
TSS	mg/L	14		15		9	
Hardness as $CaCO_3$	mg/L	36.7		36.6		34.7	
Nutrients							
Total Phosphorous	mg/L	0.374		--		0.468	
Orthophosphate	mg/L	0.368		--		--	
Total Kjeldahl Nitrogen	mg/L	1.6		2.4		2	
Nitrate-Nitrite	mg/L	0.513		0.461		0.353	
Metals							
Total Recoverable Copper	ug/L	11.1		--		--	
Dissolved Copper	ug/L	9.26		--		--	
Total Recoverable Zinc	ug/L	28.4		--		--	
Dissolved Zinc	ug/L	21.2		--		--	
Particle Size Distribution							
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	2.37		19.03		14.95	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	10.3		0.01	U	0.7	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	2.23		16.71		18.77	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.01	U	0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U	0.01	U	0.01	U
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	0.01	U	0.01	U	7.29	
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	4.52		0.01	U	1.37	

Pilchuck CAVFS 4m (cont.)		Storm Event							
PARAMETER	**UNITS**	**4/12/2013**		**1/7/2014**		**3/19/2014**		**4/8/2014**	
Conventionals									
TSS	mg/L	16		15		7		10	
Hardness as $CaCO_3$	mg/L	45.9		48.4		37.3		25.3	
Nutrients									
Total Phosphorous	mg/L	0.585	J	0.250		0.297		0.878	
Orthophosphate	mg/L	--		0.195		--		0.645	
Total Kjeldahl Nitrogen	mg/L	1	U	1.2		1.4		5.6	
Nitrate-Nitrite	mg/L	0.098		0.297		0.096		0.121	
Metals									
Total Recoverable Copper	ug/L	--		18.2		--		10.6	
Dissolved Copper	ug/L	--		16.1		--		9.04	J
Total Recoverable Zinc	ug/L	--		22.1		--		23.6	
Dissolved Zinc	ug/L	--		15.9		--		15.1	J
Particle Size Distribution									
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	11.78		0.24		0.32		0.01	U
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	10.58		2.44		2.31		1.37	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	9.11		0.36		0.42		0.55	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.01	U	0.01	U	0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U	0.01	U	0.01	U	1.65	
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	0.01	U	10.59		11.45		15.02	
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	5.43		1.83		1.06		0.64	

Pilchuck MVFS PE	Storm Event							
PARAMETER	UNITS	3/12/2013		3/20/2013		4/4/2013		1/28/2014	
Conventionals									
TSS	mg/L	46		49		53		--	
Hardness as $CaCO_3$	mg/L	32.8		33.8		45.3		--	
Nutrients									
Total Phosphorous	mg/L	0.116		0.101		0.222		--	
Orthophosphate	mg/L	--		--		--		--	
Total Kjeldahl Nitrogen	mg/L	0.91	J	0.56	J	2.7		0.86	
Nitrate-Nitrite	mg/L	0.12		0.092		0.345		--	
Metals									
Total Recoverable Copper	ug/L	--		--		--		--	
Dissolved Copper	ug/L	--		--		--		--	
Total Recoverable Zinc	ug/L	--		--		--		--	
Dissolved Zinc	ug/L	--		--		--		--	
Particle Size Distribution									
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	--		5.49		--		1.41	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	--		8.51		--		8.28	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	--		10.68		--		5.65	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	--		0.01	U	--		0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	--		0.01	U	--		0.01	U
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	--		40.15		--		41.27	
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	--		11.33		--		8.74	

Pilchuck MVFS PE (cont.)		Storm Event							
PARAMETER	**UNITS**	**3/14/2014**		**3/19/2014**		**5/23/2014**		**6/12/2014**	
Conventionals									
TSS	mg/L	33		67		60		40	
Hardness as $CaCO_3$	mg/L	33.5		31.5		34		33	
Nutrients									
Total Phosphorous	mg/L	0.102		0.103		0.244		0.111	
Orthophosphate	mg/L	0.0157	J	--		--		--	
Total Kjeldahl Nitrogen	mg/L	0.77		0.43	J	2.59		1.95	
Nitrate-Nitrite	mg/L	0.112		0.344		0.4		0.22	
Metals									
Total Recoverable Copper	ug/L	21.8		--		--		--	
Dissolved Copper	ug/L	7.87		--		--		--	
Total Recoverable Zinc	ug/L	78.4	J	--		--		--	
Dissolved Zinc	ug/L	22.2		--		--		--	
Particle Size Distribution									
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	4.74		2.38		1.03	J	1.46	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	4.45		7.2		5.39	J	42.91	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	0.23		0.91		0.41	J	1.04	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.01	U	0.01	UJ	0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.11		0.01	U	2.45	J	0.01	U
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	31.78		49.86		53.43	J	0.01	U
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	2.34		7.20		2.45	J	18.48	

Pilchuck MVFS 2m (cont.)		Storm Event							
PARAMETER	**UNITS**	**3/12/2013**		**4/4/2013**		**1/28/2014**		**3/14/2014**	
Conventionals									
TSS	mg/L	37		29		--		16	
Hardness as $CaCO_3$	mg/L	29.1		55.3		--		35.5	
Nutrients									
Total Phosphorous	mg/L	0.992		3.35		--		0.938	
Orthophosphate	mg/L	--		--		--		0.676	J
Total Kjeldahl Nitrogen	mg/L	--		11	J	1.6		5.1	
Nitrate-Nitrite	mg/L	0.766		0.164		--		0.804	
Metals									
Total Recoverable Copper	ug/L	--		--		--		8.74	
Dissolved Copper	ug/L	--		--		--		5.5	
Total Recoverable Zinc	ug/L	--		--		--		51.6	J
Dissolved Zinc	ug/L	--		--		--		26.6	
Particle Size Distribution									
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	--		14.86		6.43		1.7	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	--		0.88		1.15		0.64	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	--		6.47		4.58		1.91	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	--		0.09		0.01	U	0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	--		17.81		0.28		0.03	
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	--		7.19		10.99		10.91	
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	--		0.35		0.30		0.61	

Pilchuck MVFS 2m (cont.)		Storm Event					
PARAMETER	**UNITS**	**3/19/2014**		**5/23/2014**		**6/12/2014**	
Conventionals							
TSS	mg/L	11		35	J	7	
Hardness as $CaCO_3$	mg/L	33.5		98	J	35	
Nutrients							
Total Phosphorous	mg/L	0.287		0.239	J	1.51	
Orthophosphate	mg/L	--		--		--	
Total Kjeldahl Nitrogen	mg/L	1.7		2.58	J	3.49	
Nitrate-Nitrite	mg/L	1.06		0.16	J	0.29	
Metals							
Total Recoverable Copper	ug/L	--		--		--	
Dissolved Copper	ug/L	--		--		--	
Total Recoverable Zinc	ug/L	--		--		--	
Dissolved Zinc	ug/L	--		--		--	
Particle Size Distribution							
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	8.66		2.46	J	0.84	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	0.28		2.83	J	0.26	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	2.01		0.82	J	0.42	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.28	J	0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01		27.34	J	0.01	U
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	2.61		8.95	J	11.12	
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	0.11		0.93	J	1.24	

Pilchuck MVFS 4m		Storm Event					
PARAMETER	**UNITS**	**3/12/2013**		**3/20/2013**		**4/4/2013**	
Conventionals							
TSS	mg/L	--		75		120	
Hardness as $CaCO_3$	mg/L	24.9		31.8		56.5	
Nutrients							
Total Phosphorous	mg/L	1.38		2.06		8.77	
Orthophosphate	mg/L	--		--		--	
Total Kjeldahl Nitrogen	mg/L	--		6.2		39	
Nitrate-Nitrite	mg/L	0.209		0.037		0.042	
Metals							
Total Recoverable Copper	ug/L	--		--		--	
Dissolved Copper	ug/L	--		--		--	
Total Recoverable Zinc	ug/L	--		--		--	
Dissolved Zinc	ug/L	--		--		--	
Particle Size Distribution							
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	14.03		3.79		13.84	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	2.5		3.09		3.51	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	11.17		6.15		12.83	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.01	U	11.47	
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U	1.59		43.93	
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	35.85		48.18		17.87	
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	3.76		5.55		1.2	

Pilchuck MVFS 4m (cont.)		Storm Event					
PARAMETER	**UNITS**	**1/28/2014**		**3/14/2014**		**6/12/2014**	
Conventionals							
TSS	mg/L	--		32		26	
Hardness as $CaCO_3$	mg/L	--		34.7		30	
Nutrients							
Total Phosphorous	mg/L	--		2.07		0.838	
Orthophosphate	mg/L	--		1.71	J	--	
Total Kjeldahl Nitrogen	mg/L	1.8		8		4.21	
Nitrate-Nitrite	mg/L	--		0.144		0.025	
Metals							
Total Recoverable Copper	ug/L	--		18.5		--	
Dissolved Copper	ug/L	--		7.35		--	
Total Recoverable Zinc	ug/L	--		45.2	J	--	
Dissolved Zinc	ug/L	--		27.8		--	
Particle Size Distribution							
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	1.31		0.33		2.78	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	0.98		3.72		1.61	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	0.66		2.22		1.5	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.01	U	0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U	4.27		0.08	
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	0.97		2.24		34.92	
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	0.51		31.97		4.85	

Appendix B:
WY13-14 Storm Reports

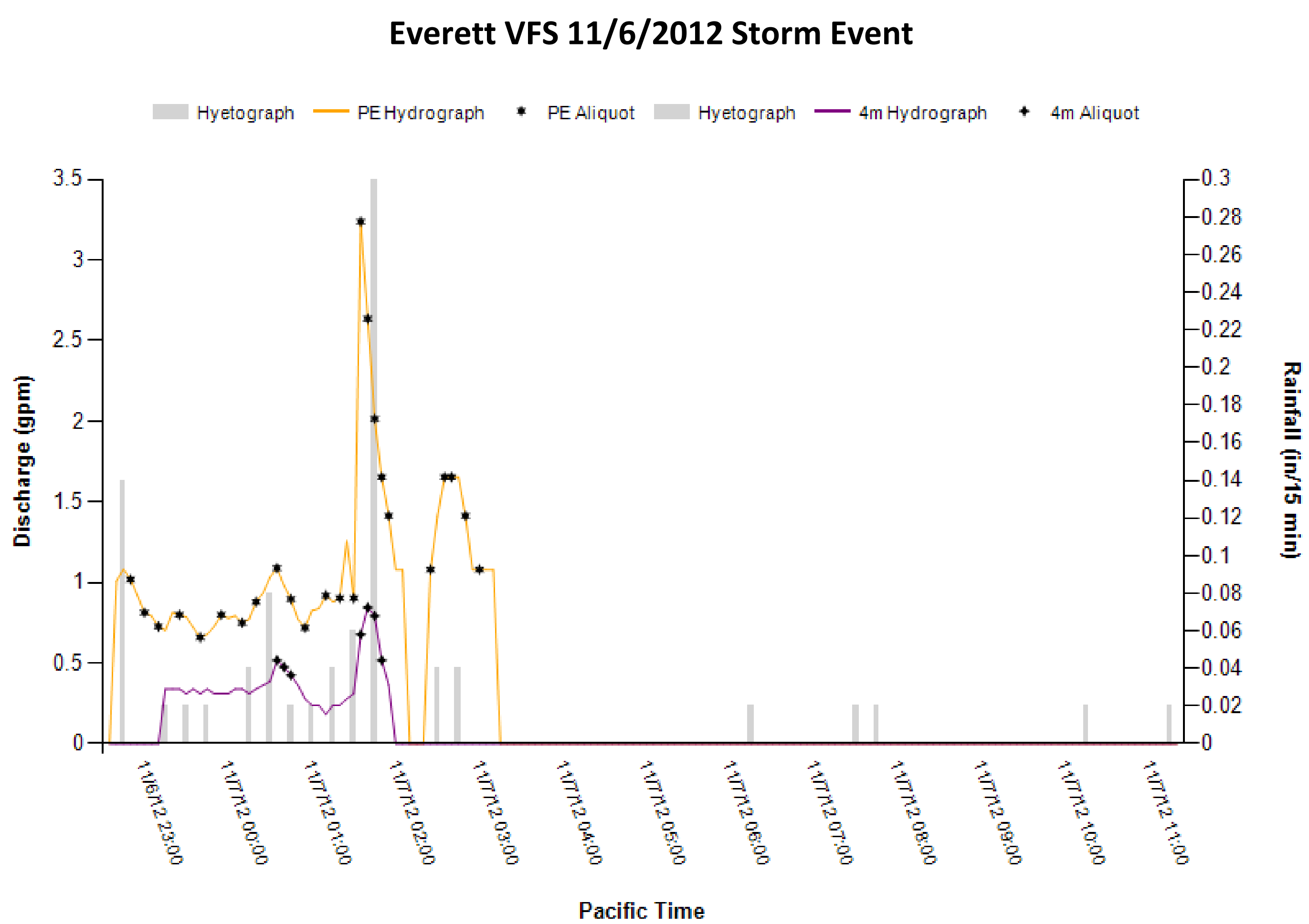
Everett VFS

Precipitation				
Total (in)	**Start Time**	**End Time**	**Duration (hrs)**	**Antecedent (hrs)**
0.47	11/6/2012 22:35	11/7/2012 11:15	12.67	47.74

Aliquots							Water Temp		Validation Code
Sample Point (m)	**Aliquots Collected**	**First Aliquot Time**	**Last Aliquot Time**	**Sampling Duration (hrs)**	**Volume (mL)**	**Total Sample Volume (mL)**	**Min (C°)**	**Max (C°)**	
PE	24	11/6/2012 22:50	11/07/2012 1300	4.17	250	6,000	8.98	10.65	J
4	7	11/7/2012 0:35	11/7/2012 1:50	1.25	250	1,750	9.44	10.01	

Runoff / Discharge												
	Runoff Time			**Volume**			**Sampled**		**Flow**			**Stage**
Sample Point (m)	**Start Time**	**End Time**	**Duration (hrs)**	**Total (gal)**	**Intensity (gal/hr)**	**First 24Hrs (gal)**	**Discharge Total Volume Sampled (gal)**	**% Hydrograph Sampled**	**Peak (gpm)**	**Min (gpm)**	**Mean (gpm)**	**Max (ft)**
PE	11/6/2012 22:40	11/7/2012 3:10	4.50	281.24	62.50	281.24	270.44	96.16	3.24	0.66	1.08	0.500
4	11/6/2012 23:15	11/7/2012 1:55	2.67	61.38	22.99	61.38	59.56	97.05	0.84	0.18	0.37	0.053

J=Estimate of Hydrology information



Everett VFS 11/6/2012 Storm Event
Hyetograph
PE Hydrograph
PE Aliquot
Hyetograph
4m Hydrograph
4m Aliquot
Discharge (gpm)
Rainfall (in/15 min)
Pacific Time

Precipitation				
Total (in)	**Start Time**	**End Time**	**Duration (hrs)**	**Antecedent (hrs)**
0.51	12/11/2012 13:45	12/12/2012 7:00	17.25	78

Aliquots							Water Temp		Validation Code
Sample Point (m)	**Aliquots Collected**	**First Aliquot Time**	**Last Aliquot Time**	**Sampling Duration (hrs)**	**Volume (mL)**	**Total Sample Volume (mL)**	**Min (C°)**	**Max (C°)**	
PE	N/A	N/A	N/A	N/A	N/A	N/A	5.34	5.97	
4	12	12/11/2012 15:25	12/12/2012 3:40	12.25	250	4,000	5.35	6.50	

Runoff / Discharge												
	Runoff Time			**Volume**			**Sampled**		**Flow**			**Stage**
Sample Point (m)	**Start Time**	**End Time**	**Duration (hrs)**	**Total (gal)**	**Intensity (gal/hr)**	**First 24Hrs (gal)**	**Discharge Total Volume Sampled (gal)**	**% Hydrograph Sampled**	**Peak (gpm)**	**Min (gpm)**	**Mean (gpm)**	**Max (ft)**
PE	12/11/2012 16:40	12/12/2012 7:25	14.75	525.19	35.61	525.19	N/A	N/A	1.02	0.18	0.66	0.087
4	12/11/2012 15:20	12/12/2012 5:10	13.83	179.68	12.99	179.68	158.55	88.24	0.46	0.18	0.32	0.011

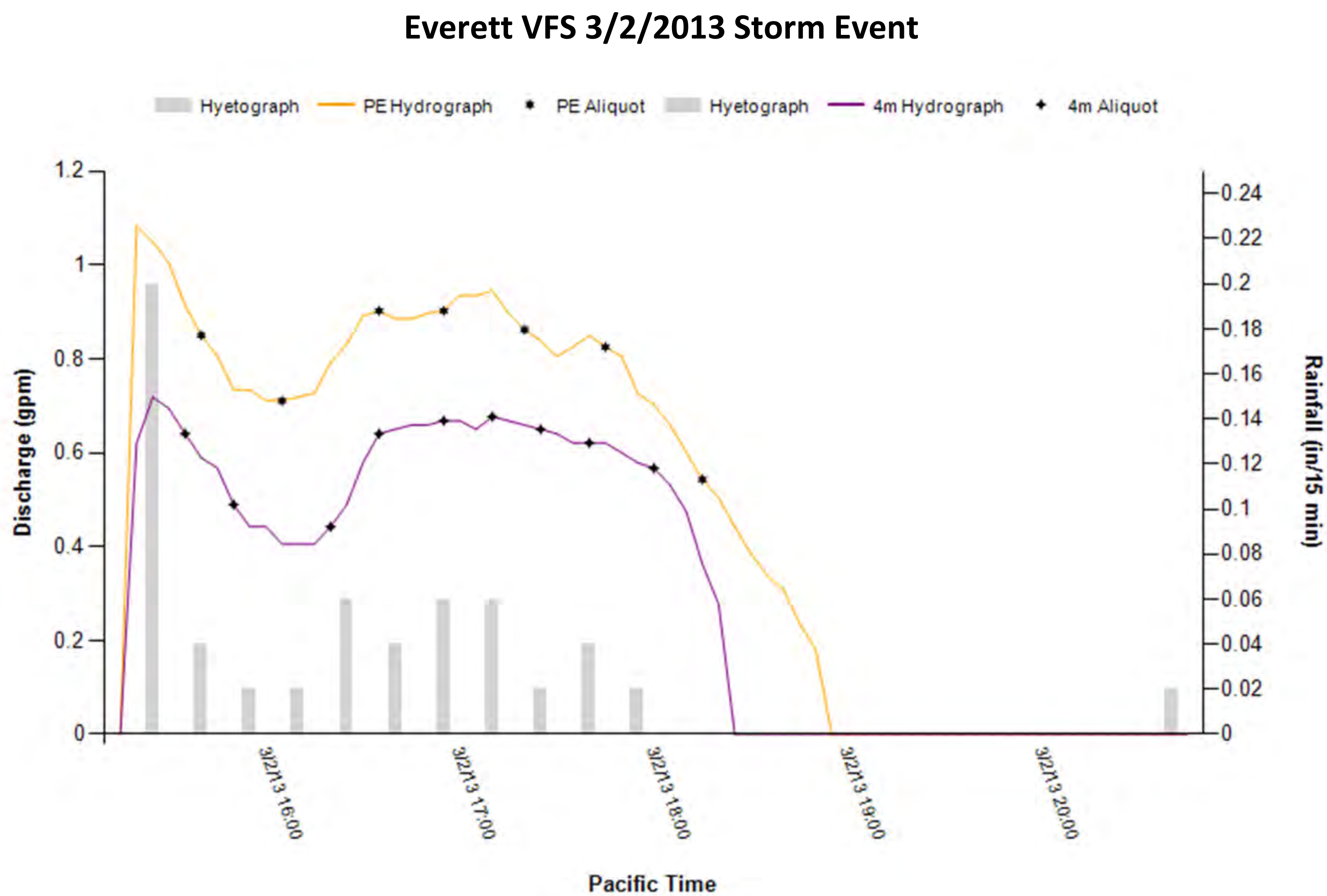
Only grab samples collected at influent.

Precipitation				
Total (in)	**Start Time**	**End Time**	**Duration (hrs)**	**Antecedent (hrs)**
0.30	3/2/2013 15:15	3/2/2013 20:30	5.25	45

Aliquots							**Water Temp**		**Validation Code**
Sample Point (m)	**Aliquots Collected**	**First Aliquot Time**	**Last Aliquot Time**	**Sampling Duration (hrs)**	**Volume (mL)**	**Total Sample Volume (mL)**	**Min (C°)**	**Max (C°)**	
PE	7	3/2/2013 15:40	3/2/2013 18:15	2.58	250	1,750	7.10	9.12	
2	28	3/2/2013 15:25	3/2/2013 18:50	3.42	250	7,000	6.79	9.36	R
4	9	3/2/2013 15:35	3/2/2013 18:00	2.42	250	2,250	7.29	9.12	

Runoff / Discharge												
	Runoff Time			**Volume**			**Sampled**		**Flow**			**Stage**
Sample Point (m)	**Start Time**	**End Time**	**Duration (hrs)**	**Total (gal)**	**Intensity (gal/hr)**	**First 24Hrs (gal)**	**Discharge Total Volume Sampled (gal)**	**% Hydrograph Sampled**	**Peak (gpm)**	**Min (gpm)**	**Mean (gpm)**	**Max (ft)**
PE	3/2/2013 15:20	3/2/2013 18:50	3.50	160.90	45.97	160.90	148.92	92.55	1.08	0.18	0.75	0.101
2	3/2/2013 15:20	3/2/2013 22:25	7.08	204.62	28.90	204.62	148.28	72.46	1.04	0.18	0.51	0.090
4	3/2/2013 15:20	3/23/2013 18:20	3.00	105.36	35.12	105.36	97.13	92.19	0.72	0.28	0.57	0.035

Rejected because less than 75% of the hydrograph was sampled.


Everett VFS 3/2/2013 Storm Event
Hyetograph
PE Hydrograph
PE Aliquot
Hyetograph
4m Hydrograph
4m Aliquot
Discharge (gpm)
Rainfall (in/15 min)
Pacific Time
3/2/13 16:00
3/2/13 17:00
3/2/13 18:00
3/2/13 19:00
3/2/13 20:00

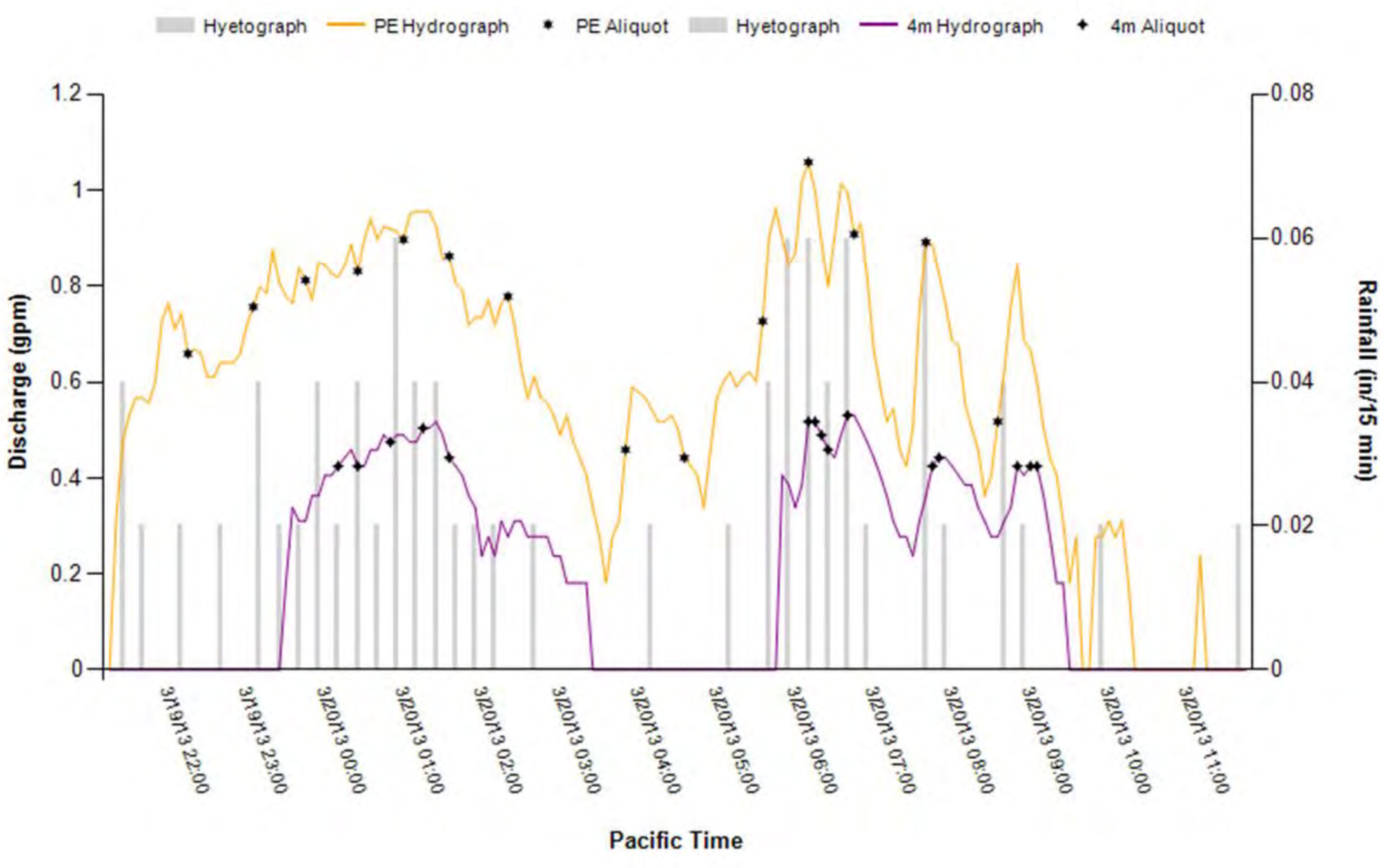
Precipitation				
Total (in)	Start Time	End Time	Duration (hrs)	Antecedent (hrs)
0.51	3/19/2013 21:15	3/20/2013 11:40	14.42	38.25

Aliquots							Water Temp		Validation Code
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)	
PE	13	3/19/2013 22:15	3/20/2013 8:35	10.33	250	3,500	6.31	7.63	J
2	13	3/19/2013 23:55	3/20/2013 10:15	10.33	250	3,250	6.42	9.31	R
4	15	3/20/2013 0:10	3/20/2013 9:05	8.92	250	3,750	6.46	7.99	

Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	3/19/2013 21:20	3/20/2013 11:10	13.83	506.35	36.61	506.35	465.53	86.3	1.06	0.18	0.65	0.095
2	3/19/2013 23:25	3/20/2013 12:15	12.83	309.15	24.10	309.15	290.07	N/A	0.86	0.18	0.49	0.056
4	3/19/2013 23:30	3/20/2013 9:25	9.92	169.00	17.04	169.00	163.99	97.04	0.53	0.18	0.37	0.016

J=Estimate of Hydrology information
Rejected because less than 75% of the hydrograph was sampled.

Everett VFS 3/19/2013 Storm Event



Precipitation				
Total (in)	**Start Time**	**End Time**	**Duration (hrs)**	**Antecedent (hrs)**
0.72	5/21/2013 3:15	5/22/2013 2:45	23.50	43.75

Aliquots							Water Temp		Validation Code
Sample Point (m)	**Aliquots Collected**	**First Aliquot Time**	**Last Aliquot Time**	**Sampling Duration (hrs)**	**Volume (mL)**	**Total Sample Volume (mL)**	**Min (C°)**	**Max (C°)**	
PE	29	5/21/2013 3:55	5/22/2013 4:30	24.58	250	7,250	8.43	16.25	
2	19	5/21/2013 3:50	5/22/2013 0:30	20.67	250	7,000	10.36	16.25	R

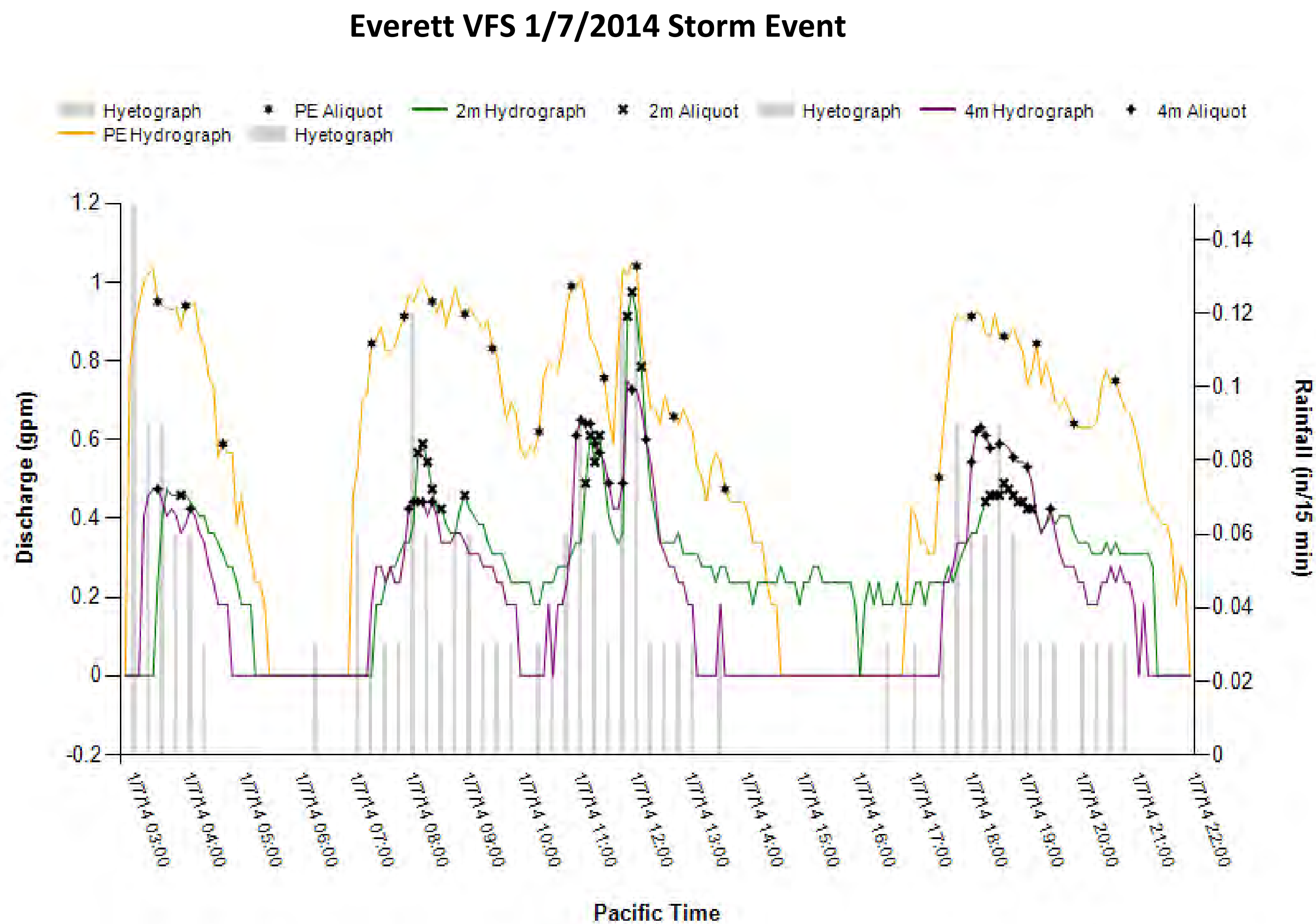
Runoff / Discharge												
	Runoff Time			**Volume**			**Sampled**		**Flow**			**Stage**
Sample Point (m)	**Start Time**	**End Time**	**Duration (hrs)**	**Total (gal)**	**Intensity (gal/hr)**	**First 24Hrs (gal)**	**Discharge Total Volume Sampled (gal)**	**% Hydrograph Sampled**	**Peak (gpm)**	**Min (gpm)**	**Mean (gpm)**	**Max (ft)**
PE	5/21/2013 3:25	5/22/2013 6:15	26.83	922.20	34.37	849.49	849.49	100.00	1.24	0.18	0.53	0.143
2	5/21/2013 3:40	5/22/2013 2:00	22.33	251.48	11.26	251.48	222.55	66.70	0.83	0.18	0.39	0.051

Rejected because less than 75% of the hydrograph was sampled.

Precipitation				
Total (in)	Start Time	End Time	Duration (hrs)	Antecedent (hrs)
0.81	01/07/2014 02:50	01/07/2014 20:35	17.75	101

Aliquots							Water Temp		Validation Code
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)	
PE	20	01/07/2014 03:25	01/07/2014 20:35	17.17	250	5,000	2.94	6.97	
2	25	01/07/2014 03:50	01/07/2014 19:05	15.25	250	6,250	3.10	6.97	
4	26	01/07/2014 03:25	01/07/2014 19:25	16.00	250	6,500	2.94	6.97	

Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	01/07/2014 02:55	01/07/2014 21:50	18.92	642.6	34.0	642.6	608.4	94.70	1.05	0.18	0.70	0.093
2	01/07/2014 03:25	01/07/2014 21:15	17.83	313.9	17.6	313.9	269.4	85.80	0.98	0.18	0.33	0.077
4	01/07/2014 03:10	01/07/2014 21:05	17.92	232.9	13.0	232.9	209.8	90.10	0.75	0.18	0.37	0.039



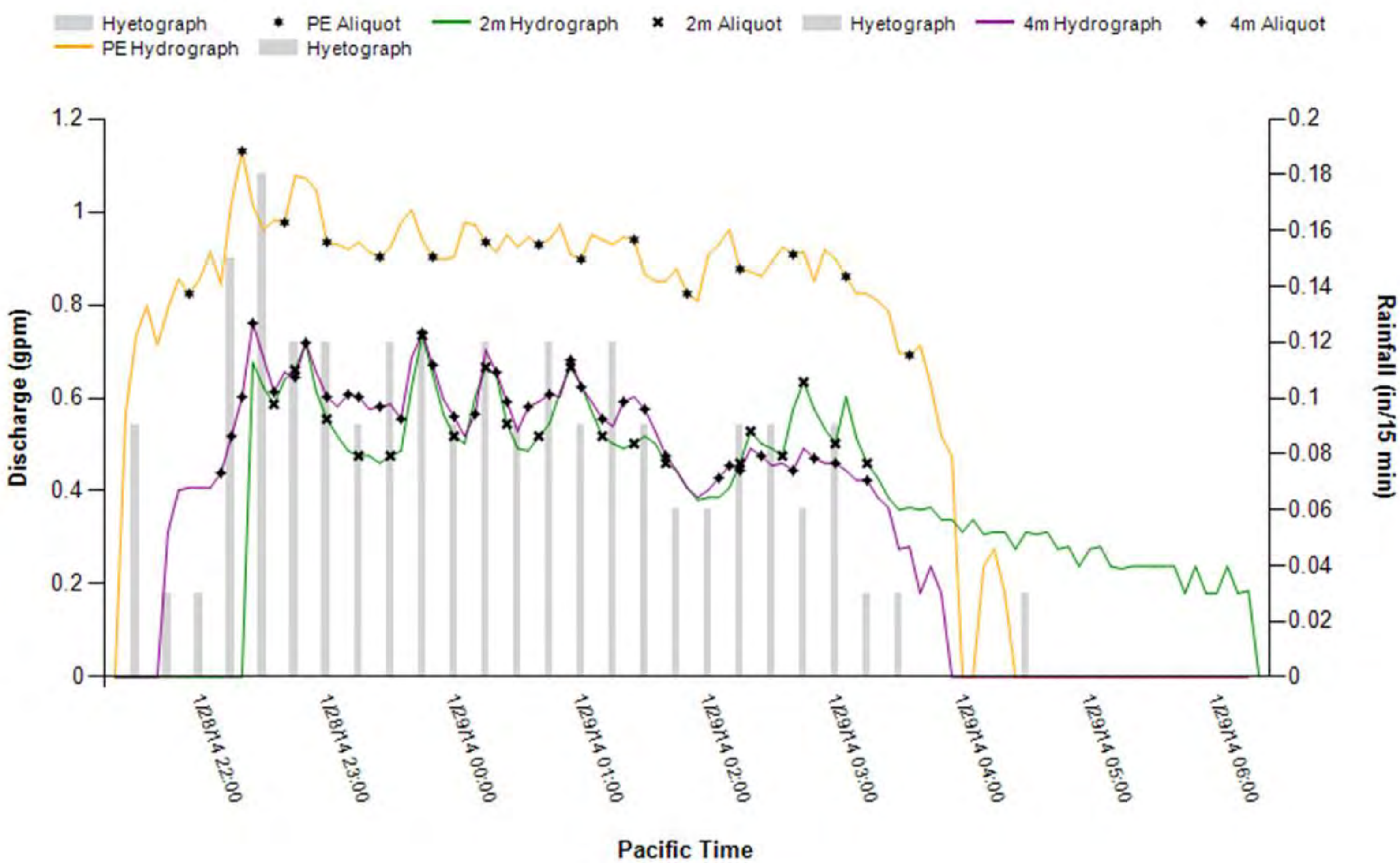
Everett VFS 1/7/2014 Storm Event
Hyetograph
PE Aliquot
2m Hydrograph
2m Aliquot
Hyetograph
4m Hydrograph
4m Aliquot
PE Hydrograph
Hyetograph
Discharge (gpm)
Rainfall (in/15 min)
Pacific Time
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
1/7/14 03:00
1/7/14 04:00
1/7/14 05:00
1/7/14 06:00
1/7/14 07:00
1/7/14 08:00
1/7/14 09:00
1/7/14 10:00
1/7/14 11:00
1/7/14 12:00
1/7/14 13:00
1/7/14 14:00
1/7/14 15:00
1/7/14 16:00
1/7/14 17:00
1/7/14 18:00
1/7/14 19:00
1/7/14 20:00
1/7/14 21:00
1/7/14 22:00

Precipitation				
Total (in)	Start Time	End Time	Duration (hrs)	Antecedent (hrs)
0.77	01/28/2014 21:20	01/29/2014 04:25	7.08	386.5

Aliquots							Water Temp		Validation Code
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)	
PE	15	01/28/2014 21:55	01/29/2014 03:35	5.67	250	3,750	6.30	6.93	
2	20	01/28/2014 22:35	01/29/2014 03:15	4.67	250	5,000	6.38	6.93	
4	34	01/28/2014 22:10	01/29/2014 03:15	5.08	250	8,500	6.38	6.93	

Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	01/28/2014 21:25	01/29/2014 04:20	6.92	352.8	51.0	352.8	337.7	95.70	1.13	0.18	0.86	0.113
2	01/28/2014 22:25	01/29/2014 06:15	7.83	209.4	26.7	209.4	158.9	75.90	0.73	0.18	0.44	0.037
4	01/28/2014 21:45	01/29/2014 03:50	6.08	191.2	31.4	191.2	181.7	95.00	0.76	0.18	0.52	0.041

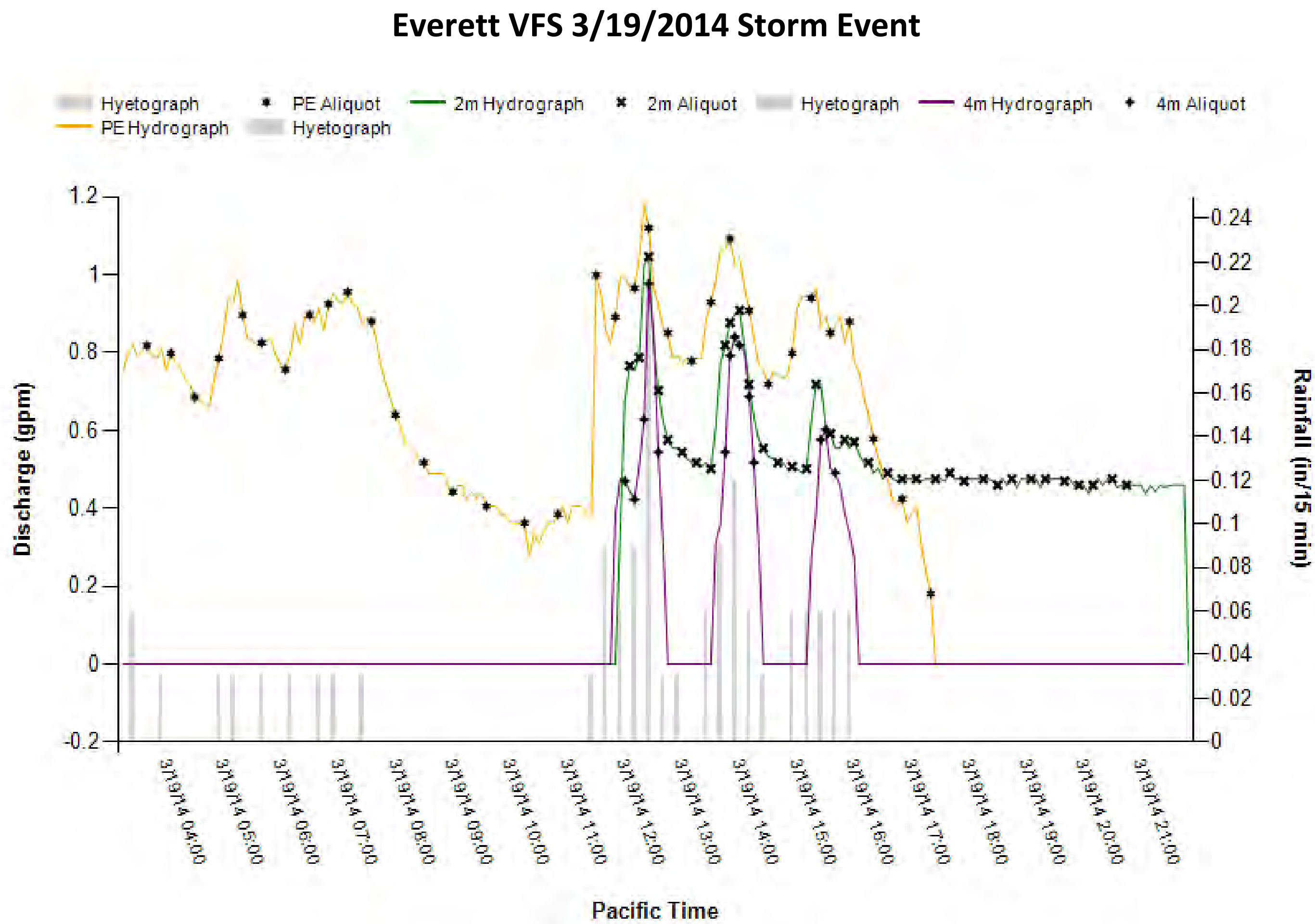
Everett VFS 1/28/2014 Storm Event



Precipitation				
Total (in)	Start Time	End Time	Duration (hrs)	Antecedent (hrs)
0.50	03/19/2014 03:15	03/19/2014 15:55	12.67	48

Aliquots							Water Temp		Validation Code
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)	
PE	37	03/19/2014 03:40	03/19/2014 18:50	15.17	250	9,250	6.59	9.49	J
2	37	03/19/2014 12:05	03/19/2014 20:45	8.67	250	9,250	6.06	9.49	
4	14	03/19/2014 12:00	03/19/2014 15:40	3.67	250	3,500	7.45	9.49	

Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	03/19/2014 03:15	03/19/2014 17:20	14.08	607.3	43.1	607.3	607.3	100.00	1.18	0.18	0.71	0.126
2	03/19/2014 11:55	03/19/2014 21:45	9.83	316.7	32.2	316.7	293.9	92.80	1.05	0.34	0.54	0.092
4	03/19/2014 11:50	03/19/2014 16:00	4.17	81.4	19.5	81.4	74.2	91.00	0.98	0.27	0.53	0.077


Everett VFS 3/19/2014 Storm Event
Hyetograph
PE Hydrograph
PE Aliquot
Hyetograph
2m Hydrograph
2m Aliquot
Hyetograph
4m Hydrograph
4m Aliquot
Discharge (gpm)
Rainfall (in/15 min)
Pacific Time
3/19/14 04:00
3/19/14 05:00
3/19/14 06:00
3/19/14 07:00
3/19/14 08:00
3/19/14 09:00
3/19/14 10:00
3/19/14 11:00
3/19/14 12:00
3/19/14 13:00
3/19/14 14:00
3/19/14 15:00
3/19/14 16:00
3/19/14 17:00
3/19/14 18:00
3/19/14 19:00
3/19/14 20:00
3/19/14 21:00

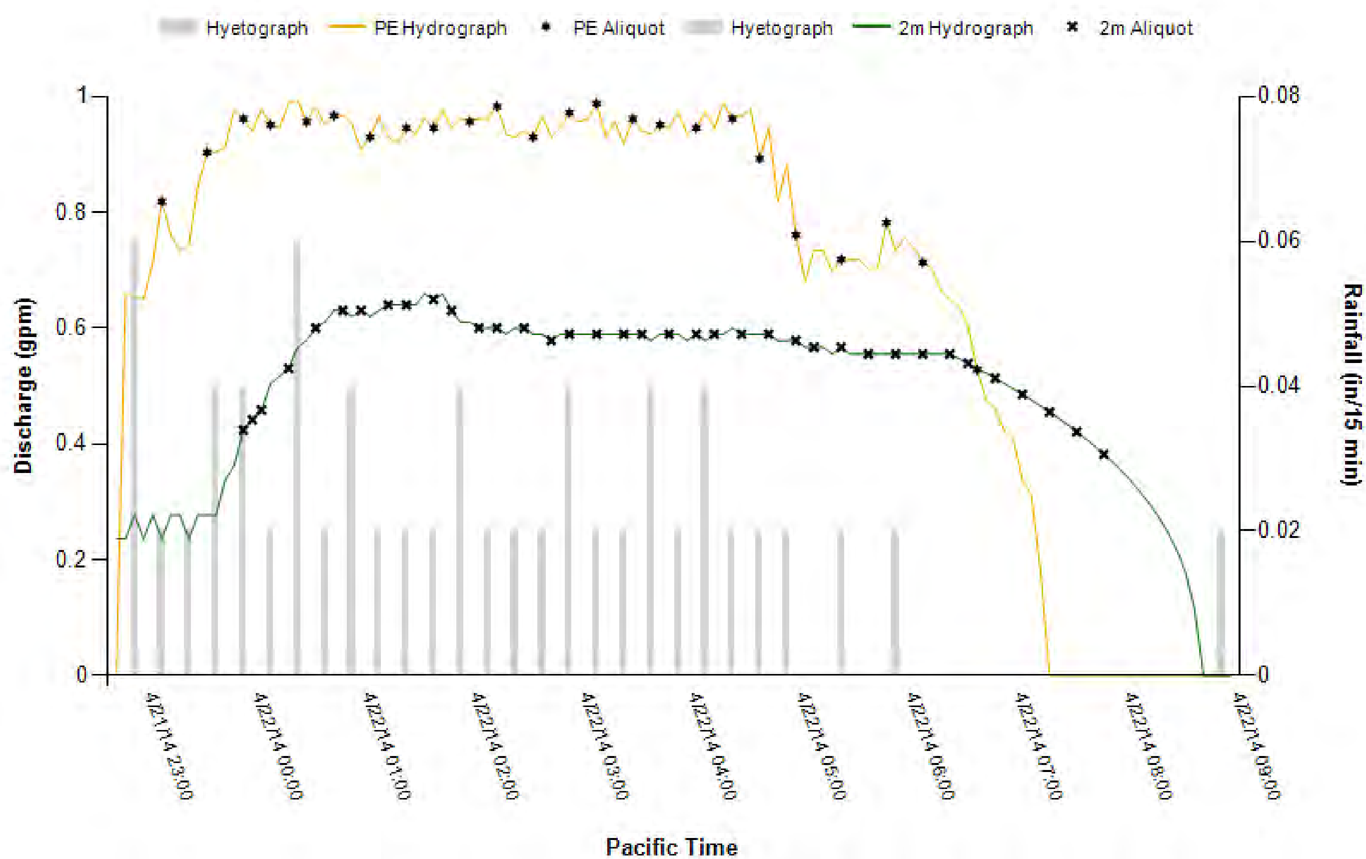
Precipitation				
Total (in)	Start Time	End Time	Duration (hrs)	Antecedent (hrs)
0.39	04/21/2014 22:40	04/22/2014 08:50	10.17	51

Aliquots							Water Temp		Validation Code
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)	
PE	24	04/21/2014 23:05	04/22/2014 06:35	7.50	250	6,000	6.67	9.80	
2	37	04/21/2014 23:50	04/22/2014 07:45	7.92	250	9,250	6.57	9.37	
4	23	04/21/2014 23:45	04/22/2014 04:45	5.00	250	5,750	7.34	9.37	R

Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	04/21/2014 22:45	04/22/2014 07:10	8.42	427.4	50.8	427.4	414.4	97.00	0.99	0.18	0.84	0.080
2	04/21/2014 22:40	04/22/2014 08:35	9.92	303.1	30.6	303.1	289.6	95.50	0.66	0.12	0.51	0.028
4	04/21/2014 23:30	04/22/2014 11:45	12.25	254.4	20.8	254.4	152.4	59.90	0.57	0.18	0.35	0.019

Rejected because less than 75% of the hydrograph was sampled.

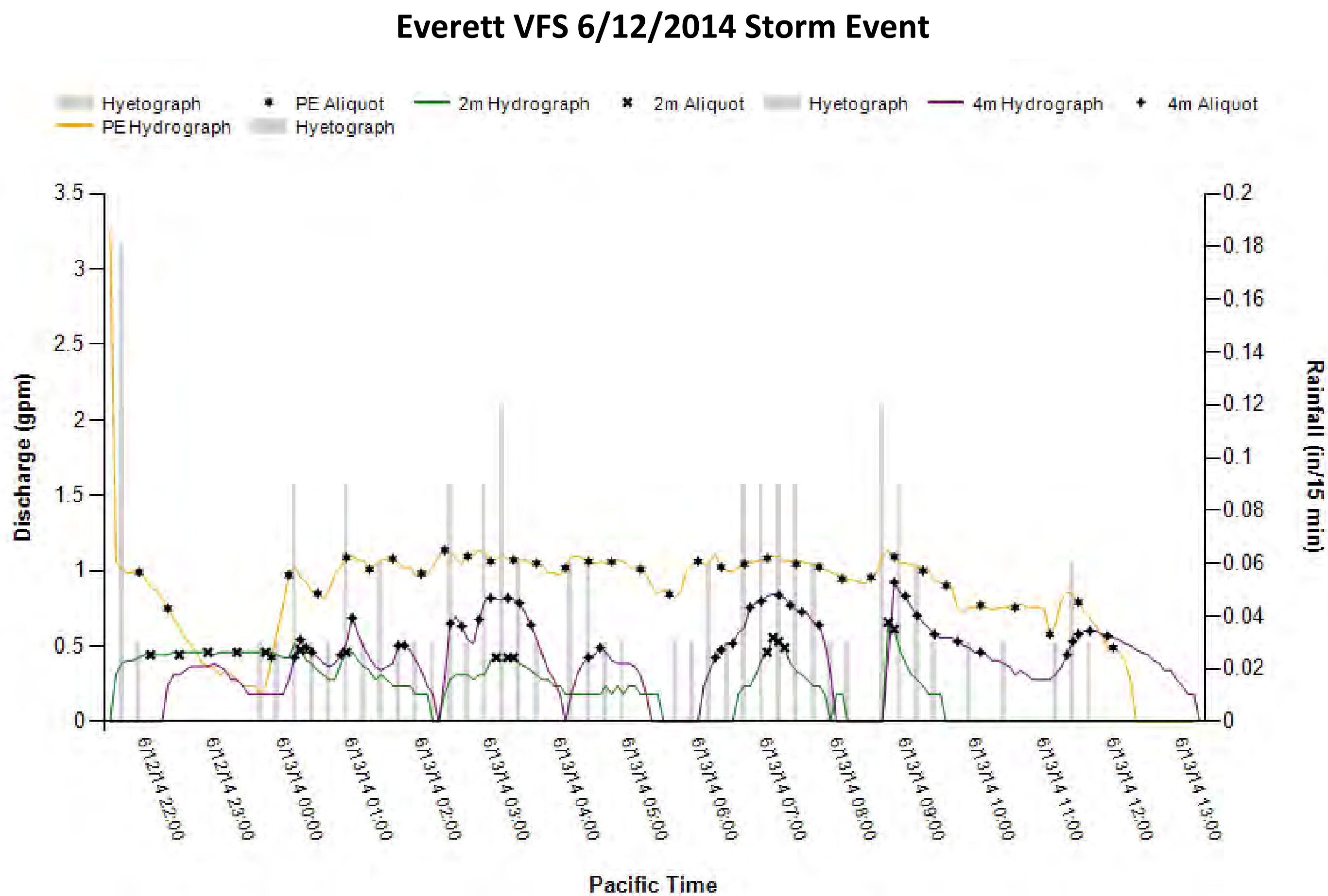
Everett VFS 4/21/2014 Storm Event



Precipitation				
Total (in)	Start Time	End Time	Duration (hrs)	Antecedent (hrs)
0.80	06/12/2014 21:30	06/13/2014 11:35	14.08	79.91

Aliquots							Water Temp		Validation Code
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)	
PE	37	06/12/2014 21:55	06/13/2014 13:20	15.42	250	9,250	13.20	16.30	
2	16	06/12/2014 22:05	06/13/2014 08:50	10.75	250	4,000	13.20	16.20	
4	37	06/13/2014 00:10	06/13/2014 11:55	11.75	250	9,250	13.20	14.20	

Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	06/12/2014 21:30	06/13/2014 12:15	14.75	801.4	54.3	801.4	801.4	100.00	1.14	0.18	0.89	0.114
2	06/12/2014 21:35	06/13/2014 09:30	11.92	203.6	17.1	203.6	192.5	94.50	0.66	0.18	0.34	0.028
4	06/12/2014 22:20	06/13/2014 13:10	14.83	373.3	25.2	373.3	344.2	92.20	0.92	0.18	0.47	0.067


Everett VFS 6/12/2014 Storm Event
Hyetograph
PE Aliquot
2m Hydrograph
2m Aliquot
Hyetograph
4m Hydrograph
4m Aliquot
PE Hydrograph
Hyetograph
Discharge (gpm)
Rainfall (in/15 min)
Pacific Time
3.5
3
2.5
2
1.5
1
0.5
0
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
6/12/14 22:00
6/12/14 23:00
6/13/14 00:00
6/13/14 01:00
6/13/14 02:00
6/13/14 03:00
6/13/14 04:00
6/13/14 05:00
6/13/14 06:00
6/13/14 07:00
6/13/14 08:00
6/13/14 09:00
6/13/14 10:00
6/13/14 11:00
6/13/14 12:00
6/13/14 13:00

Everett MVFS

Precipitation				
Total (in)	Start Time	End Time	Duration (hrs)	Antecedent (hrs)
0.48	11/6/2012 22:25	11/7/2012 10:15	11.83	48.25

Aliquots							Water Temp		Validation Code
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)	
PE	29	11/6/2012 22:45	11/7/2012 10:35	11.83	250	7,250	6.73	11.54	
2	10	11/7/2012 0:25	11/7/2012 2:05	1.67	250	4,750	9.62	10.45	R

Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	11/6/2012 22:30	11/7/2012 10:55	12.42	312.99	25.20	312.99	307.18	98.14	1.63	0.18	0.66	0.291
2	11/6/2012 23:05	11/7/2012 11:20	12.25	121.84	9.95	121.84	77.51	63.62	0.75	0.18	0.36	0.039

Rejected because less than 75% of the hydrograph was sampled.

Precipitation				
Total (in)	Start Time	End Time	Duration (hrs)	Antecedent (hrs)
0.53	12/11/2012 13:45	12/12/2012 6:55	17.17	42.24

Aliquots							Water Temp		Validation Code
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)	
PE	N/A	N/A	N/A	N/A	N/A	N/A	5.29	6.50	
4	12	12/11/2012 22:25	12/12/2012 5:00	6.58	250	3,000	5.33	5.64	

Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	12/11/2012 14:00	12/11/2012 13:45	0.25	595.68	2382.73	519.47	N/A	N/A	1.01	0.18	-0.09	0.085
4	12/11/2012 15:20	12/12/2012 7:20	16.00	208.17	13.01	208.17	191.87	92.17	0.45	0.01	0.11	0.010

Only grab samples collected at influent.

Precipitation				
Total (in)	Start Time	End Time	Duration (hrs)	Antecedent (hrs)
0.27	3/2/2013 15:15	3/2/2013 17:50	2.58	51.49

Aliquots							Water Temp		Validation Code
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)	
PE	8	3/2/2013 15:35	3/2/2013 18:45	3.17	250	2,250	6.72	9.70	R
2	10	3/2/2013 15:40	3/2/2013 18:25	2.75	250	2,500	6.99	9.70	
4	13	3/2/2013 16:40	3/2/2013 18:40	2.00	250	3,250	6.85	8.01	R

Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	3/2/2013 15:15	3/2/2013 22:00	6.75	310.27	45.97	310.27	222.58	71.74	1.25	0.00	0.75	0.146
2	3/2/2013 15:25	3/2/2013 19:15	3.83	124.11	32.40	124.11	106.88	86.12	0.68	0.18	0.53	0.030
4	3/2/2013 16:30	3/2/2013 20:00	3.50	92.75	26.50	92.75	68.90	74.28	0.59	0.10	0.43	0.021

Rejected because less than 75% of the hydrograph was sampled.

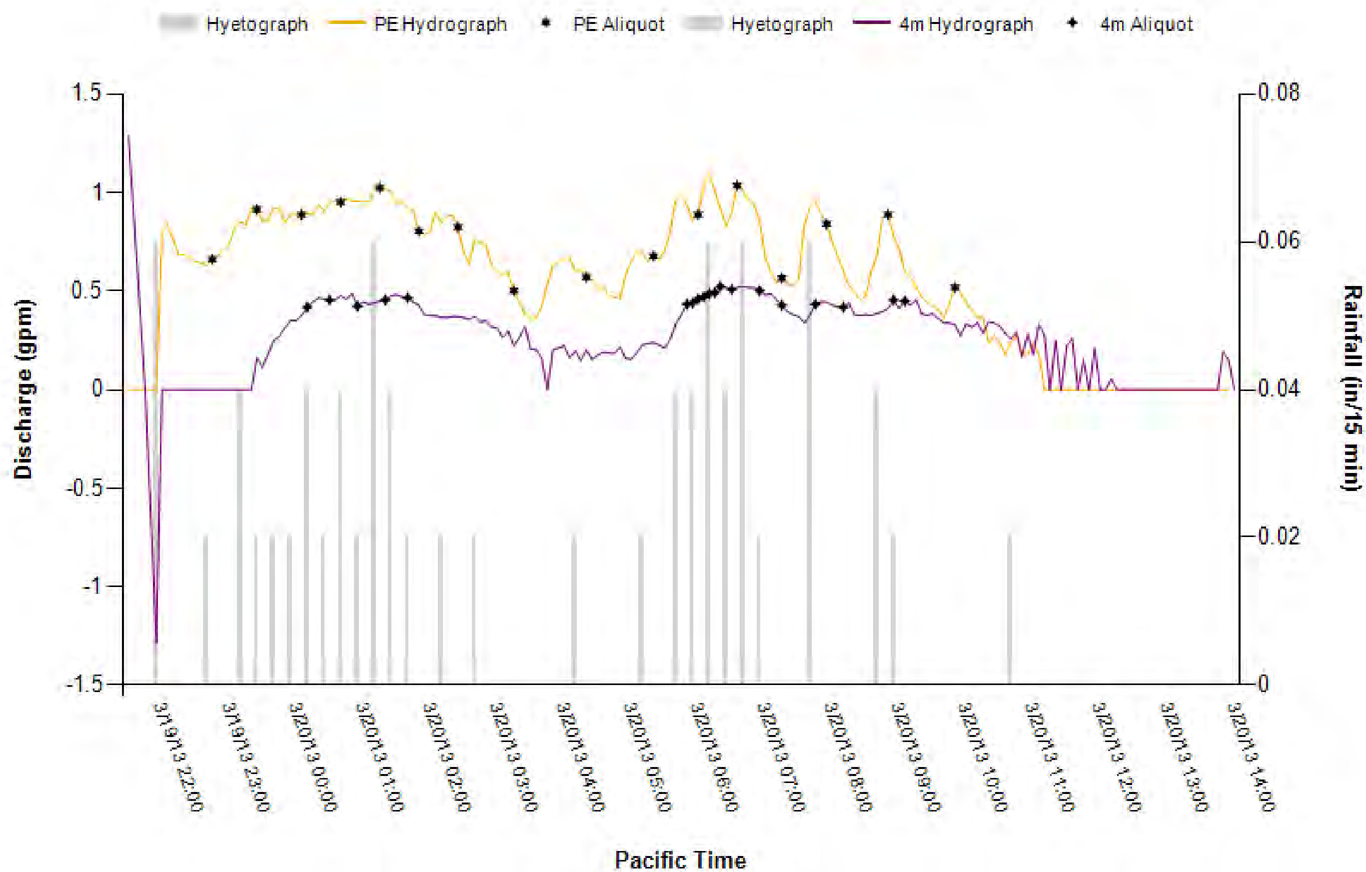
Precipitation				
Total (in)	**Start Time**	**End Time**	**Duration (hrs)**	**Antecedent (hrs)**
0.45	3/19/2013 21:30	03/20/2013 17:40	13.17	38.74

Aliquots							Water Temp		Validation Code
Sample Point (m)	**Aliquots Collected**	**First Aliquot Time**	**Last Aliquot Time**	**Sampling Duration (hrs)**	**Volume (mL)**	**Total Sample Volume (mL)**	**Min (C°)**	**Max (C°)**	
PE	16	3/19/2013 22:45	3/20/2013 9:50	11.08	250	4,000	5.77	8.18	
4	19	3/20/2013 0:10	3/20/2013 9:05	8.92	250	4,750	5.77	7.57	J

Runoff / Discharge												
	Runoff Time			**Volume**			**Sampled**		**Flow**			**Stage**
Sample Point (m)	**Start Time**	**End Time**	**Duration (hrs)**	**Total (gal)**	**Intensity (gal/hr)**	**First 24Hrs (gal)**	**Discharge Total Volume Sampled (gal)**	**% Hydrograph Sampled**	**Peak (gpm)**	**Min (gpm)**	**Mean (gpm)**	**Max (ft)**
PE	3/19/2013 22:00	3/20/2013 11:05	13.08	550.09	42.06	550.09	528.63	96.10	1.09	0.18	0.49	0.103
4	3/19/2013 23:25	3/20/2013 13:55	14.50	255.06	17.59	255.06	207.59	81.39	0.52	0.05	0.33	0.016

J=Estimate of Hydrology information

Everett MVFS 3/19/2013 Storm Event



Precipitation				
Total (in)	Start Time	End Time	Duration (hrs)	Antecedent (hrs)
0.17	4/12/2013 13:45	4/12/2013 16:20	2.58	32.5

Aliquots							Water Temp		Validation Code
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)	
PE	14	4/12/2013 14:05	4/12/2013 16:20	2.25	250	3,500	6.14	7.62	
2	17	4/12/2013 14:45	4/12/2013 18:05	3.33	250	5,750	6.01	7.02	R

Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	4/12/2013 13:55	4/12/2013 16:50	2.92	122.52	41.96	122.52	111.11	90.69	1.00	0.18	0.38	0.082
2	4/12/2013 14:30	4/12/2013 18:55	4.42	137.08	31.01	137.08	122.68	66.00	0.72	0.18	0.22	0.035

Rejected because less than 75% of the hydrograph was sampled.

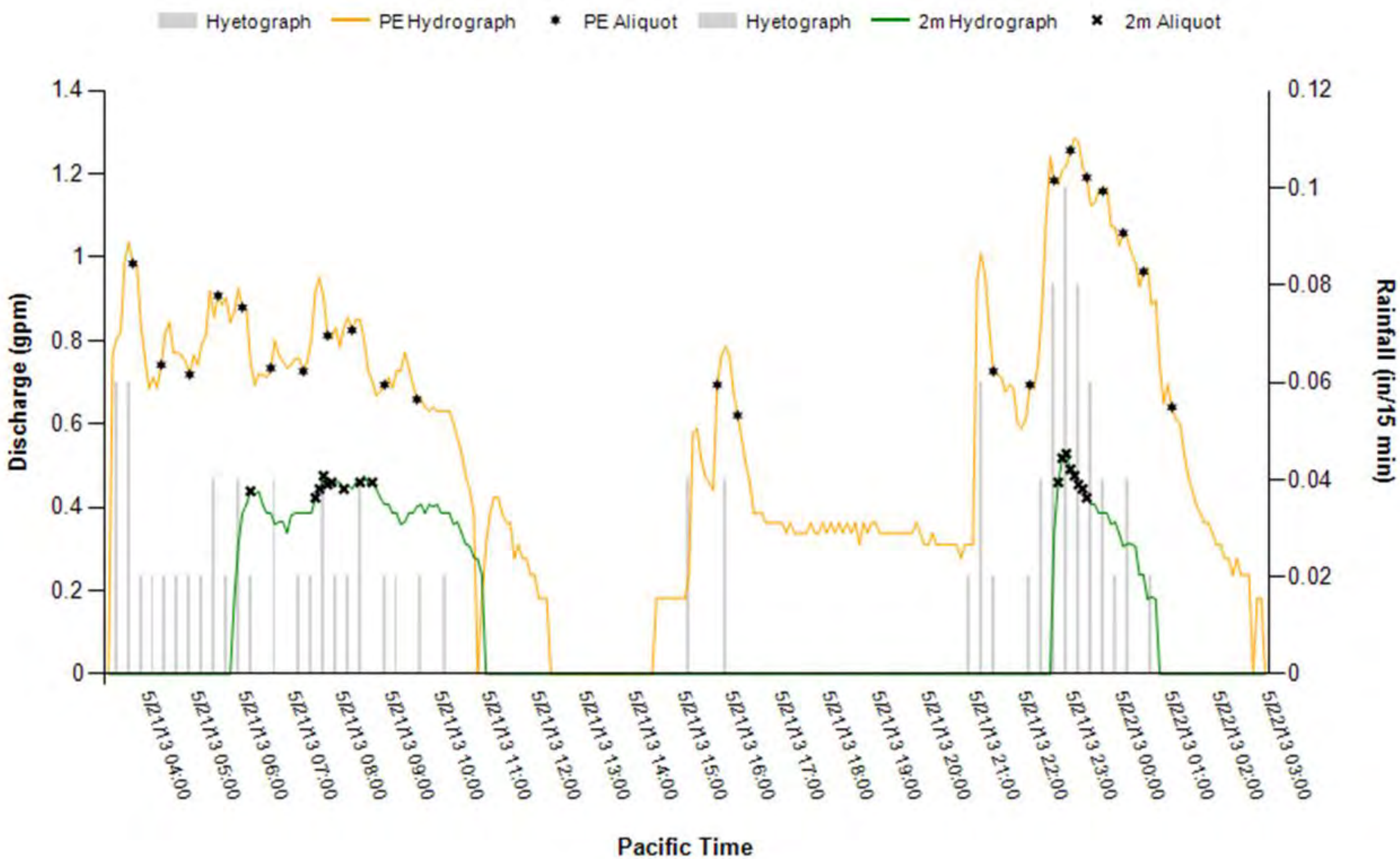
Precipitation				
Total (in)	Start Time	End Time	Duration (hrs)	Antecedent (hrs)
0.66	5/21/2013 3:10	5/22/2013 0:25	21.25	44.75

Aliquots							Water Temp		Validation Code
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)	
PE	22	5/21/2013 3:40	5/22/2013 1:00	21.33	250	5,500	8.83	12.09	J
2	17	5/21/2013 6:05	5/21/2013 23:15	17.17	250	4,250	8.83	12.09	

Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	5/21/2013 3:15	5/22/2013 5:55	26.67	801.61	30.06	797.08	797.08	100.00	1.29	0.18	0.58	0.157
2	5/21/2013 5:45	5/22/2013 0:40	18.92	168.67	8.92	168.67	142.23	84.32	0.53	0.18	0.38	0.016

J=Estimate of Hydrology information

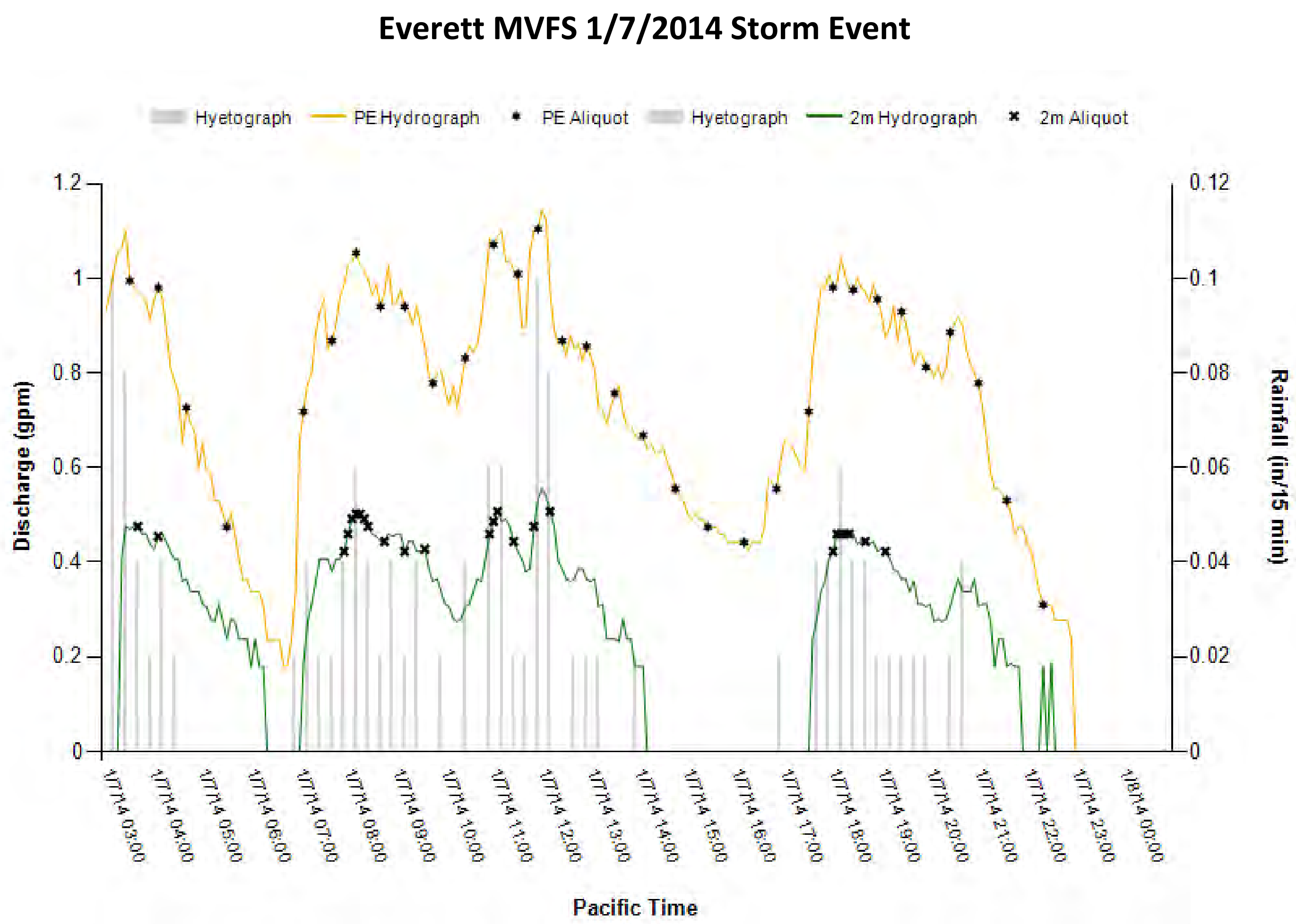
Everett MVFS 5/21/13 Storm Event



Precipitation				
Total (in)	Start Time	End Time	Duration (hrs)	Antecedent (hrs)
0.77	01/07/2014 02:55	01/07/2014 20:35	17.67	101

Aliquots							Water Temp		Validation Code
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)	
PE	36	01/07/2014 03:25	01/08/2014 01:25	22.00	250	9,000	2.80	7.06	
2	25	01/07/2014 03:35	01/07/2014 19:00	15.42	250	6,250	2.87	7.06	

Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	01/07/2014 02:55	01/08/2014 00:45	21.83	884.9	40.5	884.9	884.9	100.00	1.14	0.00	0.73	0.116
2	01/07/2014 03:15	01/07/2014 22:25	19.17	316.5	16.5	316.5	265.0	83.70	0.55	0.18	0.36	0.018


Everett MVFS 1/7/2014 Storm Event
Hyetograph
PE Hydrograph
PE Aliquot
Hyetograph
2m Hydrograph
2m Aliquot
Discharge (gpm)
Rainfall (in/15 min)
Pacific Time
1.2
1
0.8
0.6
0.4
0.2
0
0.12
0.1
0.08
0.06
0.04
0.02
0
1/7/14 03:00
1/7/14 04:00
1/7/14 05:00
1/7/14 06:00
1/7/14 07:00
1/7/14 08:00
1/7/14 09:00
1/7/14 10:00
1/7/14 11:00
1/7/14 12:00
1/7/14 13:00
1/7/14 14:00
1/7/14 15:00
1/7/14 16:00
1/7/14 17:00
1/7/14 18:00
1/7/14 19:00
1/7/14 20:00
1/7/14 21:00
1/7/14 22:00
1/7/14 23:00
1/8/14 00:00

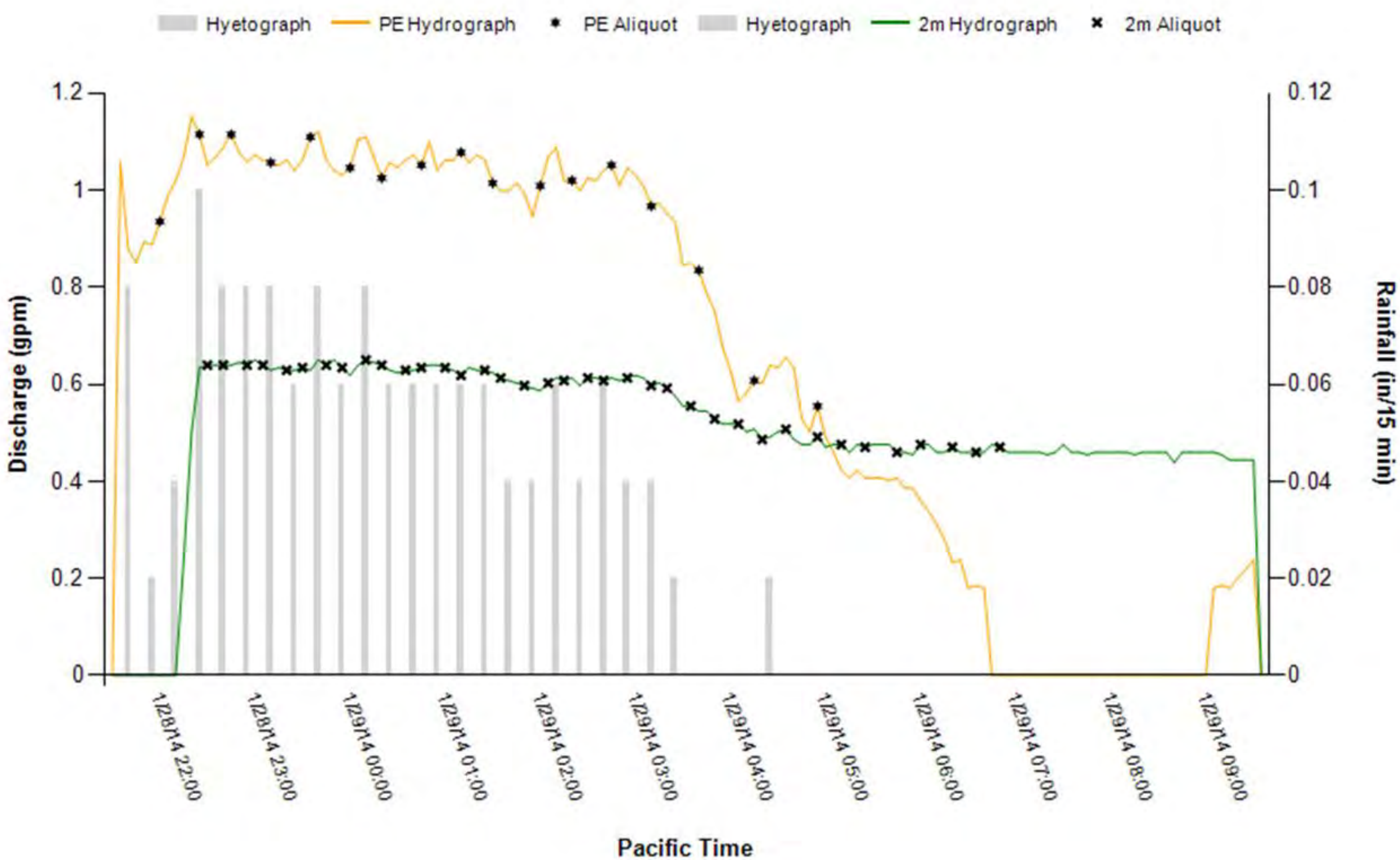
Precipitation				
Total (in)	Start Time	End Time	Duration (hrs)	Antecedent (hrs)
0.71	01/28/2014 21:30	01/29/2014 04:20	6.83	386.74

Aliquots							Water Temp		Validation Code
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)	
PE	17	01/28/2014 22:00	01/29/2014 04:55	6.92	250	4,250	6.34	7.36	
2	37	01/28/2014 22:30	01/29/2014 06:50	8.33	250	9,250	6.21	7.24	
4	37	01/28/2014 22:40	01/29/2014 03:30	4.83	250	9,250	6.42	7.24	R

Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	01/28/2014 21:35	01/29/2014 09:30	11.92	467.2	39.2	467.2	426.7	91.30	1.15	0.18	0.82	0.118
2	01/28/2014 22:15	01/29/2014 09:30	11.25	362.3	32.2	362.3	293.6	81.00	0.65	0.24	0.54	0.027
4	01/28/2014 22:30	01/29/2014 09:30	11.00	250.0	22.7	250.0	147.2	58.90	0.57	0.18	0.38	0.019

Rejected because less than 75% of the hydrograph was sampled.

Everett MVFS 1/28/2014 Storm Event



Precipitation				
Total (in)	Start Time	End Time	Duration (hrs)	Antecedent (hrs)
0.30	04/08/2014 15:15	04/08/2014 22:10	6.92	58.75

Aliquots							Water Temp		Validation Code
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)	
PE	19	04/08/2014 15:45	04/09/2014 01:45	10.00	250	4,750	6.58	14.72	
2	20	04/08/2014 15:50	04/08/2014 22:05	6.25	250	5,000	9.36	14.72	R

Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	04/08/2014 15:20	04/09/2014 02:35	11.25	406.1	36.1	406.1	396.9	97.70	1.20	0.18	0.68	0.132
2	04/08/2014 15:35	04/09/2014 03:35	12.00	202.5	16.9	202.5	134.3	66.30	0.55	0.18	0.30	0.018

Rejected because less than 75% of the hydrograph was sampled.

Precipitation				
Total (in)	Start Time	End Time	Duration (hrs)	Antecedent (hrs)
0.38	04/21/2014 22:40	04/22/2014 06:10	7.50	51

Aliquots							Water Temp		Validation Code
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)	
PE	25	04/21/2014 23:05	04/22/2014 07:10	8.08	250	6,250	6.39	9.99	
2	24	04/21/2014 23:25	04/22/2014 06:15	6.83	250	6,000	6.60	9.77	R

Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	04/21/2014 22:45	04/22/2014 11:00	12.25	572.7	46.8	572.7	496.4	86.70	1.15	0.23	0.78	0.116
2	04/21/2014 23:05	04/22/2014 10:35	11.50	273.4	23.8	273.4	191.7	70.10	0.52	0.18	0.39	0.015

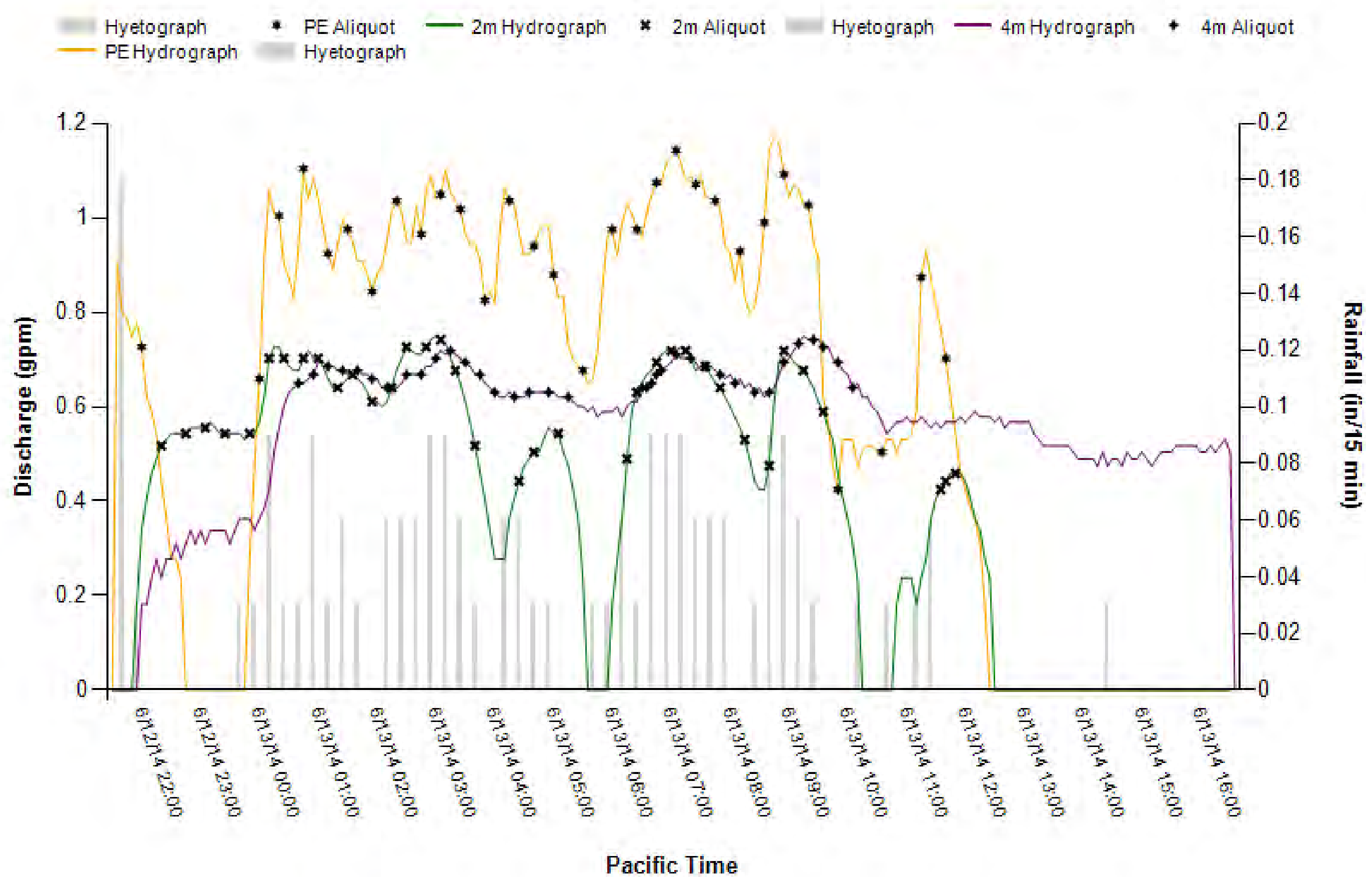
Rejected because less than 75% of the hydrograph was sampled.

Precipitation				
Total (in)	Start Time	End Time	Duration (hrs)	Antecedent (hrs)
0.78	06/12/2014 21:30	06/13/2014 14:15	16.75	76.41

Aliquots							Water Temp		Validation Code
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)	
PE	30	06/12/2014 22:00	06/13/2014 11:40	13.67	250	7,500	12.90	15.90	
2	36	06/12/2014 22:20	06/13/2014 11:50	13.50	250	9,000	12.90	15.60	
4	36	06/13/2014 00:40	06/13/2014 10:05	9.42	250	9,000	12.90	13.80	

Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	06/12/2014 21:35	06/13/2014 12:20	14.75	691.0	46.8	691.0	674.6	97.60	1.17	0.18	0.84	0.123
2	06/12/2014 21:55	06/13/2014 12:25	14.50	442.7	30.5	442.7	430.1	97.20	0.75	0.18	0.54	0.039
4	06/12/2014 22:00	06/13/2014 16:30	18.50	640.0	34.6	640.0	433.2	82.45	0.75	0.18	0.57	0.039

Everett MVFS 6/12/2014 Storm Event



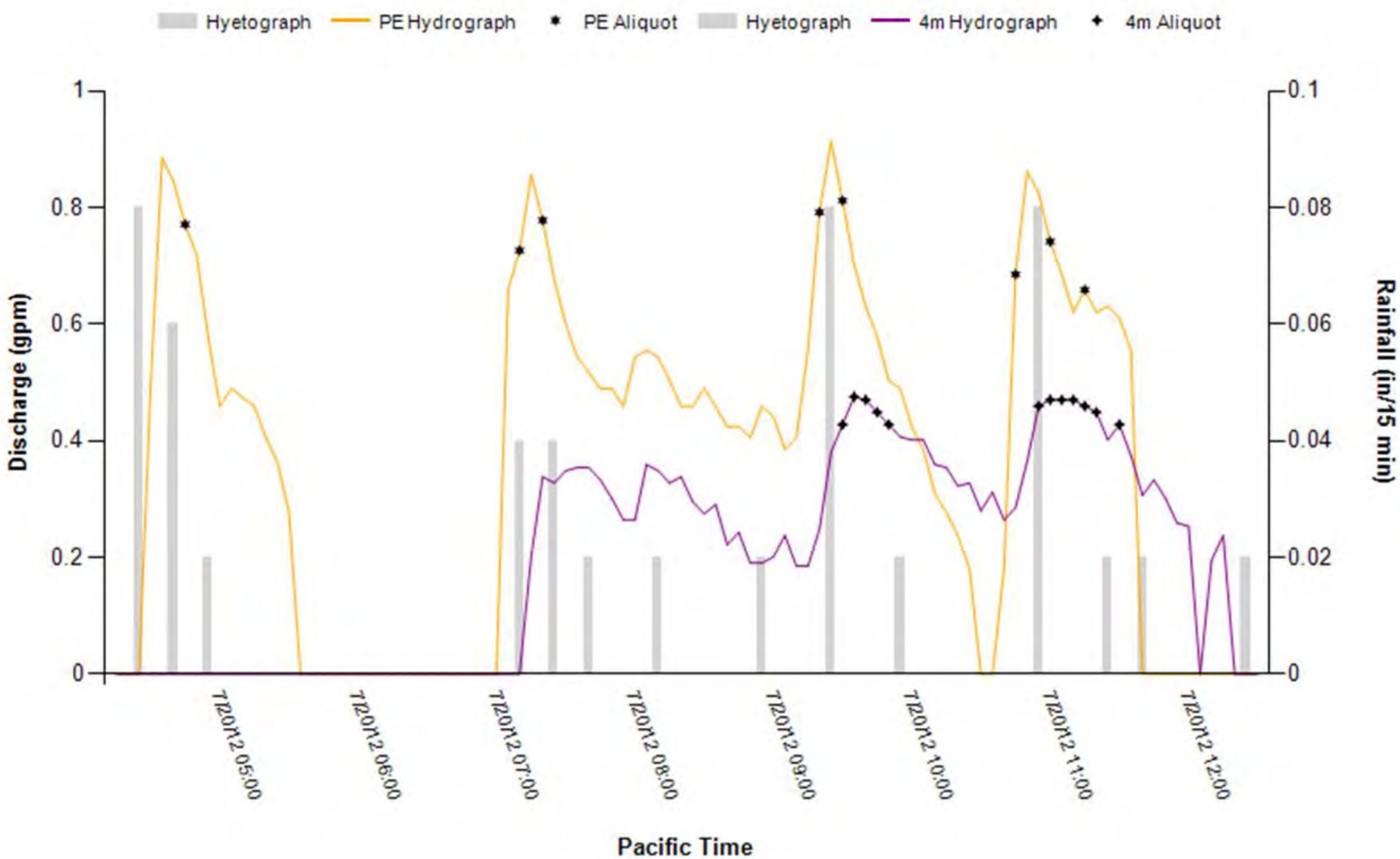
Pilchuck VFS

Precipitation				
Total (in)	**Start Time**	**End Time**	**Duration (hrs)**	**Antecedent (hrs)**
0.27	07/20/2012 04:15	07/20/2012 12:20	8.08	67.24

Aliquots							Water Temp		Validation Code
Sample Point (m)	**Aliquots Collected**	**First Aliquot Time**	**Last Aliquot Time**	**Sampling Duration (hrs)**	**Volume (mL)**	**Total Sample Volume (mL)**	**Min (C°)**	**Max (C°)**	
PE	8	07/20/2012 04:45	07/20/2012 11:15	6.50	250	2,000	16.48	17.59	
4	12	07/20/2012 09:30	07/20/2012 11:30	2.00	250	3,000	17.00	17.59	

Runoff / Discharge												
	Runoff Time			**Volume**			**Sampled**		**Flow**			**Stage**
Sample Point (m)	**Start Time**	**End Time**	**Duration (hrs)**	**Total (gal)**	**Intensity (gal/hr)**	**First 24Hrs (gal)**	**Discharge Total Volume Sampled (gal)**	**% Hydrograph Sampled**	**Peak (gpm)**	**Min (gpm)**	**Mean (gpm)**	**Max (ft)**
PE	07/20/2012 04:30	07/20/2012 11:35	7.08	182.2	25.7	182.2	170.1	93.40	0.91	0.18	0.55	0.065
4	07/20/2012 07:15	07/20/2012 12:15	5.00	99.0	19.8	99.0	87.7	88.60	0.48	0.18	0.33	0.012

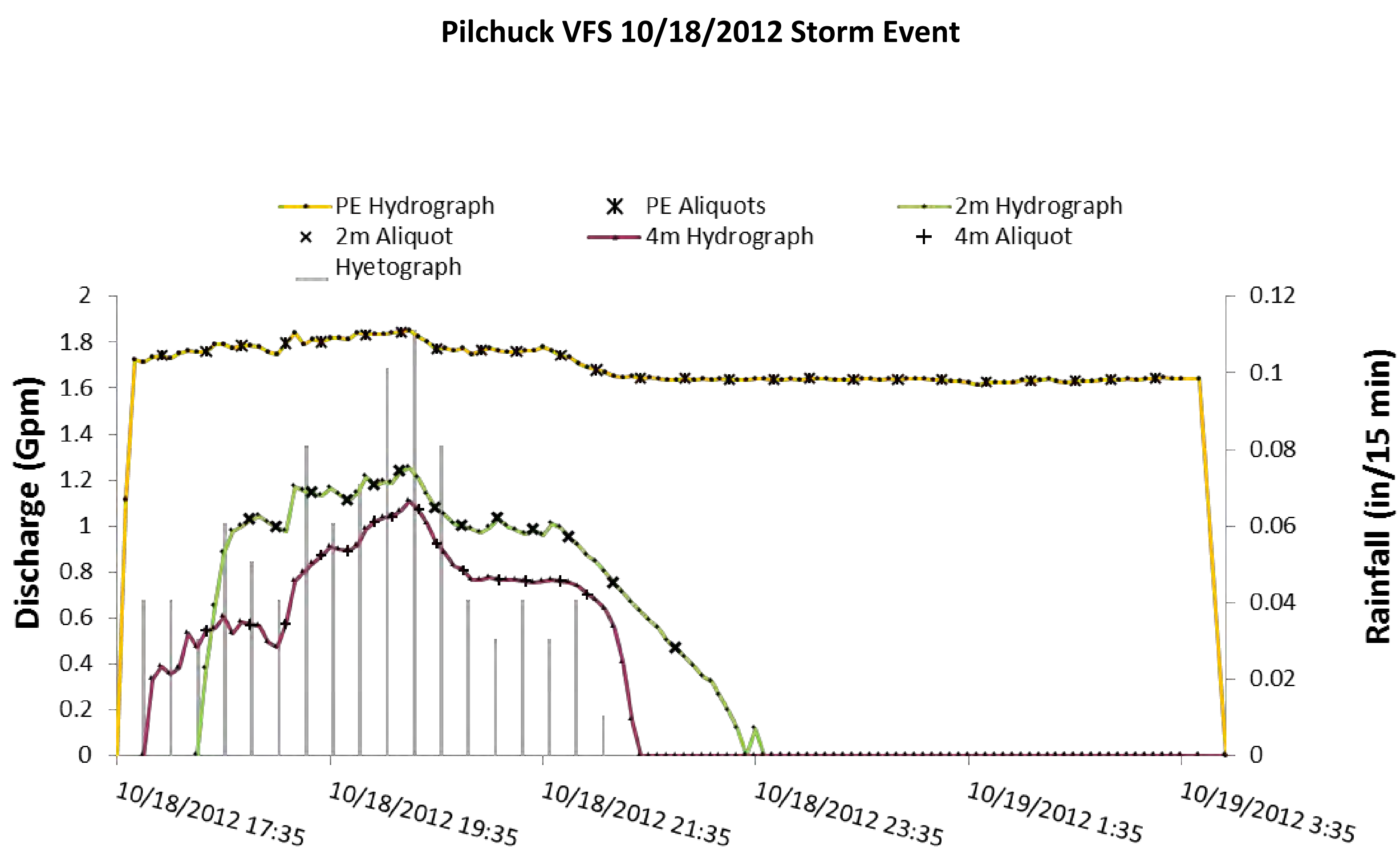
Pilchuck VFS 7/20/2012 Storm Event



Precipitation				
Total (in)	Start Time	End Time	Duration (hrs)	Antecedent (hrs)
0.95	10/18/2012 17:35	10/18/2012 21:50	4.25	62.74

Aliquots							Water Temp		Validation Code
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)	
PE	25	10/18/2012 18:00	10/19/2012 3:20	9.33	250	6,250	11.25	12.98	
2	13	10/18/2012 18:50	10/19/2012 22:50	4.00	250	3,250	11.25	11.79	
4	14	10/18/2012 18:25	10/18/2012 22:00	3.58	250	3,500	11.31	11.79	

Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	10/18/2012 17:40	10/19/2012 3:45	10.08	1,025.60	101.75	1,025.60	992.71	96.79	1.85	1.11	1.70	0.119
2	10/18/2012 18:25	10/18/2012 23:35	5.17	270.51	52.32	270.51	259.65	95.99	1.25	0.12	0.55	0.147
4	10/18/2012 17:55	10/18/2012 22:25	4.50	198.34	44.08	198.34	186.16	93.86	1.11	0.15	0.46	0.107

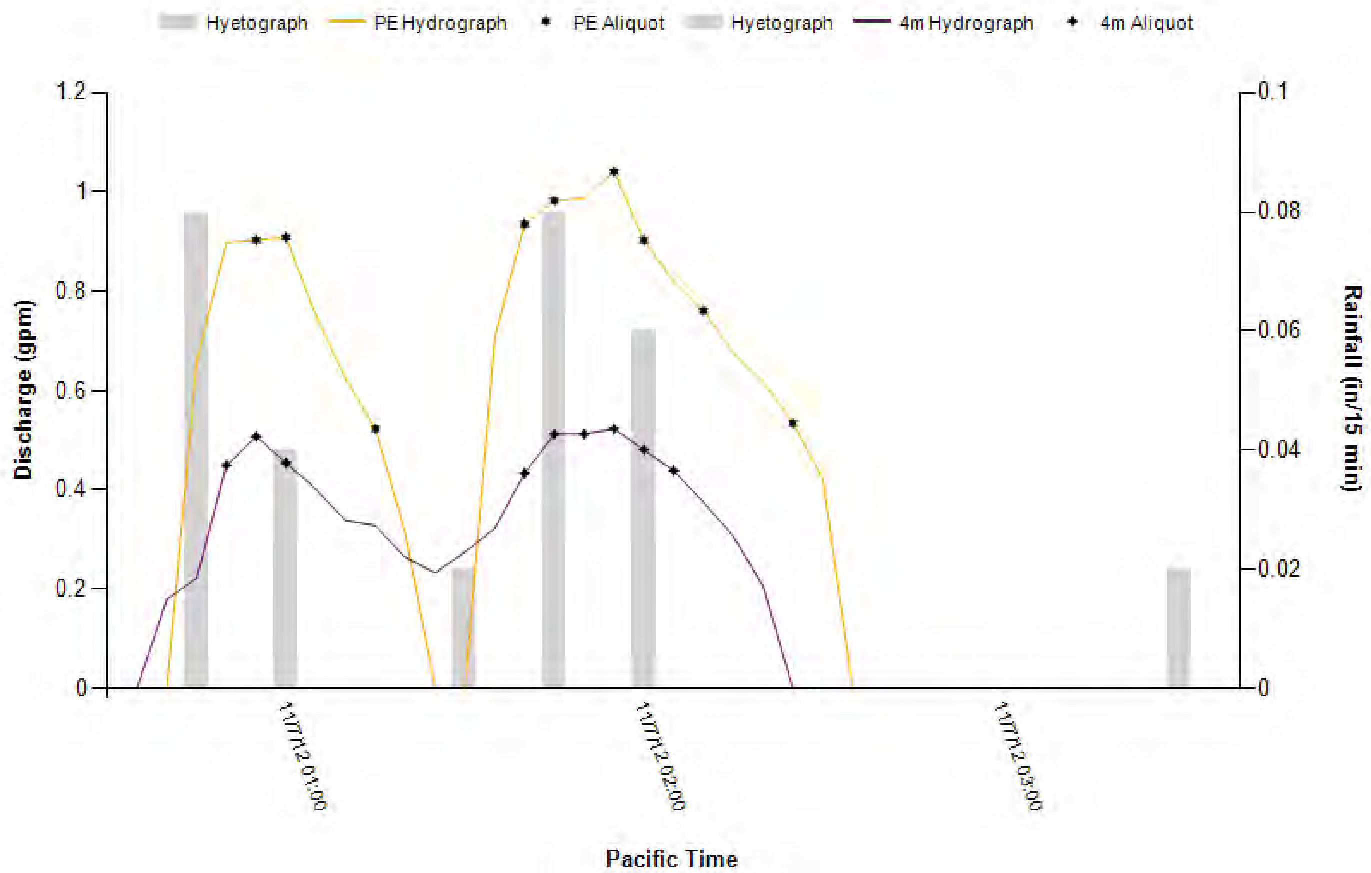

Pilchuck VFS 10/18/2012 Storm Event
PE Hydrograph
PE Aliquots
2m Hydrograph
2m Aliquot
4m Hydrograph
4m Aliquot
Hyetograph
Discharge (Gpm)
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Rainfall (in/15 min)
0.12
0.1
0.08
0.06
0.04
0.02
0
10/18/2012 17:35
10/18/2012 19:35
10/18/2012 21:35
10/18/2012 23:35
10/19/2012 1:35
10/19/2012 3:35

Precipitation				
Total (in)	Start Time	End Time	Duration (hrs)	Antecedent (hrs)
0.15	11/7/2012 0:35	11/7/2012 3:25	2.83	49.5

Aliquots							Water Temp		Validation Code
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)	
PE	9	11/7/2012 0:55	11/7/2012 2:25	1.50	250	2,250	9.18	10.56	
4	9	11/7/2012 0:50	11/7/2012 2:05	1.25	250	2,250	9.24	10.56	

Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	11/7/2012 0:45	11/7/2012 2:30	1.75	74.84	42.77	74.84	72.73	97.18	1.04	0.31	0.75	0.091
4	11/7/2012 0:40	11/7/2012 2:20	1.67	38.81	23.24	38.81	34.37	88.56	0.52	0.18	0.37	0.015

Pilchuck VFS 11/7/2012 Storm Event



Precipitation				
Total (in)	Start Time	End Time	Duration (hrs)	Antecedent (hrs)
0.62	12/11/2012 9:35	12/12/2012 11:30	25.92	37.25

Aliquots							Water Temp		Validation code
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)	
PE	N/A	N/A	N/A	N/A	N/A	N/A	5.18	6.54	
4	37	12/11/2012 13:55	12/12/2012 11:35	21.67	250	9,250	4.40	6.34	

Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	12/11/2012 9:45	12/12/2012 12:40	26.92	779.94	28.97	708.09	N/A	N/A	0.97	0.08	0.52	0.076
4	12/11/2012 10:15	12/12/2012 15:20	29.08	472.34	16.24	417.87	417.87	100.00	0.76	0.07	0.33	0.040

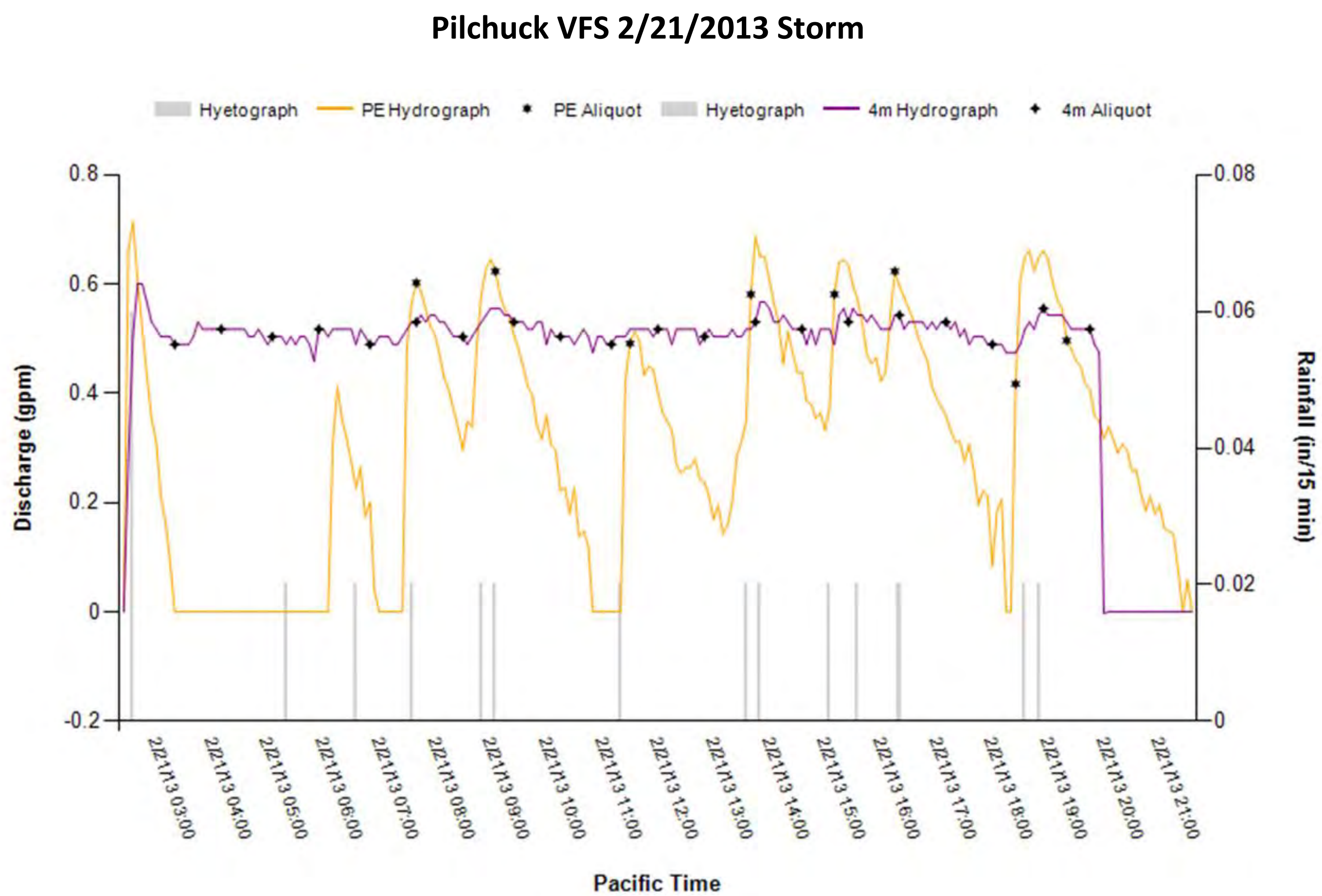
Only grab samples collected at influent.

Precipitation				
Total (in)	Start Time	End Time	Duration (hrs)	Antecedent (hrs)
0.16	2/21/2013 2:25	2/21/2013 18:50	16.42	37.99

Aliquots							Water Temp		Validation Code
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)	
PE	8	2/21/2013 7:40	2/21/2013 19:20	11.67	250	2,000	3.72	5.88	
4	22	02/21/2013 11:20	02/22/2013 05:30	18.17	250	5,500	3.43	5.88	J

Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	2/21/2013 2:30	2/21/2013 21:30	19.00	351.43	18.50	351.43	317.09	90.23	0.71	0.04	0.39	0.035
4	02/21/2013 10:30	02/22/2013 05:15	18.75	348.94	18.61	348.94	348.94	100.00	0.72	0.18	0.41	0.022

J=Estimate of Hydrology information



Pilchuck VFS 2/21/2013 Storm
Hyetograph
PE Hydrograph
PE Aliquot
Hyetograph
4m Hydrograph
4m Aliquot
Discharge (gpm)
Rainfall (in/15 min)
0.8
0.6
0.4
0.2
0
-0.2
0.08
0.06
0.04
0.02
0
2/21/13 03:00
2/21/13 04:00
2/21/13 05:00
2/21/13 06:00
2/21/13 07:00
2/21/13 08:00
2/21/13 09:00
2/21/13 10:00
2/21/13 11:00
2/21/13 12:00
2/21/13 13:00
2/21/13 14:00
2/21/13 15:00
2/21/13 16:00
2/21/13 17:00
2/21/13 18:00
2/21/13 19:00
2/21/13 20:00
2/21/13 21:00
Pacific Time

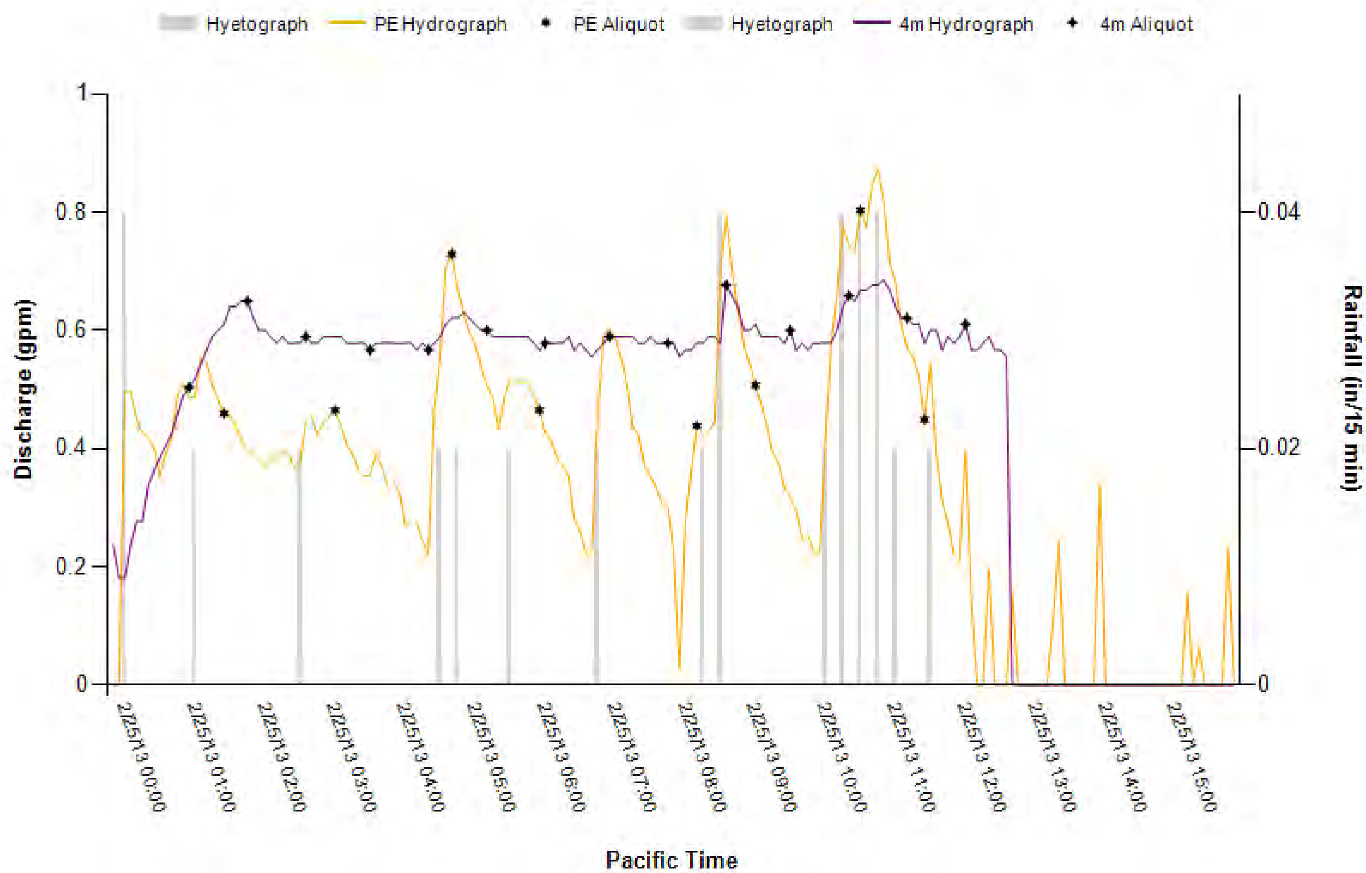
Precipitation				
Total (in)	**Start Time**	**End Time**	**Duration (hrs)**	**Antecedent (hrs)**
0.20	2/24/2013 23:50	2/25/2013 11:25	11.58	38

Aliquots							Water Temp		Validation code
Sample Point (m)	**Aliquots Collected**	**First Aliquot Time**	**Last Aliquot Time**	**Sampling Duration (hrs)**	**Volume (mL)**	**Total Sample Volume (mL)**	**Min (C°)**	**Max (C°)**	
PE	8	2/25/2013 1:25	2/25/2013 11:25	10.00	250	2,000	4.74	5.21	J
4	19	2/25/2013 0:55	2/25/2013 16:20	15.42	250	4,750	4.74	8.57	J

Runoff / Discharge												
	Runoff Time			**Volume**			**Sampled**		**Flow**			**Stage**
Sample Point (m)	**Start Time**	**End Time**	**Duration (hrs)**	**Total (gal)**	**Intensity (gal/hr)**	**First 24Hrs (gal)**	**Discharge Total Volume Sampled (gal)**	**% Hydrograph Sampled**	**Peak (gpm)**	**Min (gpm)**	**Mean (gpm)**	**Max (ft)**
PE	2/25/2013 0:00	2/25/2013 15:45	15.75	337.45	21.43	337.45	317.53	94.10	0.87	0.03	0.44	0.057
4	2/24/2013 23:55	2/25/2013 16:45	16.83	774.13	46.00	774.13	755.29	97.57	0.84	0.60	0.76	0.052

J=Estimate of Hydrology information

Pilchuck VFS 2/24/2013 Storm Event



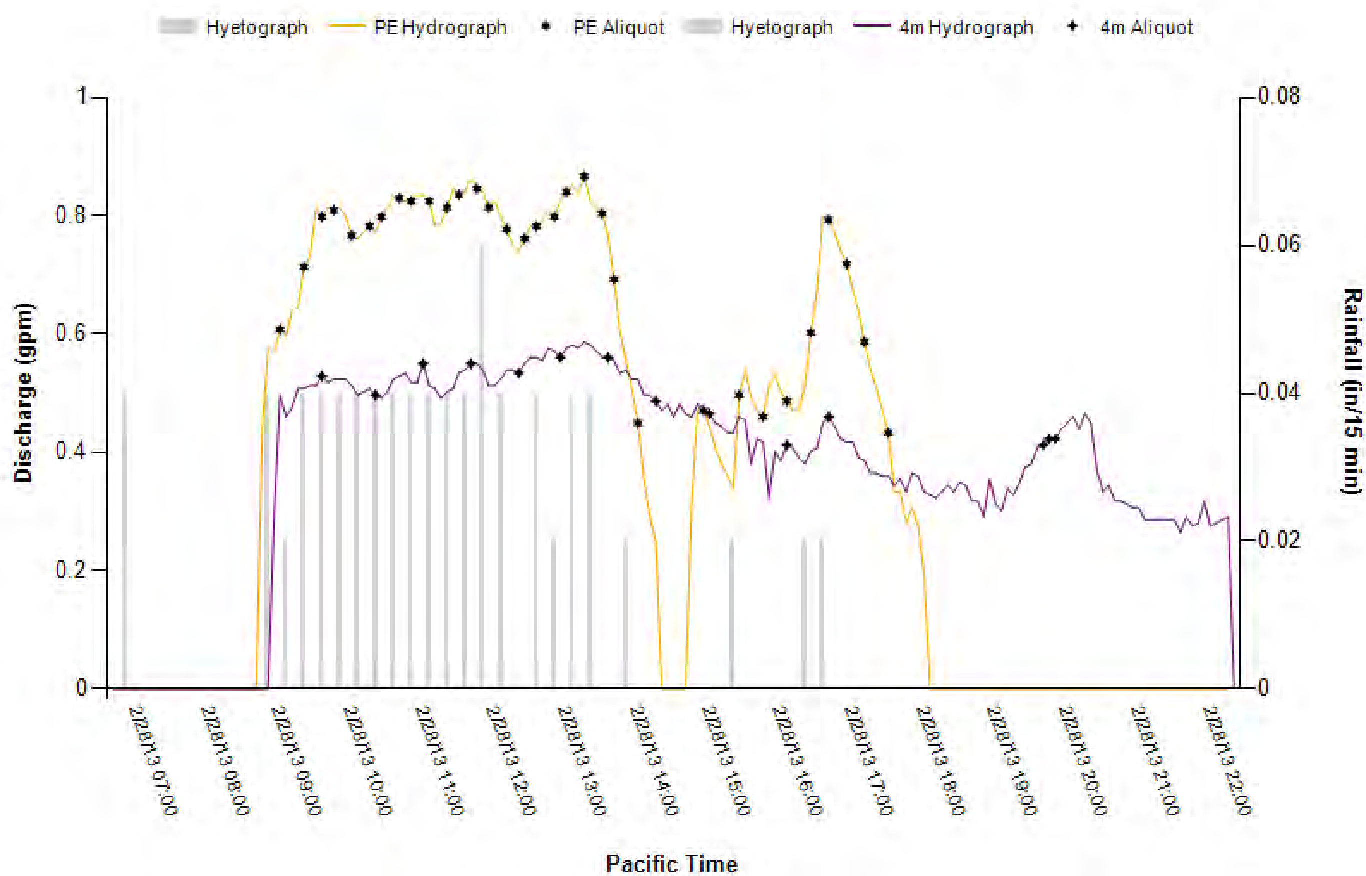
Precipitation				
Total (in)	Start Time	End Time	Duration (hrs)	Antecedent (hrs)
0.41	2/28/2013 6:40	2/28/2013 16:35	9.92	67.75

Aliquots							Water Temp		Validation Code
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)	
PE	32	2/28/2013 9:00	2/28/2013 17:30	8.50	250	8,000	5.46	7.77	
2	9	2/28/2013 11:45	2/28/2013 13:30	1.75	250	2,250	7.01	7.71	R
4	14	2/28/2013 9:35	2/28/2013 19:50	10.25	250	3,500	5.87	8.22	

Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	02/28/2013 16:45	2/28/2013 18:00	9.25	347.12	37.53	347.12	338.51	97.52	0.87	0.20	0.65	0.057
2	2/28/2013 11:00	2/28/2013 22:15	11.25	55.08	4.90	55.08	43.51	78.99	0.50	0.07	0.35	0.014
4	2/28/2013 8:55	2/28/2013 22:15	13.33	348.26	26.13	348.26	301.82	86.66	0.59	0.26	0.44	0.021

Rejected because hydrology information is unreliable.

Pilchuck VFS 2/28/2013 Storm Event



Precipitation				
Total (in)	Start Time	End Time	Duration (hrs)	Antecedent (hrs)
0.33	3/2/2013 14:40	3/2/2013 18:30	3.83	46.24

Aliquots							Water Temp		Validation Code
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)	
PE	10	3/2/2013 15:05	3/2/2013 17:55	2.83	250	2,500	6.85	9.20	
2	19	3/2/2013 15:35	3/2/2013 17:05	1.50	250	4,750	7.17	8.65	R

Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	3/2/2013 14:45	3/2/2013 18:20	3.58	182.60	51.00	182.60	171.92	94.16	0.98	0.20	0.83	0.079
2	3/2/2013 14:45	3/2/2013 17:10	2.42	57.09	23.59	57.09	55.87	97.87	0.63	0.18	0.50	0.025

Rejected because hydrology information is unreliable.

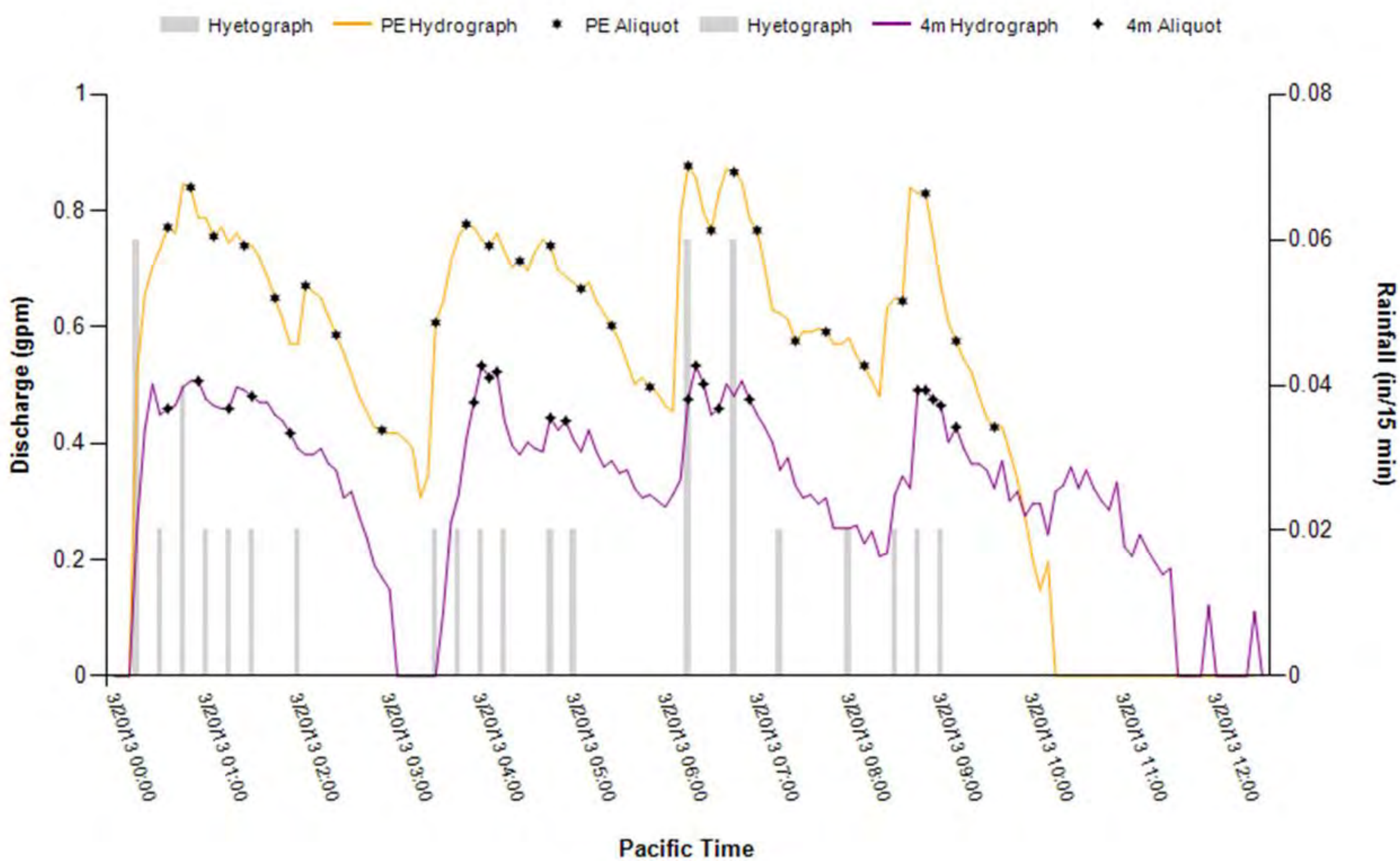
Precipitation				
Total (in)	Start Time	End Time	Duration (hrs)	Antecedent (hrs)
0.27	3/20/2013 0:10	3/20/2013 8:50	8.83	41.74

Aliquots							Water Temp		Validation Code
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)	
PE	27	3/20/2013 0:35	3/20/2013 9:35	9.00	250	6,750	6.64	8.99	
2	37	3/20/2013 6:30	3/20/2013 12:30	6.00	250	9,250	7.98	11.68	R
4	21	3/20/2013 0:35	3/20/2013 9:10	8.58	250	5,250	6.64	8.72	

Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	3/20/2013 0:15	3/20/2013 10:10	9.92	373.70	37.67	373.70	363.84	97.36	0.88	0.15	0.62	0.059
2	3/20/2013 4:55	3/20/2013 14:30	9.58	368.12	38.43	368.12	256.72	69.74	1.04	0.14	0.73	0.090
4	3/20/2013 0:15	3/20/2013 12:25	12.17	238.34	19.58	238.34	195.88	82.19	0.53	0.11	0.30	0.016

Rejected because less than 75% of the hydrograph was sampled.

Pilchuck VFS 3/20/2013 Storm Event

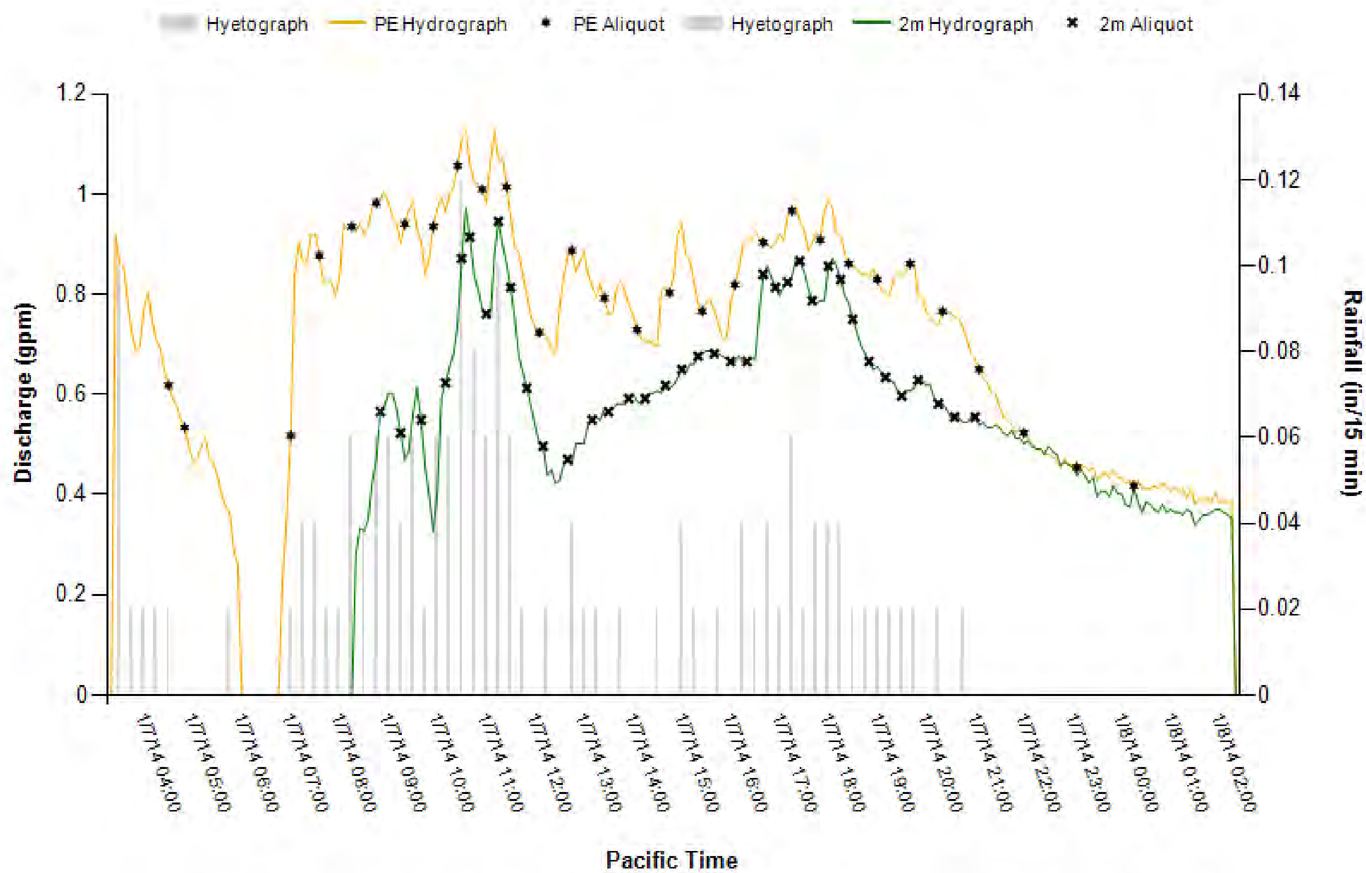


Precipitation				
Total (in)	Start Time	End Time	Duration (hrs)	Antecedent (hrs)
0.97	01/07/2014 03:20	01/07/2014 20:35	17.25	79.75

Aliquots							Water Temp		Validation Code
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)	
PE	29	01/07/2014 04:30	01/08/2014 00:15	19.75	250	7,250	2.07	6.54	
2	37	01/07/2014 08:50	01/07/2014 21:00	12.17	250	9,250	3.81	6.54	

Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	01/07/2014 03:25	01/08/2014 02:15	22.83	964.6	42.3	964.6	920.2	95.40	1.13	0.23	0.73	0.111
2	01/07/2014 08:20	01/08/2014 02:15	17.92	621.1	34.7	621.1	489.5	78.80	0.97	0.28	0.58	0.076

Pilchuck VFS 1/7/2014 Storm Event

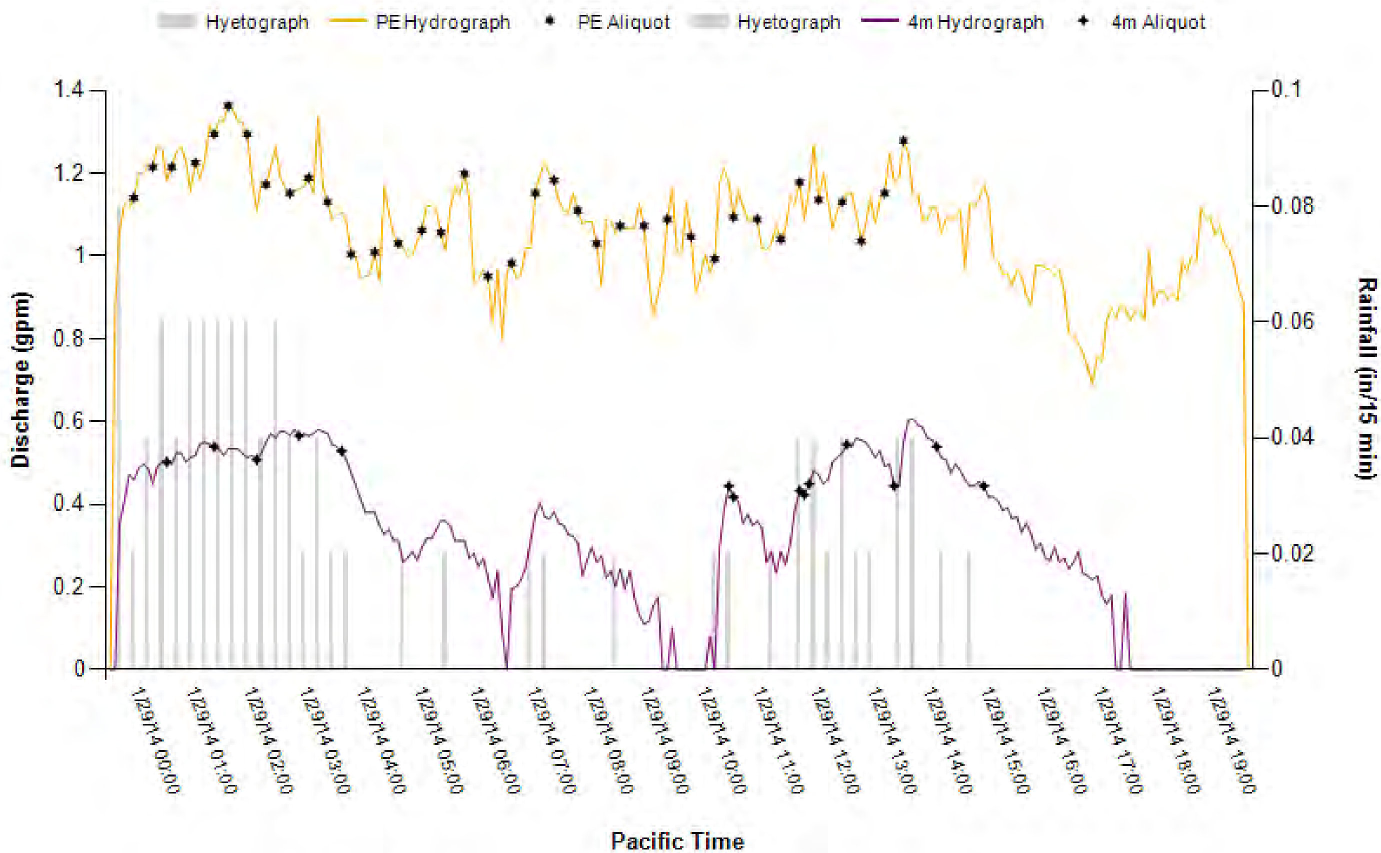


Precipitation				
Total (in)	**Start Time**	**End Time**	**Duration (hrs)**	**Antecedent (hrs)**
0.62	01/28/2014 23:30	01/29/2014 14:40	15.17	373.24

Aliquots							Water Temp		Validation Code
Sample Point (m)	**Aliquots Collected**	**First Aliquot Time**	**Last Aliquot Time**	**Sampling Duration (hrs)**	**Volume (mL)**	**Total Sample Volume (mL)**	**Min (C°)**	**Max (C°)**	
PE	37	01/28/2014 23:55	01/29/2014 13:30	13.58	250	9,250	5.82	8.87	
4	14	01/29/2014 00:30	01/29/2014 14:55	14.42	250	3,500	5.82	9.14	

Runoff / Discharge												
	Runoff Time			**Volume**			**Sampled**		**Flow**			**Stage**
Sample Point (m)	**Start Time**	**End Time**	**Duration (hrs)**	**Total (gal)**	**Intensity (gal/hr)**	**First 24Hrs (gal)**	**Discharge Total Volume Sampled (gal)**	**% Hydrograph Sampled**	**Peak (gpm)**	**Min (gpm)**	**Mean (gpm)**	**Max (ft)**
PE	01/28/2014 23:35	01/29/2014 19:30	19.92	1,280.3	64.3	1,280.3	931.5	72.80	1.36	0.69	1.07	0.181
4	01/28/2014 23:40	01/29/2014 17:25	17.75	392.1	22.1	392.1	351.5	89.70	0.61	0.08	0.39	0.023

Pilchuck VFS 1/28/2014 Storm Event

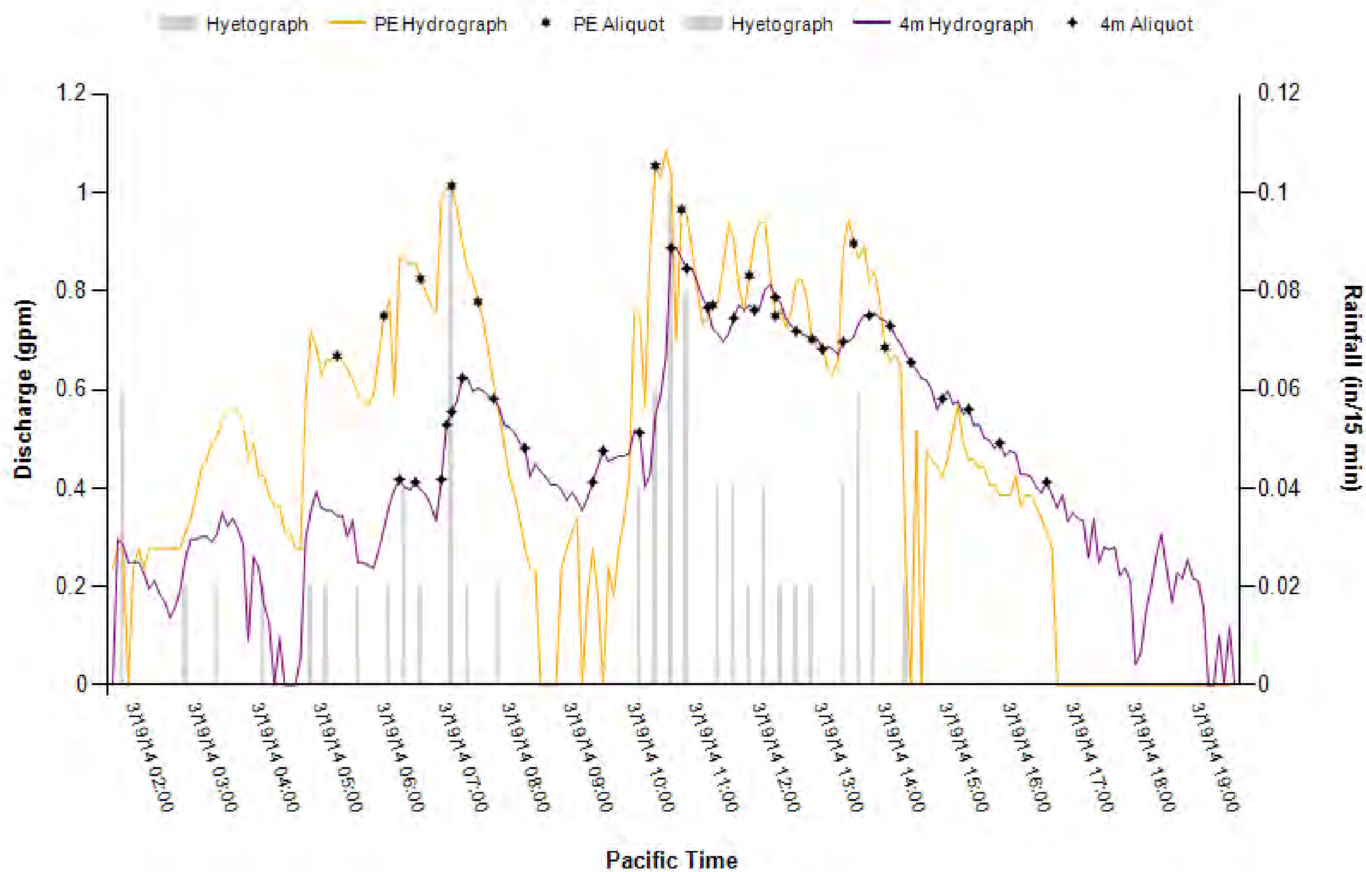


Precipitation				
Total (in)	Start Time	End Time	Duration (hrs)	Antecedent (hrs)
0.51	03/19/2014 01:40	03/19/2014 14:15	12.58	40

Aliquots							Water Temp		Validation Code
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)	
PE	13	03/19/2014 05:15	03/19/2014 14:00	8.75	250	3,250	7.28	8.92	
4	27	03/19/2014 06:15	03/19/2014 16:35	10.33	250	6,750	7.28	8.92	

Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	03/19/2014 01:40	03/19/2014 16:40	15.00	502.3	33.5	502.3	436.4	86.90	1.08	0.18	0.59	0.101
4	03/19/2014 01:45	03/19/2014 19:30	17.75	470.5	26.5	470.5	431.7	91.70	0.89	0.01	0.45	0.061

Pilchuck VFS 3/19/2014 Storm Event

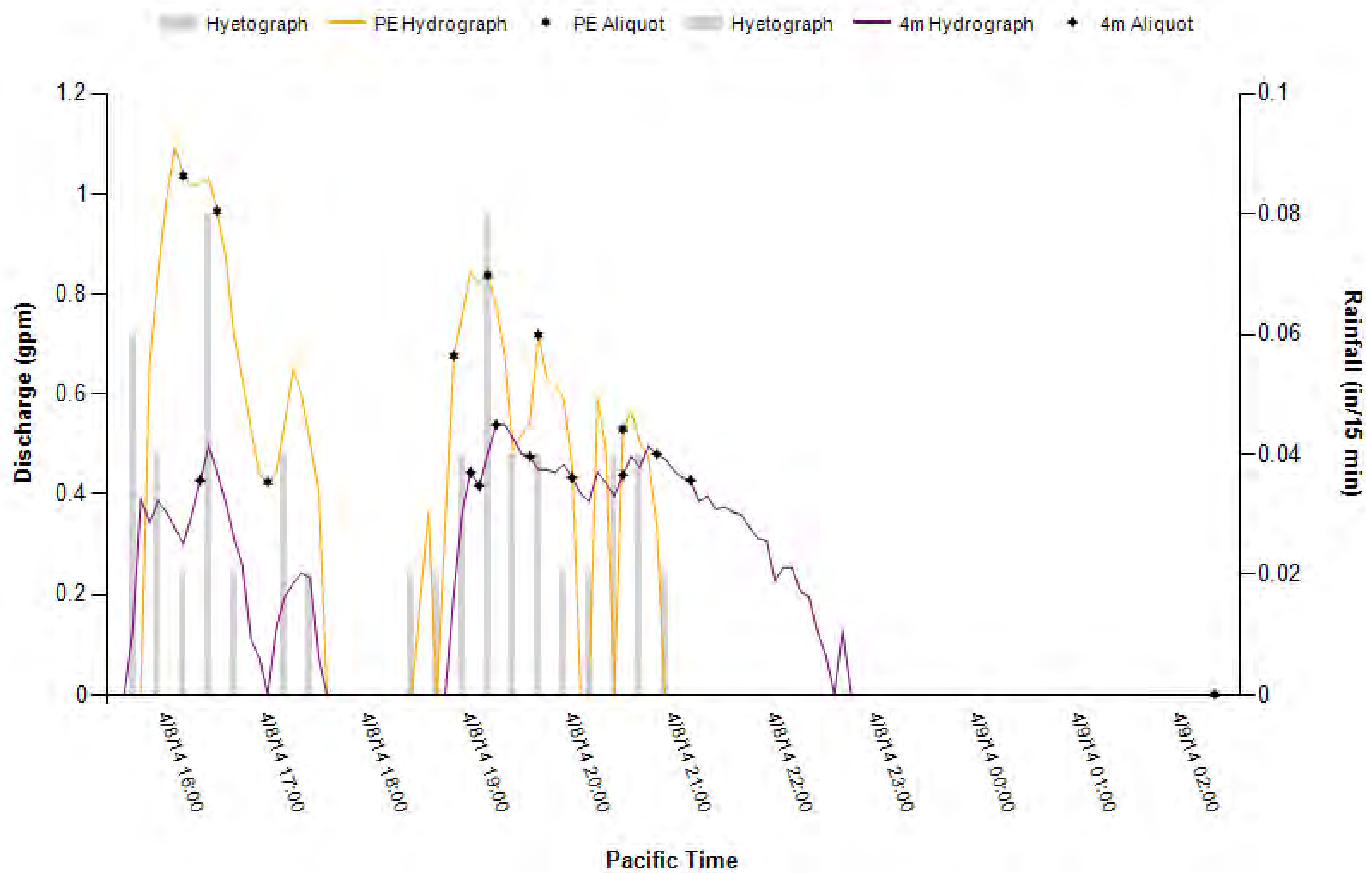


Precipitation				
Total (in)	Start Time	End Time	Duration (hrs)	Antecedent (hrs)
0.33	04/08/2014 15:30	04/08/2014 20:55	5.42	57.49

Aliquots							Water Temp		Validation Code
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)	
PE	12	04/08/2014 16:10	04/09/2014 02:20	10.17	250	3,000	6.39	13.78	
4	9	04/08/2014 16:20	04/08/2014 21:10	4.83	250	2,250	9.71	13.42	

Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	04/08/2014 15:50	04/09/2014 02:20	10.50	148.7	14.2	148.7	148.7	100.00	1.09	0.00	0.63	0.103
4	04/08/2014 15:40	04/08/2014 22:40	7.00	118.7	17.0	118.7	95.4	80.30	0.54	0.07	0.35	0.017

Pilchuck VFS 4/8/2014 Storm Event

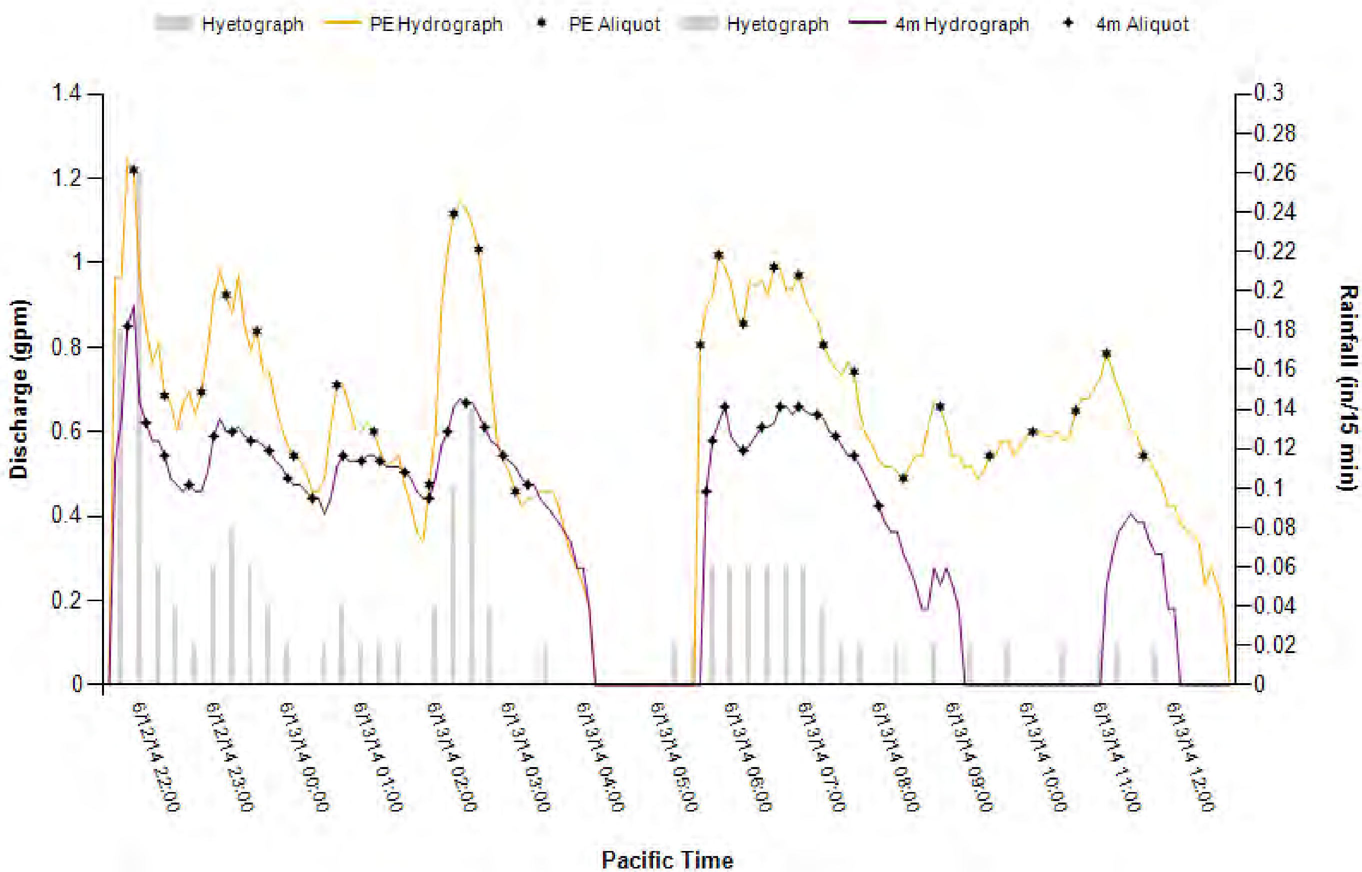


Precipitation				
Total (in)	Start Time	End Time	Duration (hrs)	Antecedent (hrs)
0.96	06/12/2014 21:35	06/13/2014 11:35	14.00	352.24

Aliquots							Water Temp		Validation Code
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)	
PE	26	06/12/2014 21:55	06/13/2014 11:35	13.67	250	6,500	12.60	14.90	
4	31	06/12/2014 21:50	06/13/2014 08:00	10.17	250	7,750	12.60	15.50	

Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	06/12/2014 21:40	06/13/2014 12:40	15.00	539.4	36.0	539.4	515.7	95.60	1.24	0.18	0.66	0.144
4	06/12/2014 21:40	06/13/2014 12:00	14.33	325.2	22.7	325.2	288.7	88.80	0.90	0.18	0.49	0.062

Pilchuck VFS 6/12/2014 Storm Event



Pilchuck CAVFS

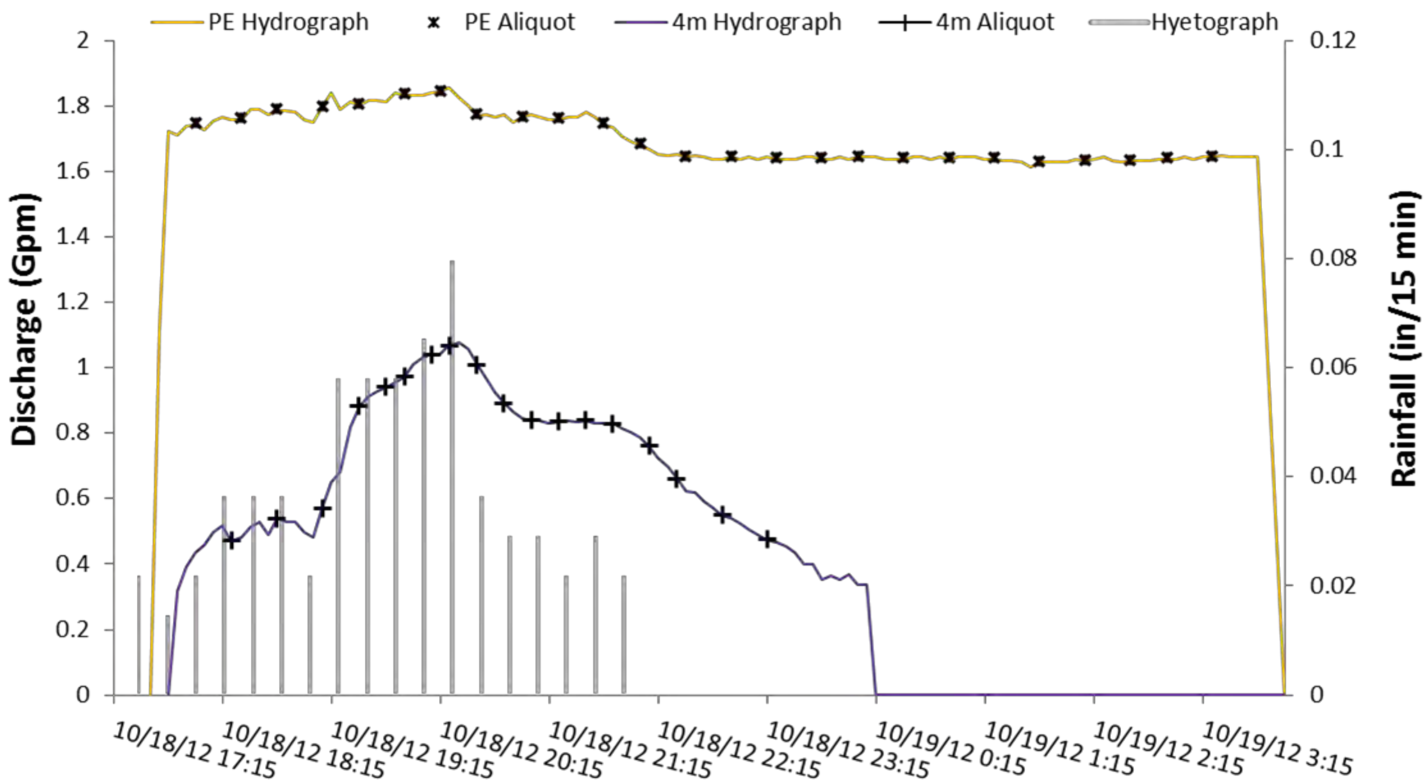
Precipitation				
Total (in)	Start Time	End Time	Duration (hrs)	Antecedent (hrs)
0.93	10/18/2012 17:25	10/18/2012 21:50	4.42	63.25

Aliquots							Water Temp		Validation Code
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)	
PE	25	10/18/2012 18:00	10/19/2012 3:20	9.33	250	6,250	11.25	12.98	
4	18	10/18/2012 18:20	10/18/2012 23:15	4.92	250	4,500	11.07	11.58	J

Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	10/18/2012 17:40	10/19/2012 3:45	10.08	1,025.60	101.75	1,025.60	992.71	96.79	1.85	1.11	1.70	0.119
4	10/18/2012 17:50	10/19/2012 0:15	6.42	266.92	41.58	266.92	239.50	89.73	1.21	0.32	0.68	0.099

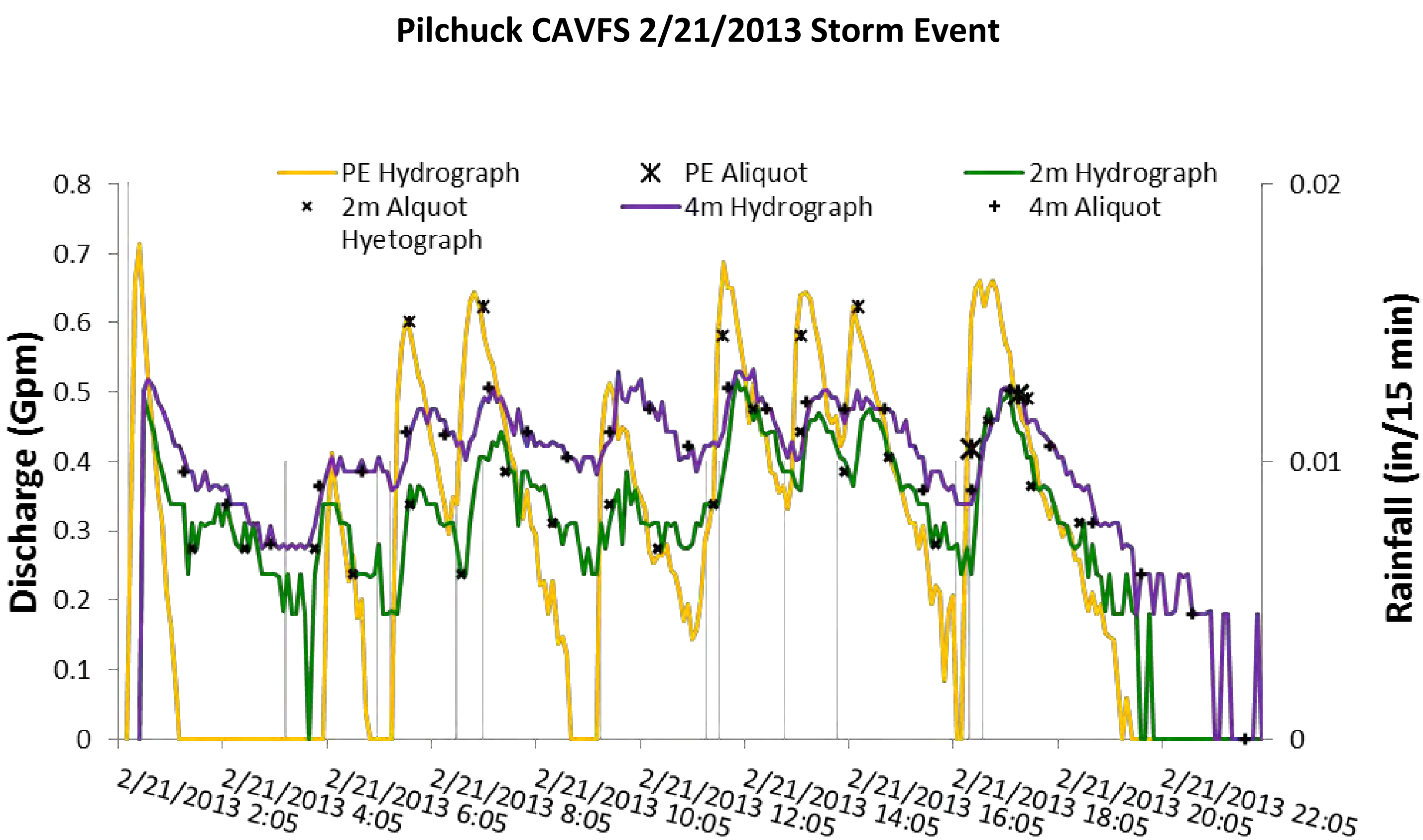
J=Estimate of Hydrology information

Pilchuck CAVFS 10/18/2012 Storm Event



Precipitation												
Total (in)	Start Time	End Time	Duration (hrs)	Antecedent (hrs)								
0.16	2/21/2013 2:30	2/21/2013 18:55	16.42	37.5								
Aliquots							**Water Temp**		**Validation Code**			
Sample Point (m)	**Aliquots Collected**	**First Aliquot Time**	**Last Aliquot Time**	**Sampling Duration (hrs)**	**Volume (mL)**	**Total Sample Volume (mL)**	**Min (C°)**	**Max (C°)**				
PE	8	2/21/2013 7:40	2/21/2013 19:20	11.67	250	2,000	3.72	5.88				
2	19	2/21/2013 3:30	2/21/2013 20:30	17.00	250	4,750	3.32	6.01	J			
4	26	2/21/2013 3:20	2/21/2013 23:40	20.33	250	6,500	3.32	6.01	J			
Runoff / Discharge												
	Runoff Time			**Volume**			**Sampled**		**Flow**			**Stage**
Sample Point (m)	**Start Time**	**End Time**	**Duration (hrs)**	**Total (gal)**	**Intensity (gal/hr)**	**First 24Hrs (gal)**	**Discharge Total Volume Sampled (gal)**	**% Hydrograph Sampled**	**Peak (gpm)**	**Min (gpm)**	**Mean (gpm)**	**Max (ft)**
PE	2/21/2013 2:30	2/21/2013 21:30	19.00	351.43	18.50	351.43	317.09	90.23	0.71	0.04	0.39	0.035
2	2/21/2013 02:30	2/21/2013 21:45	19.25	382.6	19.9	382.6	369.0	96.40	0.52	0.18	0.33	0.015
4	2/21/2013 02:30	2/21/2013 23:50	21.33	496.8	23.3	496.8	495.9	99.80	0.53	0.18	0.40	0.016

J=Estimate of Hydrology information



Pilchuck CAVFS 2/21/2013 Storm Event
PE Hydrograph
PE Aliquot
2m Hydrograph
2m Alquot
4m Hydrograph
4m Aliquot
Hyetograph
Discharge (Gpm)
Rainfall (in/15 min)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.02
0.01
0
2/21/2013 2:05
2/21/2013 4:05
2/21/2013 6:05
2/21/2013 8:05
2/21/2013 10:05
2/21/2013 12:05
2/21/2013 14:05
2/21/2013 16:05
2/21/2013 18:05
2/21/2013 20:05
2/21/2013 22:05

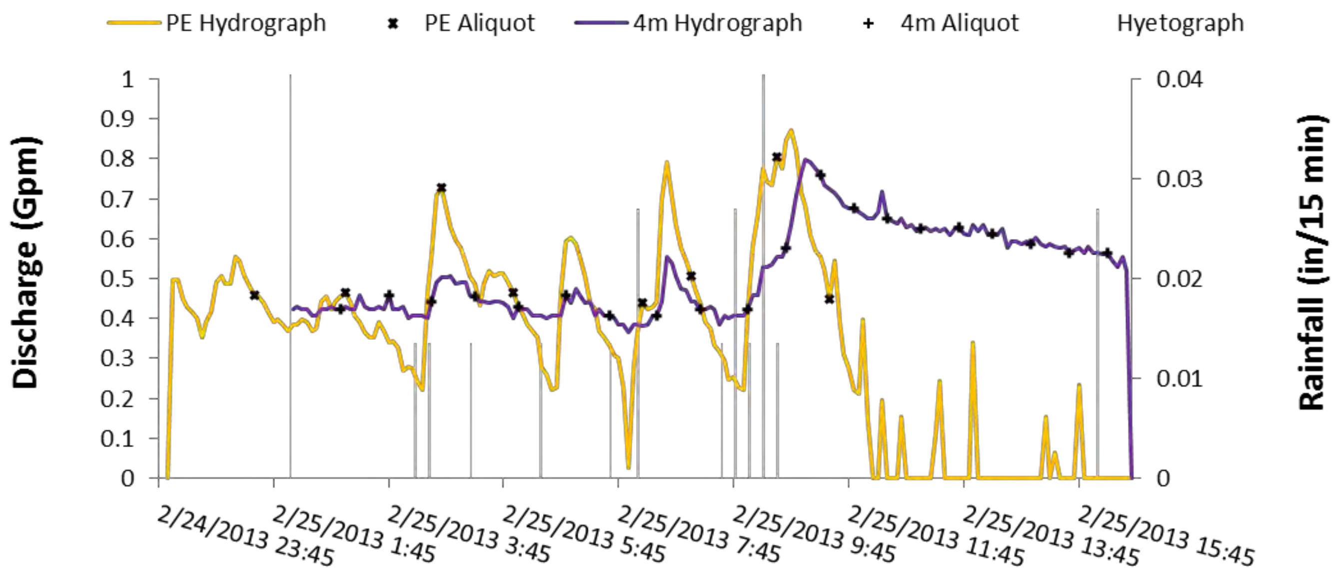
Precipitation				
Total (in)	Start Time	End Time	Duration (hrs)	Antecedent (hrs)
0.18	2/25/2013 2:05	2/25/2013 10:55	8.83	40.25

Aliquots							Water Temp		Validation Code
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)	
PE	8	2/25/2013 1:25	2/25/2013 11:25	10.00	250	2,000	4.74	5.21	J
4	21	2/25/2013 2:55	2/25/2013 16:15	13.33	250	5,000	4.69	10.49	J

Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	2/25/2013 0:00	2/25/2013 15:45	15.75	337.45	21.43	337.45	317.53	94.10	0.87	0.03	0.44	0.057
4	2/25/2013 2:10	2/25/2013 16:45	14.58	546.44	37.48	546.44	530.54	97.09	0.86	0.52	0.62	0.055

J=Estimate of Hydrology information

Pilchuck CAVFS 2/25/2013 Storm Event



Precipitation

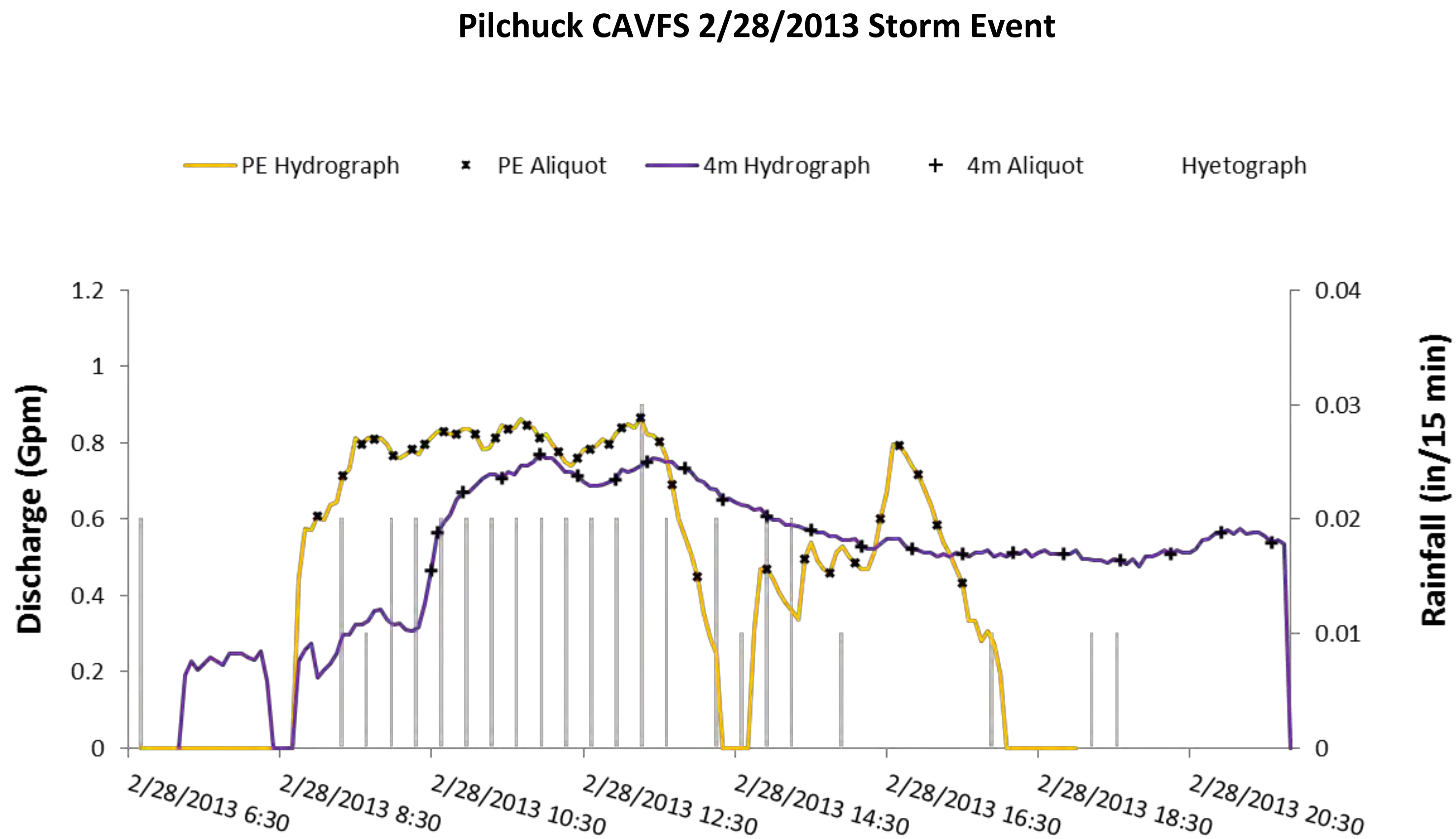
Total (in)	Start Time	End Time	Duration (hrs)	Antecedent (hrs)
0.39	2/28/2013 7:10	2/28/2013 17:10	10.00	68.25

Aliquots							Water Temp		Validation Code
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)	
PE	32	2/28/2013 9:00	2/28/2013 17:30	8.50	250	8,000	5.46	7.77	
2	17	2/28/2013 8:45	2/28/2013 18:25	9.67	250	4,250	5.10	7.94	R
4	21	2/28/2013 10:30	2/28/2013 21:35	11.08	250	5,250	5.83	9.45	

Runoff / Discharge

	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	02/28/2013 16:45	2/28/2013 18:00	9.25	347.12	37.53	347.12	338.51	97.52	0.87	0.20	0.65	0.057
2	2/28/2013 7:15	2/28/2013 21:45	14.50	439.48	30.31	439.48	359.99	72	0.70	0.26	0.50	0.033
4	2/28/2013 7:15	2/28/2013 21:45	14.50	451.15	31.11	451.15	445.76	98.81	0.77	0.17	0.53	0.041

Rejected because less than 75% of the hydrograph was sampled.

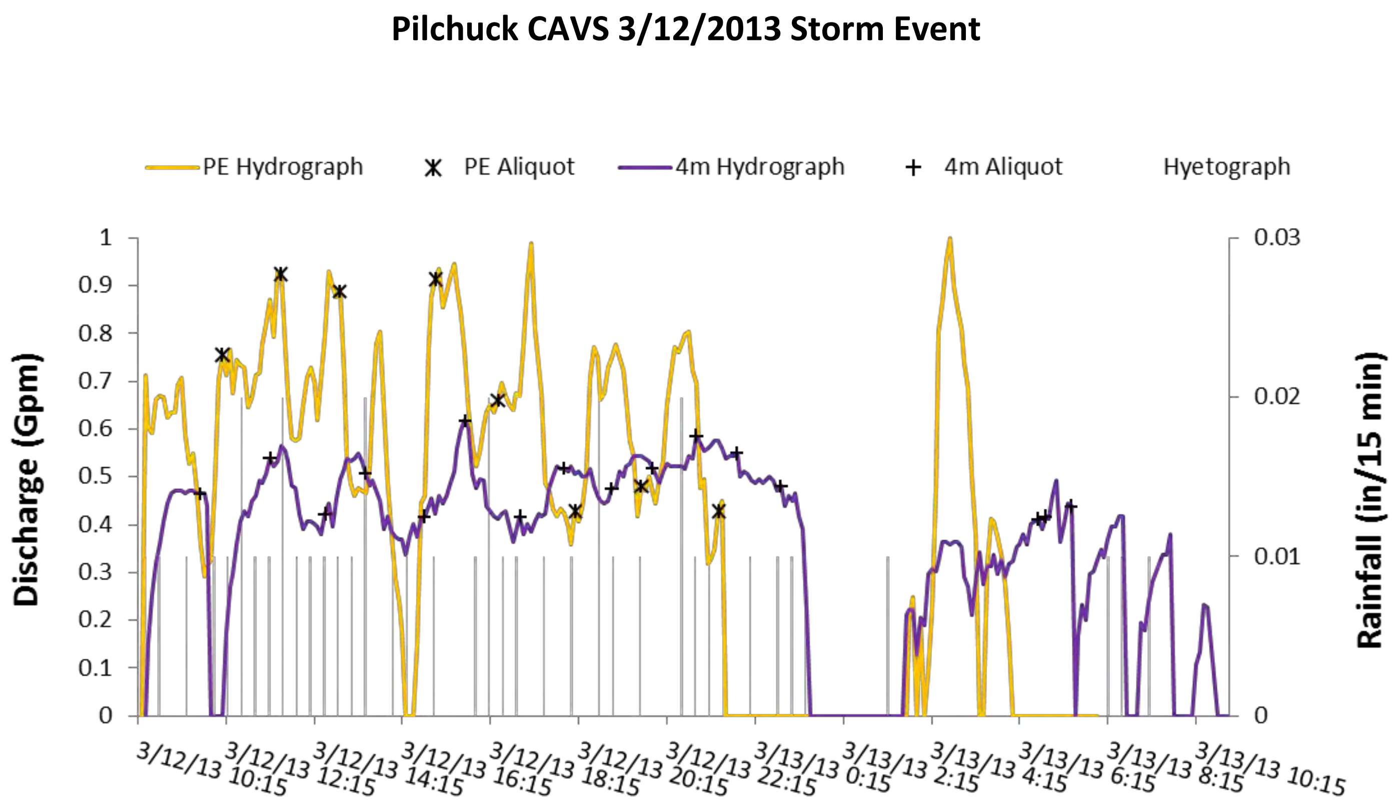


Precipitation

Total (in)	Start Time	End Time	Duration (hrs)	Antecedent (hrs)
0.48	3/12/2013 10:15	3/13/2013 5:05	18.83	117.24

Aliquots							Water Temp		Validation Code
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)	
PE	8	3/12/2013 12:10	3/12/2013 23:25	11.25	250	2,000	9.85	10.54	
4	15	3/12/2013 11:40	3/13/2013 7:25	19.75	250	4,000	9.91	10.75	

Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	3/12/2013 10:25	3/13/2013 6:00	19.58	549.61	28.07	549.61	486.31	88.48	1.00	0.10	0.61	0.082
4	3/12/2013 10:30	3/13/2013 10:30	24.00	524.06	21.84	520.58	486.68	93.49	0.62	0.11	0.42	0.024



Pilchuck CAVS 3/12/2013 Storm Event
PE Hydrograph
PE Aliquot
4m Hydrograph
4m Aliquot
Hyetograph
Discharge (Gpm)
Rainfall (in/15 min)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.03
0.02
0.01
0
3/12/13 10:15
3/12/13 12:15
3/12/13 14:15
3/12/13 16:15
3/12/13 18:15
3/12/13 20:15
3/12/13 22:15
3/13/13 0:15
3/13/13 2:15
3/13/13 4:15
3/13/13 6:15
3/13/13 8:15
3/13/13 10:15

Precipitation				
Total (in)	Start Time	End Time	Duration (hrs)	Antecedent (hrs)
0.26	3/20/2013 0:15	3/20/2013 9:15	9.00	42

Aliquots							Water Temp		Validation Code
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)	
PE	27	3/20/2013 0:35	3/20/2013 9:35	9.00	250	6,750	6.64	8.99	
4	21	3/20/2013 0:50	3/20/2013 14:25	13.58	250	7,000	6.42	14.74	R

Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	3/20/2013 0:15	3/20/2013 10:10	9.92	373.70	37.67	373.70	363.84	97.36	0.88	0.15	0.62	0.059
4	3/20/2013 0:20	3/20/2013 14:45	14.42	598.85	41.53	598.85	591.80	73.8	0.88	0.46	0.70	0.059

Rejected because less than 75% of the hydrograph was sampled.

Precipitation				
Total (in)	Start Time	End Time	Duration (hrs)	Antecedent (hrs)
0.33	4/12/2013 14:05	4/12/2013 22:40	8.58	48.25

Aliquots							Water Temp		Validation Code
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)	
PE	17	04/12/2013 14:25	04/12/2013 22:55	8.50	250	4,250	5.81	7.24	
4	29	4/12/2013 15:55	4/12/2013 23:40	7.75	250	9,250	5.27	6.59	R

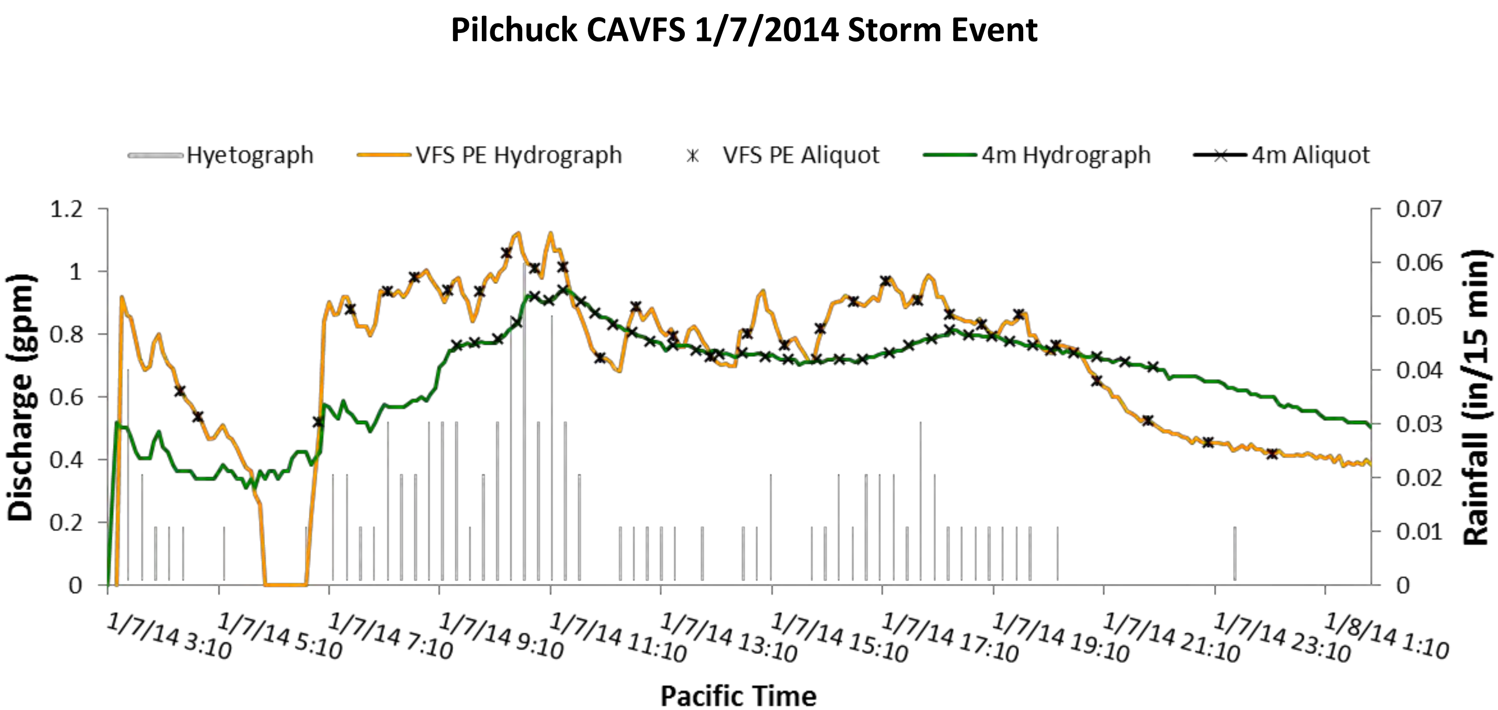
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	04/12/2013 14:00	04/12/2013 23:20	9.33	279.63	29.97	279.63	270.04	96.57	1.00	0.14	0.62	0.081
4	4/12/2013 14:15	4/13/2013 1:10	10.92	339.99	31.13	339.99	295.58	68.3	0.76	0.09	0.54	0.041

Rejected because less than 75% of the hydrograph was sampled.

Precipitation				
Total (in)	**Start Time**	**End Time**	**Duration (hrs)**	**Antecedent (hrs)**
0.99	01/07/2014 03:15	01/07/2014 23:40	20.42	79.5

Aliquots							Water Temp		Validation Code
Sample Point (m)	**Aliquots Collected**	**First Aliquot Time**	**Last Aliquot Time**	**Sampling Duration (hrs)**	**Volume (mL)**	**Total Sample Volume (mL)**	**Min (C°)**	**Max (C°)**	
PE	29	01/07/2014 04:30	01/08/2014 00:15	19.75	250	7,250	2.07	6.54	
4	34	01/07/2014 09:30	01/07/2014 22:05	12.58	250	8,500	3.82	6.76	

Runoff / Discharge												
	Runoff Time			**Volume**			**Sampled**		**Flow**			**Stage**
Sample Point (m)	**Start Time**	**End Time**	**Duration (hrs)**	**Total (gal)**	**Intensity (gal/hr)**	**First 24Hrs (gal)**	**Discharge Total Volume Sampled (gal)**	**% Hydrograph Sampled**	**Peak (gpm)**	**Min (gpm)**	**Mean (gpm)**	**Max (ft)**
PE	01/07/2014 03:25	01/08/2014 02:15	22.83	964.6	42.3	964.6	920.2	95.40	1.13	0.23	0.73	0.111
4	01/07/2014 03:15	01/08/2014 02:10	22.92	907.2	39.6	907.2	761.8	84.00	0.94	0.31	0.66	0.070



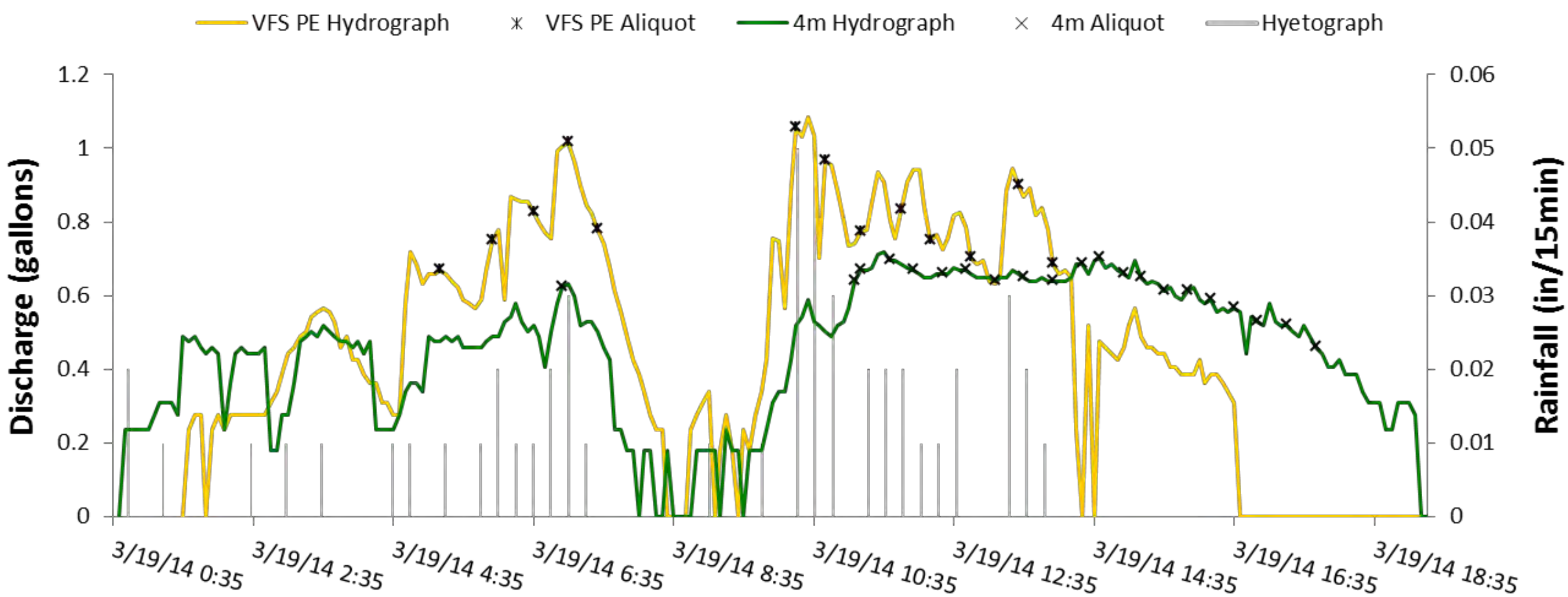
Pilchuck CAVFS 1/7/2014 Storm Event
Hyetograph
VFS PE Hydrograph
VFS PE Aliquot
4m Hydrograph
4m Aliquot
Discharge (gpm)
Rainfall (in/15 min)
1.2
1
0.8
0.6
0.4
0.2
0
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
1/7/14 3:10
1/7/14 5:10
1/7/14 7:10
1/7/14 9:10
1/7/14 11:10
1/7/14 13:10
1/7/14 15:10
1/7/14 17:10
1/7/14 19:10
1/7/14 21:10
1/7/14 23:10
1/8/14 1:10
Pacific Time

Precipitation				
Total (in)	Start Time	End Time	Duration (hrs)	Antecedent (hrs)
0.51	03/19/2014 00:45	03/19/2014 13:50	13.08	35.74

Aliquots							Water Temp		Validation Code
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)	
PE	13	03/19/2014 05:15	03/19/2014 14:00	8.75	250	3,250	7.28	8.92	
4	21	03/19/2014 07:00	03/19/2014 17:45	10.75	250	5,250	6.80	7.82	

Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	03/19/2014 01:40	03/19/2014 16:40	15.00	502.3	33.5	502.3	436.4	86.90	1.08	0.18	0.59	0.101
4	03/19/2014 00:45	03/19/2014 19:10	18.42	507.6	27.6	507.6	478.6	94.30	0.72	0.18	0.48	0.035

Pilchuck CAVFS 3/19/2014 Storm Report

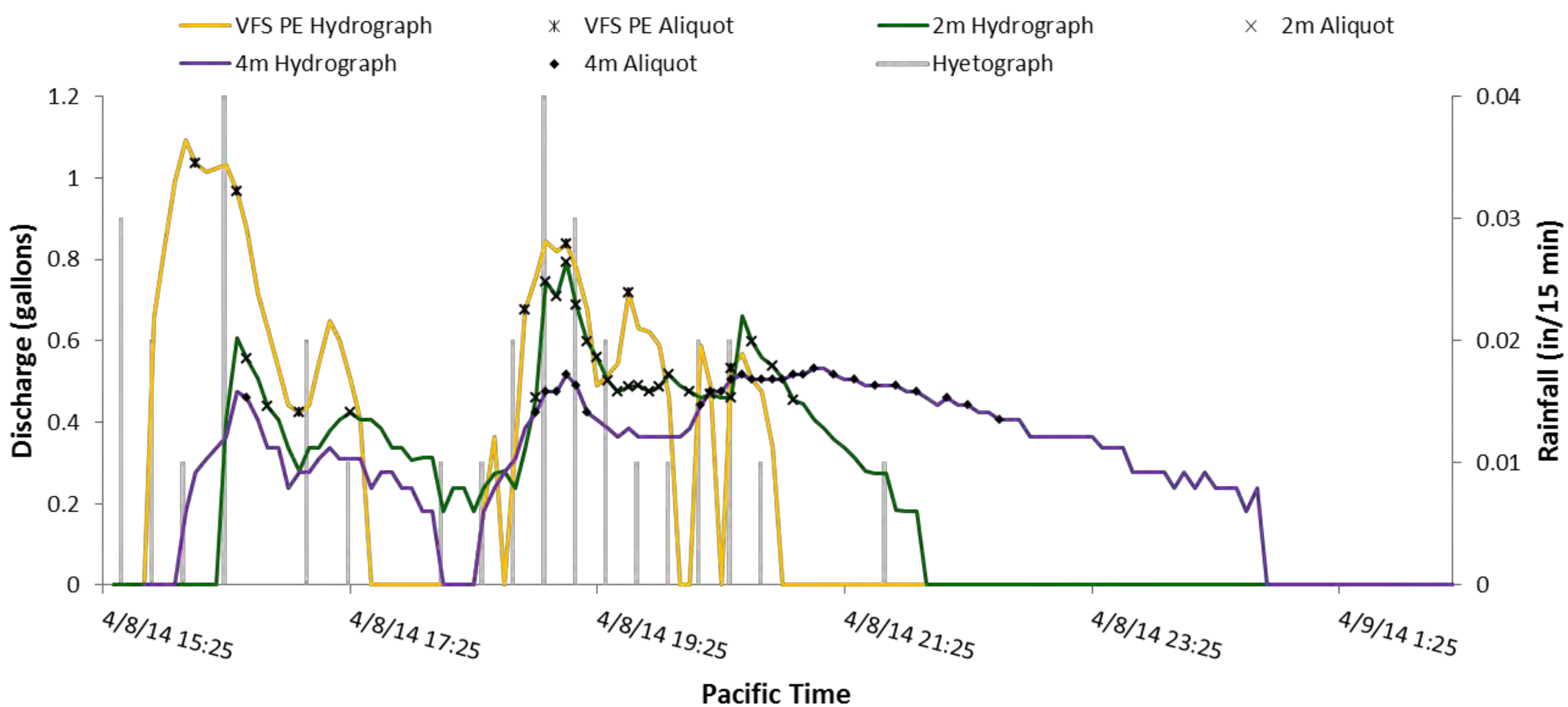


Precipitation				
Total (in)	Start Time	End Time	Duration (hrs)	Antecedent (hrs)
0.36	04/08/2014 15:30	04/08/2014 21:50	6.33	57.24

Aliquots							Water Temp		Validation Code
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)	
PE	12	04/08/2014 16:10	04/09/2014 02:20	10.17	250	3,000	6.39	13.78	
2	23	04/08/2014 16:35	04/08/2014 21:00	4.42	250	5,750	9.43	13.44	
4	27	04/08/2014 16:35	04/08/2014 22:40	6.08	250	6,750	8.26	13.44	

Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	04/08/2014 15:50	04/09/2014 02:20	10.50	148.7	14.2	148.7	148.7	100.00	1.09	0.00	0.63	0.103
2	04/08/2014 16:25	04/08/2014 22:00	5.58	140.8	25.2	140.8	122.7	87.20	0.79	0.18	0.41	0.045
4	04/08/2014 15:30	04/09/2014 00:45	9.25	187.5	20.3	187.5	149.3	79.70	0.53	0.18	0.37	0.016

Pilchuck CAVFS 4/8/2014 Storm Report

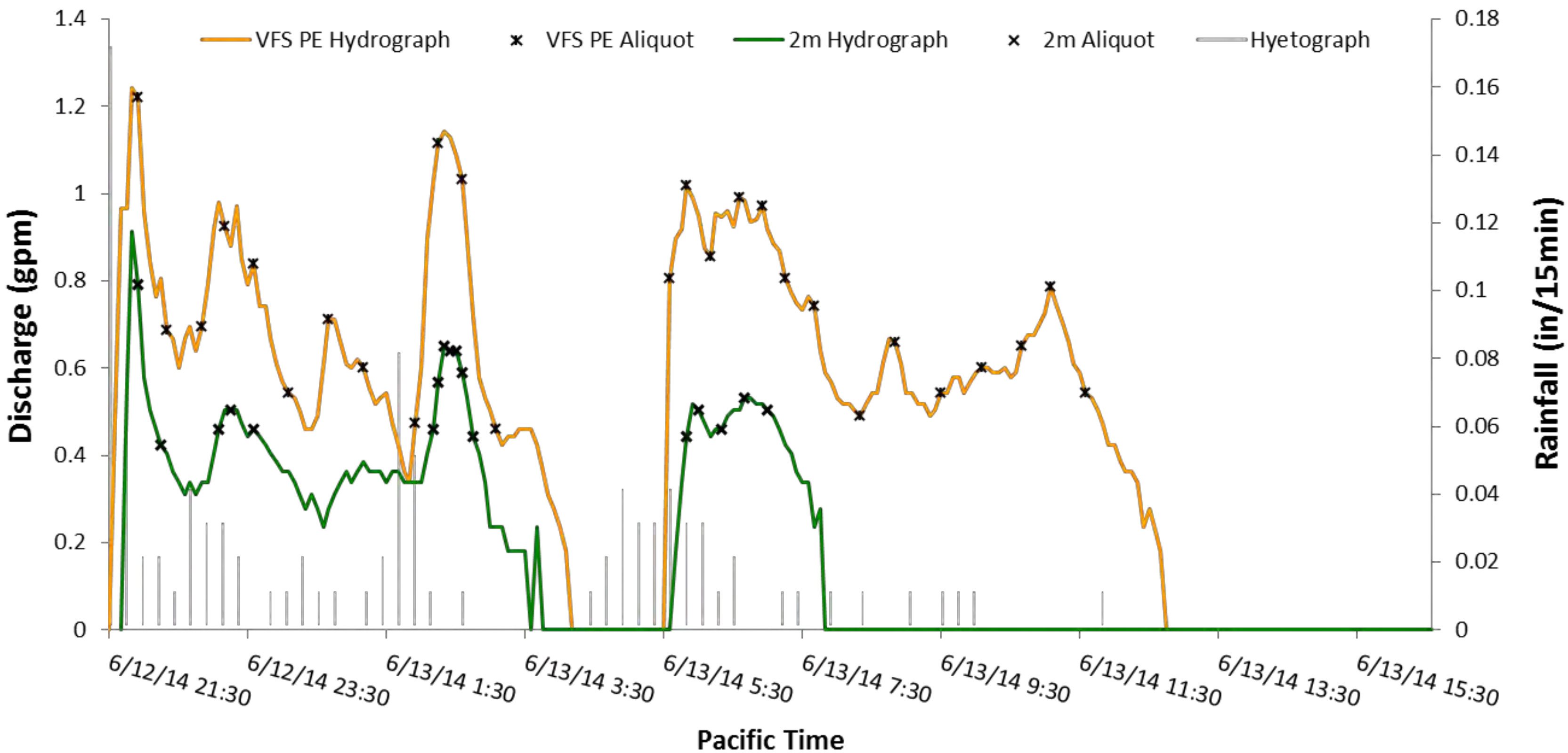


Precipitation				
Total (in)	Start Time	End Time	Duration (hrs)	Antecedent (hrs)
1.00	06/12/2014 21:40	06/13/2014 13:20	15.67	352.16

Aliquots							Water Temp		Validation Code
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)	
PE	26	06/12/2014 21:55	06/13/2014 11:35	13.67	250	6,500	12.60	14.90	
2	17	06/12/2014 21:55	06/13/2014 07:00	9.08	250	4,250	N/A	N/A	

Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	06/12/2014 21:40	06/13/2014 12:40	15.00	539.4	36.0	539.4	515.7	95.60	1.24	0.18	0.66	0.144
2	06/12/2014 21:45	06/13/2014 07:45	10.00	196.6	19.7	196.6	179.9	91.50	0.91	0.18	0.41	0.065

Pilchuck CAVFS 6/12/2014 Storm Event



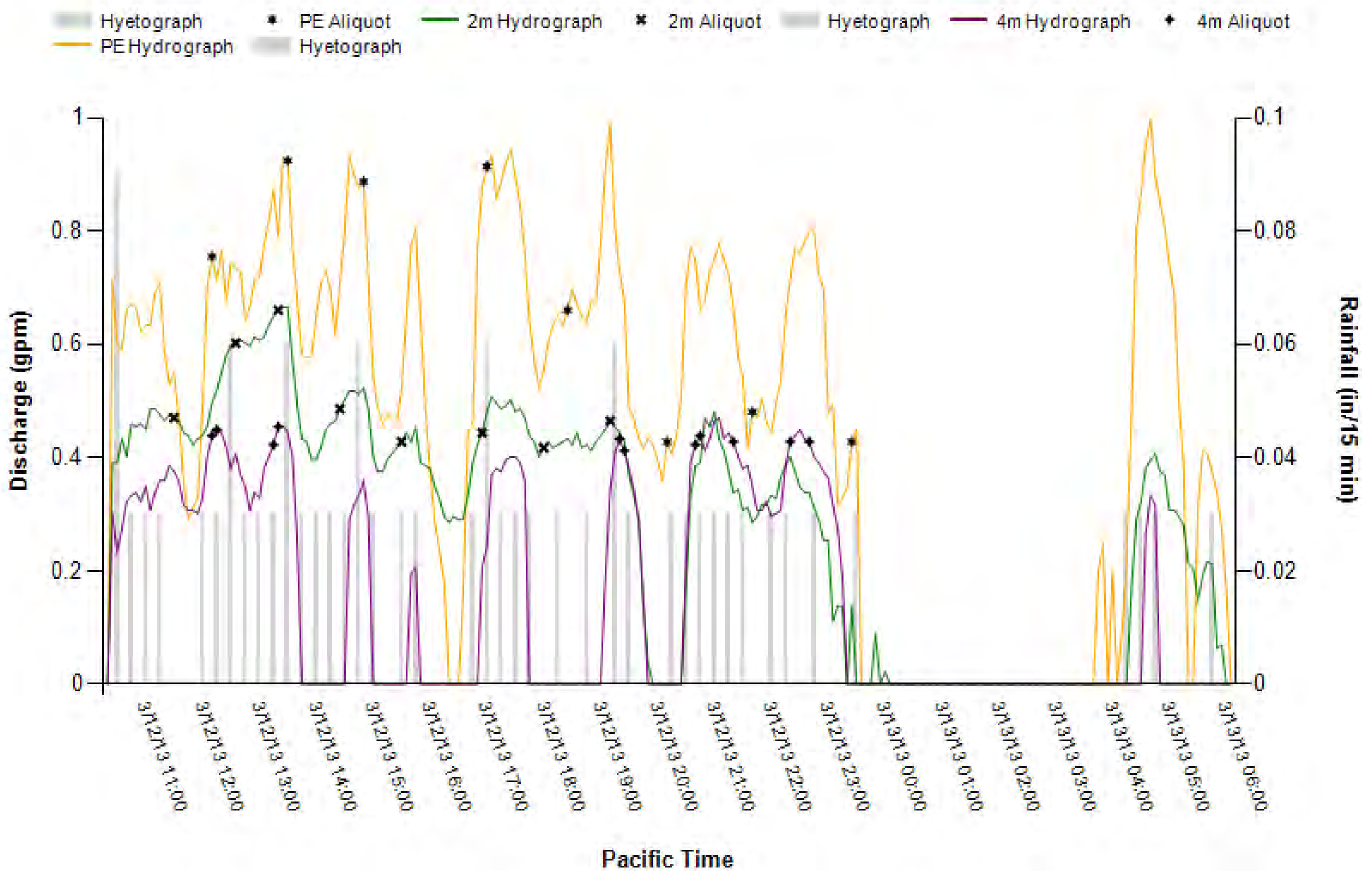
Pilchuck MVFS

Precipitation				
Total (in)	Start Time	End Time	Duration (hrs)	Antecedent (hrs)
0.49	3/12/2013 10:20	3/13/2013 5:45	19.42	117.49

Aliquots							Water Temp		Validation Code
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)	
PE	8	3/12/2013 12:10	3/12/2013 23:25	11.25	250	2,000	9.85	10.54	
2	8	3/12/2013 11:30	3/12/2013 19:10	7.67	250	2,000	9.85	10.54	
4	11	3/12/2013 12:10	3/12/2013 22:40	10.50	250	2,750	9.85	10.54	

Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	3/12/2013 10:25	3/13/2013 6:00	19.58	549.61	28.07	549.61	486.31	88.48	1.00	0.10	0.61	0.082
2	3/12/2013 10:25	3/13/2013 5:55	19.50	339.62	17.42	339.62	244.15	77.90	0.67	0.02	0.40	0.029
4	3/12/2013 10:25	3/13/2013 4:45	18.33	182.54	9.96	182.54	166.40	91.16	0.47	0.15	0.35	0.012

Pilchuck MVFS 3/12/2013 Storm Event



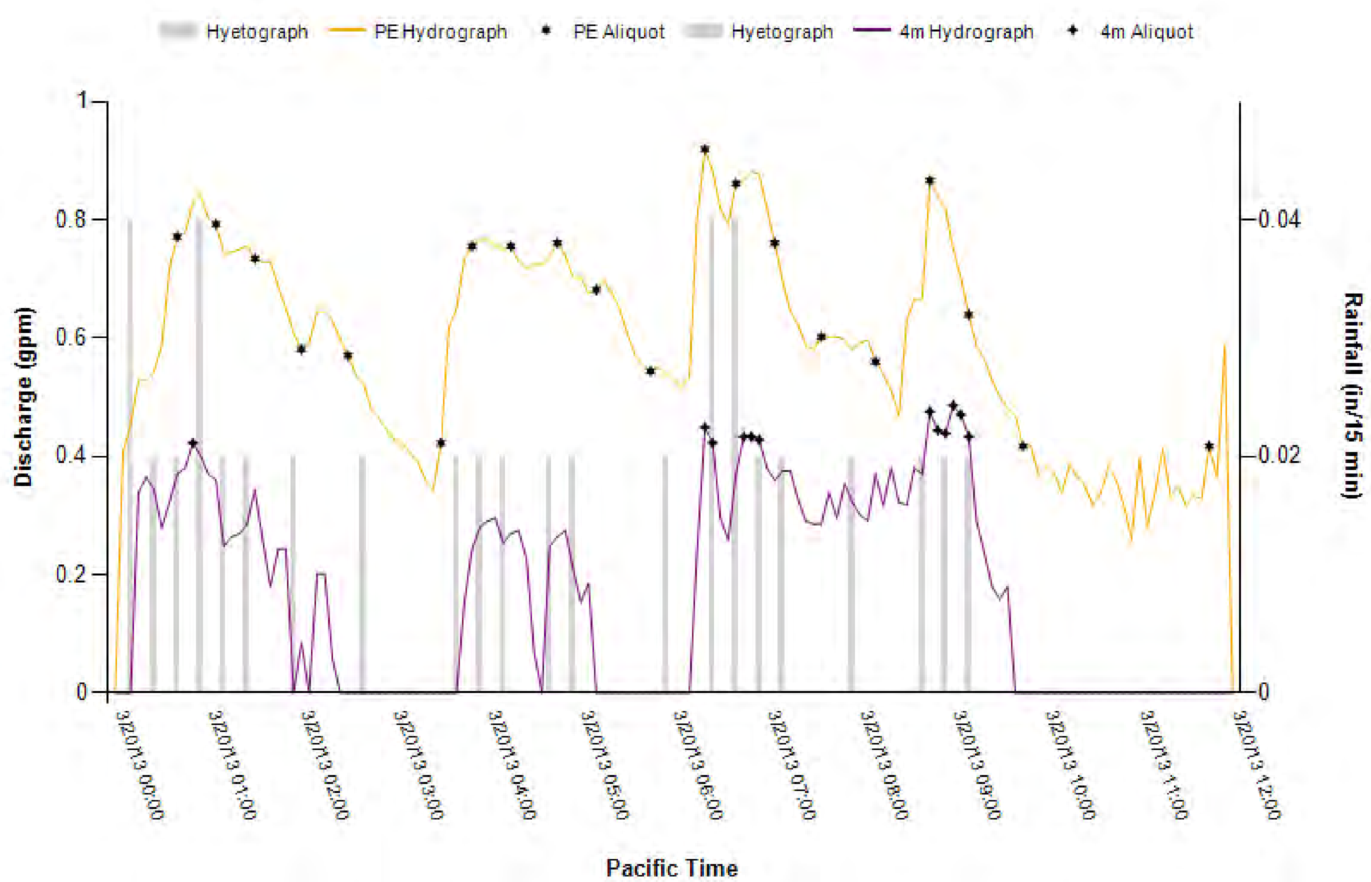
Precipitation				
Total (in)	Start Time	End Time	Duration (hrs)	Antecedent (hrs)
0.26	3/19/2013 23:55	3/20/2013 8:55	9.00	41.74

Aliquots							Water Temp		Validation Code
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)	
PE	20	3/20/2013 0:35	3/20/2013 11:40	11.08	250	5,000	6.83	14.03	J
4	12	3/20/2013 0:45	3/20/2013 9:05	8.33	250	3,000	6.83	8.87	

Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	3/20/2013 0:00	3/20/2013 11:50	11.83	424.08	35.85	424.08	419.32	98.88	0.92	0.26	0.59	0.066
4	3/20/2013 0:10	3/20/2013 9:30	9.33	123.42	13.23	123.42	118.19	95.76	0.49	0.06	0.30	0.013

J=Estimate of Hydrology information

Pilchuck MVFS 3/20/2013 Storm Event

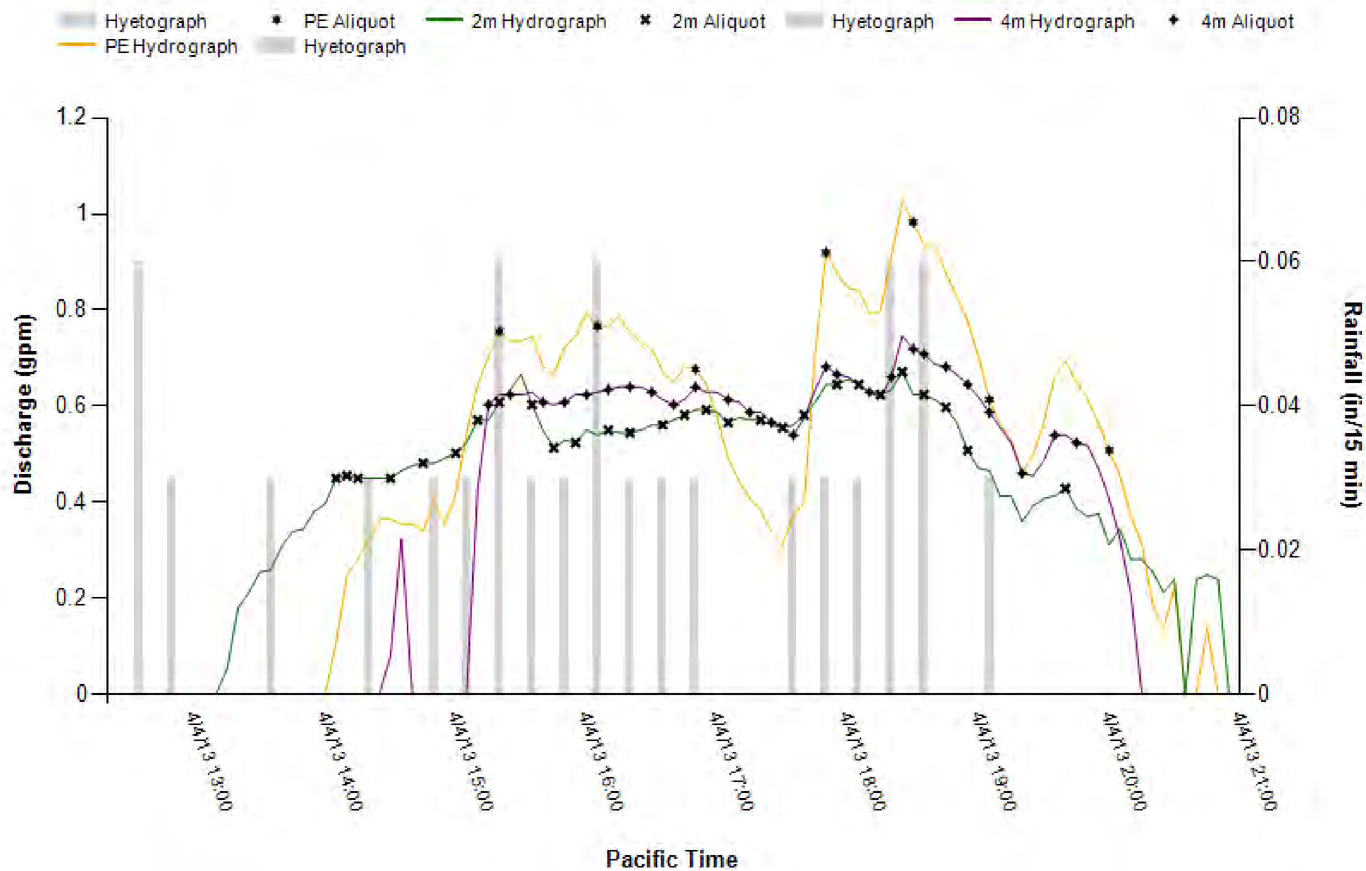


Precipitation				
Total (in)	**Start Time**	**End Time**	**Duration (hrs)**	**Antecedent (hrs)**
0.24	4/4/2013 12:25	4/4/2013 18:55	6.50	321

Aliquots							Water Temp		Validation Code
Sample Point (m)	**Aliquots Collected**	**First Aliquot Time**	**Last Aliquot Time**	**Sampling Duration (hrs)**	**Volume (mL)**	**Total Sample Volume (mL)**	**Min (C°)**	**Max (C°)**	
PE	7	4/4/2013 15:20	4/4/2013 20:00	4.67	250	1,750	12.25	12.65	
2	28	4/4/2013 14:05	4/4/2013 19:40	5.58	250	7,000	12.25	12.69	
4	26	4/4/2013 15:15	4/4/2013 19:45	4.50	250	6,500	12.25	12.65	

Runoff / Discharge												
	Runoff Time			**Volume**			**Sampled**		**Flow**			**Stage**
Sample Point (m)	**Start Time**	**End Time**	**Duration (hrs)**	**Total (gal)**	**Intensity (gal/hr)**	**First 24Hrs (gal)**	**Discharge Total Volume Sampled (gal)**	**% Hydrograph Sampled**	**Peak (gpm)**	**Min (gpm)**	**Mean (gpm)**	**Max (ft)**
PE	4/4/2013 19:50	4/4/2013 12:25	7.42	424.08	57.15	232.13	223.04	96.09	0.57	0.14	-3.84	0.088
2	4/4/2013 13:15	4/4/2013 20:50	7.58	216.36	28.54	216.36	197.50	91.28	0.67	0.05	0.48	0.029
4	4/4/2013 14:30	4/4/2013 20:10	5.67	182.04	32.11	182.04	172.43	94.72	0.74	0.08	0.58	0.038

Pilchuck MVFS 4/4/2013 Storm Event

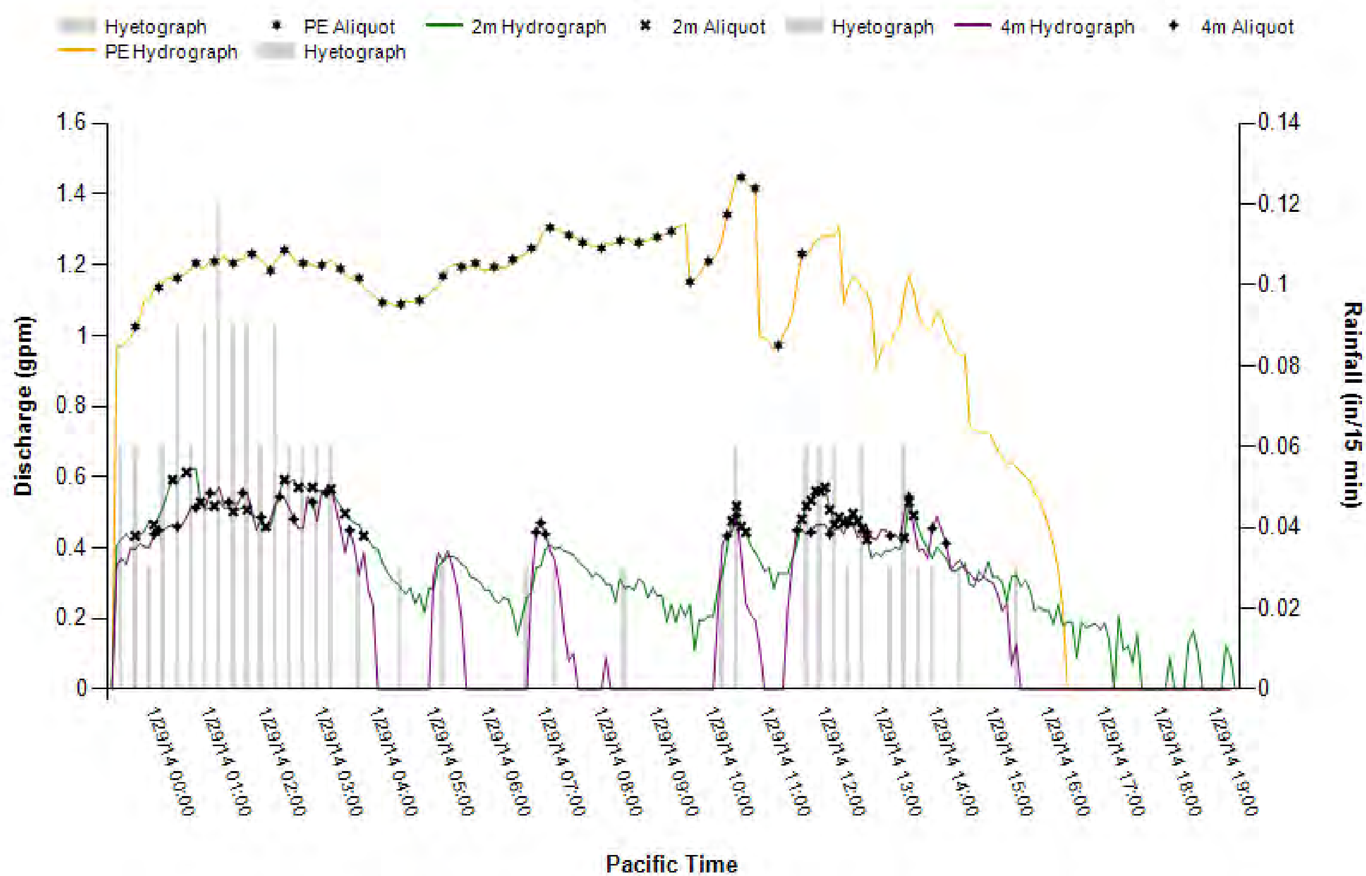


Precipitation				
Total (in)	Start Time	End Time	Duration (hrs)	Antecedent (hrs)
0.63	01/28/2014 23:15	01/29/2014 15:15	16.00	372.5

Aliquots							Water Temp		Validation Code
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)	
PE	37	01/28/2014 23:40	01/29/2014 11:35	11.92	250	9,250	5.78	8.81	
2	37	01/28/2014 23:40	01/29/2014 13:35	13.92	250	9,250	5.78	9.62	
4	27	01/29/2014 00:00	01/29/2014 14:10	14.17	250	6,750	5.78	9.82	

Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	01/28/2014 23:20	01/29/2014 16:15	16.92	1,138.5	67.3	1,138.5	884.3	77.70	1.45	0.23	1.12	0.214
2	01/28/2014 23:20	01/29/2014 19:15	19.92	407.9	20.5	407.9	342.8	84.00	0.62	0.07	0.36	0.024
4	01/28/2014 23:20	01/29/2014 15:25	16.08	271.5	16.9	271.5	250.5	92.30	0.58	0.07	0.41	0.020

Pilchuck MVFS 1/28/2014 Storm Event

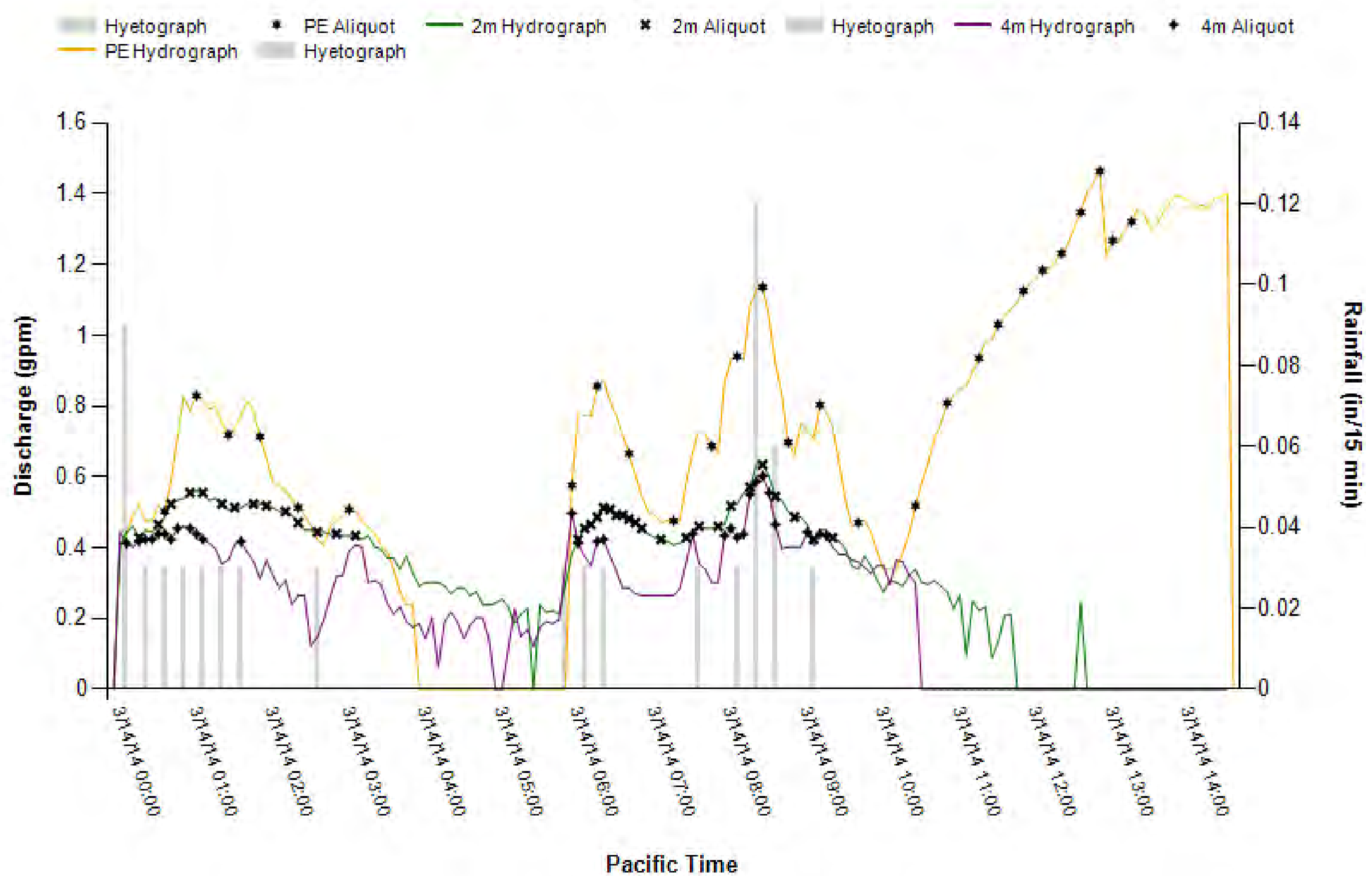


Precipitation				
Total (in)	**Start Time**	**End Time**	**Duration (hrs)**	**Antecedent (hrs)**
0.22	03/13/2014 23:55	03/14/2014 09:05	9.17	91.99

Aliquots							Water Temp		Validation Code
Sample Point (m)	**Aliquots Collected**	**First Aliquot Time**	**Last Aliquot Time**	**Sampling Duration (hrs)**	**Volume (mL)**	**Total Sample Volume (mL)**	**Min (C°)**	**Max (C°)**	
PE	27	03/14/2014 00:35	03/14/2014 13:15	12.67	250	6,750	8.20	18.16	
2	36	03/14/2014 00:15	03/14/2014 09:20	9.08	250	9,000	8.15	10.06	
4	34	03/14/2014 00:05	03/14/2014 13:20	13.25	250	8,500	8.15	18.16	

Runoff / Discharge												
	Runoff Time			**Volume**			**Sampled**		**Flow**			**Stage**
Sample Point (m)	**Start Time**	**End Time**	**Duration (hrs)**	**Total (gal)**	**Intensity (gal/hr)**	**First 24Hrs (gal)**	**Discharge Total Volume Sampled (gal)**	**% Hydrograph Sampled**	**Peak (gpm)**	**Min (gpm)**	**Mean (gpm)**	**Max (ft)**
PE	03/14/2014 00:00	03/14/2014 14:30	14.50	596.4	41.1	596.4	501.1	84.00	1.46	0.24	0.79	0.219
2	03/14/2014 00:00	03/14/2014 12:35	12.58	279.6	22.2	279.6	239.6	85.70	0.63	0.09	0.40	0.025
4	03/14/2014 00:00	03/14/2014 10:25	10.42	203.3	19.5	203.3	203.3	100.00	0.60	0.06	0.33	0.022

Pilchuck MVFS 3/14/2014 Storm Event

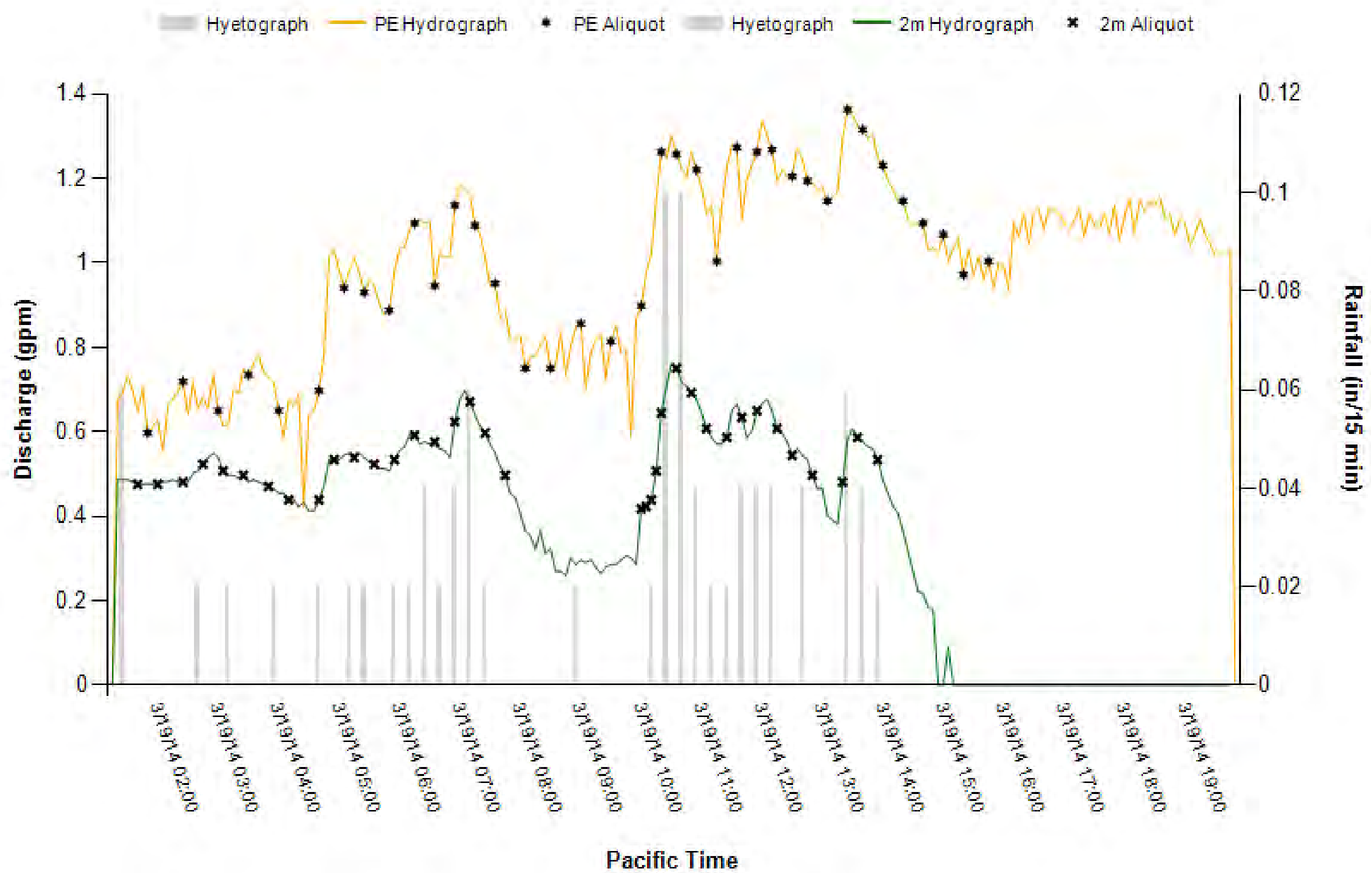


Precipitation				
Total (in)	Start Time	End Time	Duration (hrs)	Antecedent (hrs)
0.50	03/19/2014 01:15	03/19/2014 13:55	12.67	39.49

Aliquots							Water Temp		Validation Code
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)	
PE	37	03/19/2014 01:50	03/19/2014 15:45	13.92	250	9,250	6.19	9.08	
2	36	03/19/2014 01:40	03/19/2014 13:55	12.25	250	9,000	6.67	9.08	

Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	03/19/2014 01:20	03/19/2014 19:45	18.42	1,084.0	58.8	1,084.0	834.5	77.00	1.36	0.42	0.99	0.182
2	03/19/2014 01:20	03/19/2014 15:05	13.75	400.4	29.1	400.4	382.3	95.50	0.76	0.09	0.49	0.040

Pilchuck MVFS 3/19/2014 Storm Event

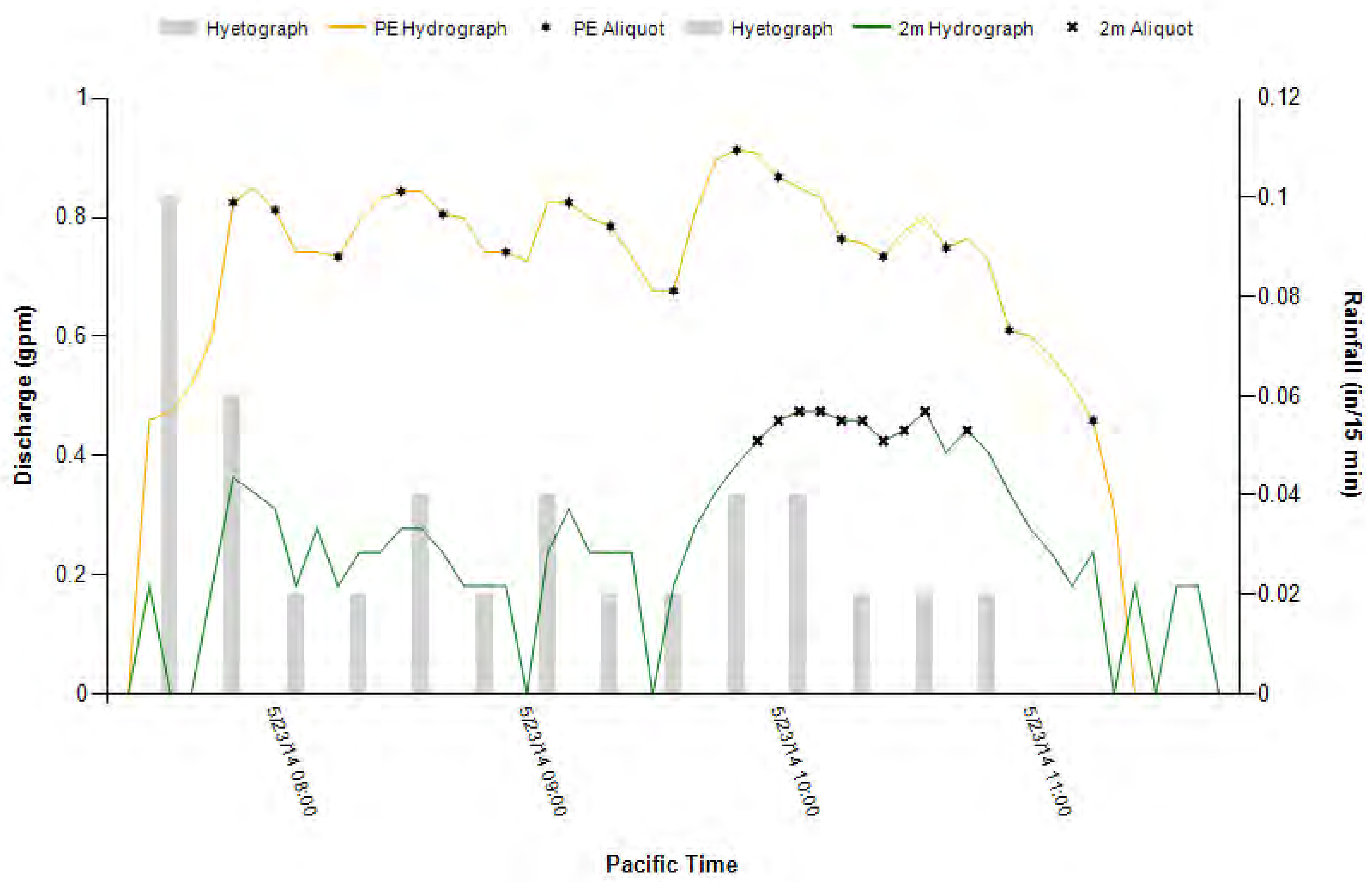


Precipitation				
Total (in)	Start Time	End Time	Duration (hrs)	Antecedent (hrs)
0.24	05/23/2014 07:25	05/23/2014 10:45	3.33	97.83

Aliquots							Water Temp		Validation Code
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)	
PE	16	05/23/2014 07:50	05/23/2014 11:15	3.42	250	4,000	13.30	15.20	
2	10	05/23/2014 09:55	05/23/2014 10:45	0.83	250	2,500	14.50	15.00	

Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	05/23/2014 07:30	05/23/2014 11:20	3.83	172.1	44.9	172.1	170.5	99.10	0.91	0.31	0.73	0.065
2	05/23/2014 07:30	05/23/2014 11:40	4.17	67.1	16.1	67.1	56.0	83.50	0.47	0.18	0.30	0.012

Pilchuck MVFS 5/23/2014 Storm Event



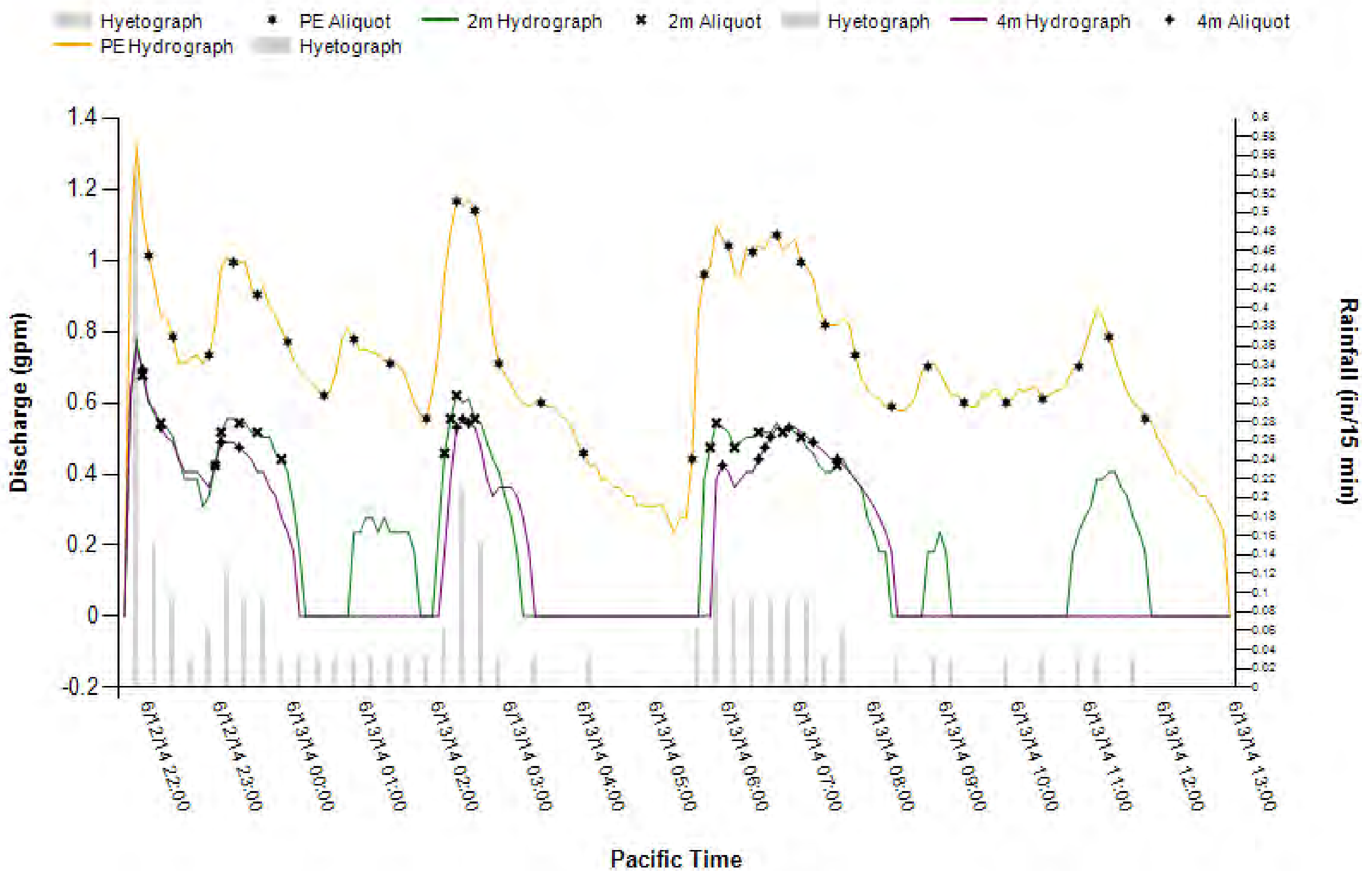
Precipitation				
Total (in)	Start Time	End Time	Duration (hrs)	Antecedent (hrs)
0.24	06/12/2014 21:40	06/13/2014 11:30	13.83	344.83

Aliquots							Water Temp		Validation Code
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)	
PE	31	06/12/2014 22:00	06/13/2014 11:45	13.75	250	7,750	12.80	15.10	R
2	18	06/12/2014 21:55	06/13/2014 07:30	9.58	250	4,500	12.80	15.10	R
4	15	06/12/2014 21:55	06/13/2014 07:30	9.58	250	3,750	12.80	15.10	

Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	06/12/2014 21:45	06/13/2014 12:50	15.08	639.5	42.4	639.5	614.4	96.10	1.32	0.24	0.70	0.169
2	06/12/2014 21:45	06/13/2014 11:45	14.00	207.2	14.8	207.2	171.0	82.50	0.78	0.18	0.41	0.043
4	06/12/2014 21:45	06/13/2014 08:15	10.50	155.1	14.8	155.1	140.5	90.60	0.76	0.18	0.42	0.040

Rejected because less than 75% of the hydrograph was sampled.

Pilchuck MVFS 6/12/2014 Storm Event



Appendix C:
Analytical Data Quality Assessment Report

This page intentionally left blank

Analytical Data Quality Assessment Report

Washington State Department of Transportation
NPDES Stormwater Monitoring Program

Baseline Monitoring of WSDOT Highway Run-off

Data Collected during October 18, 2013 through September 24, 2014

Prepared for:

Cardno
2825 Eastlake Avenue East, Suite 300
Seattle, WA 98102

Prepared by:

Pyron Environmental, Inc.
3530 32nd Way NW
Olympia, WA 98502

October 7, 2015

Executive Summary

This Data Quality Assessment Report (DQAR) presents an overview of the analytical scheme, data verification and validation procedures, and the quality of analytical data collected during the stormwater monitoring year 2014 (October 8, 2013 through September 24, 2014) under the Washington State Department of Transportation's (WSDOT) National Pollution Discharge Elimination System (NPDES) Stormwater Monitoring Program (Program), Baseline Monitoring of WSDOT Highway Run-off. The quality of data was assessed and discussed in terms of Measurement Quality Objectives (MQOs), *i.e.*, precision, accuracy, representativeness, comparability, sensitivity, and completeness.

A total of 272 water samples (187 field stormwater samples, 63 field duplicates and 22 rinsate blanks) and seven sediment samples (five field samples and two field duplicates) were collected during this monitoring period. Sample analyses were primarily performed by the Washington State Department of Ecology (Ecology), Manchester Environmental Laboratory (MEL), and AmTest Laboratories, Inc.), with specialty analyses performed by TestAmerica Laboratories, Inc. (total Kjeldahl nitrogen [TKN] and glyphosate), Analytical Resources, Inc. (particle size distribution in water), and Anatek Labs, Inc. (glyphosate).

A Stage 2B (as defined in USEAP 2009) data validation was performed on 90 percent of the analytical data, and a Stage 3+4 (USEPA 2009, WSDOT 2014b) validation was performed on 10 percent of the data. Based on the on-going oversight of the laboratory performance and the outcome of the data validation, completeness of the data collection effort was calculated as 98.6 percent. This achieves the monitoring goal of 95%. Significant observations and results of the analytical data quality assessment are summarized as follows:

1. The sample filtration for dissolved metals and *ortho*-phosphate was to be conducted within 15 minutes of collection, according to 40CFR, Part 136. Due to field technical difficulty, most of the samples were filtered outside the 15-minute window, yet within 24 hours of collection. The delay in filtration was not expected to result in significant effects on data quality. Dissolved metals and *ortho*-phosphate results were footnoted in the Annual Report for these cases.

2. A total of 41 field samples were collected for pH analysis. For 38 of the 41 samples, the analyses were performed well outside of the required 24 hour hold time. These pH data were qualified unusable, and the results should be reported from the field measurements made during the sample collection.

3. The reporting limits (namely Method Reporting Limits [MRLs] or Practical Quantitation Limits [PQLs]) achieved the Permit requirements for all analyses, except those for semi-volatile organic compounds (SVOCs) in sediment samples. The MRLs were raised three to eight times from the project-expected RLs. This range of elevations resulted from the required dilution of sample extracts to overcome the oily nature of the samples. The reported sample-specific RLs were considered the best-possible RLs given the conditions of the samples. No further actions were feasible other than noting the incident in this document.

4. As part of this overall data quality assessment, the correlation between total and dissolved metal concentrations for each metal/sample was evaluated. Metals results were considered "uncorrelated" and the usability of the results affected if the "total" concentration for a metal was less than its "dissolved" concentration in a sample and the concentration difference was beyond experimental errors (i.e., relative percent difference [RPD] value was >10%, or concentration difference value was >RL). No "uncorrelated" metals results were found.

5. As noted by the laboratory, detections of selected polycyclic aromatic hydrocarbon (PAHs) and phthalates, particularly benzo(a)anthracene and benzo(a)pyrene, could not be definitively identified and accurately quantitated in a great number of samples because the ion abundance ratios for these detections did not meet the method criteria for compound identification.

Table of Contents

Acronyms and Abbreviations

%D	percent difference
%D_f	percent drift
%R	percent recovery
ASTM	American Society of Testing and Materials
CCB	continuing calibration blank
CCV	continuing calibration verification
CLP	U.S. EPA Contract Laboratory Program
COC	chain of custody
CS1	the first (lowest concentration) initial calibration standard
DQAR	data quality assessment report
DQO	data quality objective
DVR	data validation report
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
ICAL	initial calibration
ICB	initial calibration blank
ICP	Inductively coupled plasma
ICV	initial calibration verification
LCL	lower control limit
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
MBAS	methyl blue activated substances
MDL	method detection limit
MEL	Washington State Department of Ecology Manchester Environmental Laboratory
MQO	measurement quality objective
MRL	method reporting limit
MS	matrix spike
MSD	matrix spike duplicate
NPDES	National Pollution Discharge Elimination System
OP	*ortho*-phosphate
PAH	polycyclic aromatic hydrocarbon
PCBs	polychlorinated biphenyls
PQL	practical quantitation limit

Permit	WSDOT NPDES and State Waste Discharge Permit for Municipal Stormwater
Program	NPDES Stormwater Monitoring Program
PSEP	Puget Sound Estuary Program
QAPP	quality assurance project plan
QC	quality control
RL	reporting limit
RPD	relative percent difference
SIM	selective ion monitoring
SMS	Washington State Sediment Management Standards
SVOCs	semi-volatile organic compounds
TAL	TestAmerica Laboratories, Inc.
TKN	total Kjeldahl nitrogen
TOC	total organic carbon
TP	total phosphorus
TPH	total petroleum hydrocarbon
TSS	total suspended solids
WSDOT	Washington State Department of Transportation

1.0 SAMPLE COLLECTION AND ANALYTICAL PROGRAM

1.1 Field Sampling Program

Sample collection for the Washington State Department of Transportation (WSDOT) National Pollution Discharge Elimination System (NPDES) Stormwater Monitoring Program (Program), Baseline Monitoring of WSDOT Highway Run-off was conducted from October 8, 2013 through September 24, 2014 by WSDOT personnel, following the *Quality Assurance Project Plan* (QAPP; WSDOT 2014a). A total of 272 water samples (187 field stormwater samples, 63 stormwater field duplicates and 22 rinsate blanks) and 7 sediment samples (5 field samples and 2 field duplicates) were collected during this period of monitoring.

1.2 Laboratory Analysis Program

Samples collected between October 8, 2013 and April 9, 2014 were primarily analyzed by the Washington State Department of Ecology (Ecology) Manchester Environmental Laboratory (MEL); samples collected between May 8, 2014 and September 24, 2014 were primarily analyzed by AmTest Laboratories, Inc. in Kirkland, Washington. Primary analytes included polycyclic aromatic hydrocarbons (PAHs), phthalates, pesticides (triclopyr, 2,4-D, clopyralid, and picloram), herbicides (diuron and dichlobenil), polychlorinated biphenyls (PCBs), gasoline range total petroleum hydrocarbon (TPH), diesel/motor oil range TPH, metals (total and dissolved cadmium, copper, lead, and zinc), and inorganic parameters (total suspended solids [TSS], hardness, chloride, nitrate/nitrite, *ortho*-phosphate [OP], and total phosphorus [TP]). Selected specialty analyses were performed by TestAmerica Laboratories, Inc. (total Kjeldahl nitrogen [TKN] and glyphosate), Anatek Labs, Inc. in Moscow, Idaho (glyphosate), and Analytical Resources, Inc. (particle size distribution [PSD] in water).

Sample analysis schedule is summarized in **Table 1-1**.

2.0 DATA VERIFICATION AND VALIDATION

2.1 Data Quality Objectives

Data quality objectives (DQOs) for the Program were defined to meet the WSDOT NPDES and State Waste Discharge Permit for Municipal Stormwater (Permit), which was issued by Ecology on February 4, 2009 (Permit No. WAR043000A). Specific data quality goals (i.e., measurement quality objectives [MQOs] commonly presented as precision, accuracy, representativeness, comparability, sensitivity, and completeness) are defined in the QAPP (WSDOT 2014a).

2.2 Data Verification Procedures

Data verification was performed to ensure completeness of the hardcopy and electronic analytical data that was reported and archived. A complete cross-checking of laboratory identification numbers with field identification numbers was performed to ensure that analyses had been performed as specified by the chain of custody (COC) documentation.

Hardcopy laboratory reports were inventory checked for sample result forms, instrument run logs, instrument initial calibration and continuing calibration verifications, associated quality control (QC) analyses, and supporting documents.

2.3 Data Validation Procedures

A Stage 2B data validation (as defined in EPA 2009) was performed on 90 percent of the data, and a Stage 3+4 validation (EPA 2009, WSDOT 2014b) was performed on 10 percent of the data. The validation followed the procedures specified in U.S. Environmental Protection Agency (EPA) Contract Laboratory Program (CLP) National Functional Guidelines for Data Review (EPA 2014a,b), with modifications to accommodate program and analytical method requirements as specified in the WSDOT Stormwater Monitoring Chemical Data Validation Guidance and Criteria, Version 2.0 (WSDOT 2014b).

2.4 Data Assessment Results

As a result of the data validation, data qualifiers were appended to the affected data as:

- H – The sample required filtration within 15 minutes of collection but was not technically feasible. Sample was filtered immediately upon receipt at the laboratory, and the data is usable without further qualification.

- **J** – The result is an estimated quantity. The associated numerical value is an approximate concentration of the analyte in the sample.
- **R** – The data are unusable due to deficiencies in the ability to analyze the sample and meet QC criteria.
- **U** – The analyte was analyzed for, but not detected. The associated numerical value is at or below the method reporting limit (MRL) or practical quantitation limit (PQL).
- **UJ** – The analyte was analyzed for, but not detected. The method detection limit (MDL) and practical quantitation limit (PQL) are estimated values.

A detailed scope of the data validation, validation findings, and data qualification was presented in the data validation reports (DVRs).

3.0 DATA QUALITY AND USABILITY ASSESSMENT

Based on the outcomes of the validation, the following sections present a data quality overview for analytical data collected during the stormwater monitoring year 2014. The following sections address accuracy, precision, representativeness, comparability, sensitivity, and completeness. Quality control parameters applied to evaluating each of the MQOs are summarized in **Table 3-1**.

3.1 Accuracy

Accuracy is a statistical measurement of correctness and includes components of random and systematic errors. It is quantified as the degree of agreement between a measurement and a known reference. Analytical accuracy is evaluated using percent recovery (%R), percent difference (%D), or percent drift (%D_f) for the values of initial and continuing calibration, internal standards, surrogate spikes, matrix spike (MS)/matrix spike duplicate (MSD), and laboratory control sample (LCS)/ laboratory control sample duplicate (LCSD), in conjunction with results of method blanks, calibration blanks, and trip blanks. Results of blanks assist in identifying the type and magnitude of effects on system errors introduced via field and/or laboratory procedures.

Quality control anomalies affecting data accuracy were identified as follows:

3.1.1 Sample Preservation and Holding Times

- The sample filtration for dissolved metals and *ortho*-phosphate was to be conducted within 15 minutes of collection, according to 40CFR, Part 136. Due to field technical difficulty, most of the samples were filtered outside the 15-minute window, yet within 24 hours of collection. The delay in filtration was not expected to result in significant effects on data quality. Dissolved metals and *ortho*-phosphate results were footnoted with (H) to indicate the deviation from standard protocols.

- A total of 41 field samples were collected for pH analysis in the laboratory. Due to required time for sample to be transported to the laboratory, pH analysis for 38 of these samples were performed well beyond the desired holding time (*i.e.,* measured immediately upon sampling). These pH results were determined unusable and all pH values, instead, should be reported from the measurements made in the field upon sample collection. It is recommended that pH analysis not to be submitted for laboratory analysis for future reference.

- Four water samples and one sediment sample were affected by elevated cooler temperature (i.e., >6°C), and the results for these samples were qualified as estimated.

- The sample preparation or analyses for a number of water and sediment samples were performed past the required holding time; the affected results were qualified estimated or unusable (if the required holding time was grossly exceeded).

Data qualified as a result of sample preservation and holding time violations are summarized in **Table 3-2**.

3.1.2 Calibration Verification

Initial and continuing calibration verification (ICV and CCV) analyses verify accuracy of the initial calibration (ICAL) and current instrument condition prior to sample analyses. The recovery of the first (lowest concentration) ICAL standard (CS1) was evaluated to verify the ICAL validity at the RL level. ICV, CCV, and CS1 (for organic analyses only) results are presented as %D or %D_f values. Excessive bias of a %D or %D_f value indicates a potential bias of the analytical results associated with these verification analyses.

- The surfactant result for LAK-01-NC-131008 was qualified as estimated as a result of biased-low recovery of the associated CCV (i.e., %R value was less than the lower control limit of 90-110%).

- The Dichlobenil result for PIN-01-NC-131116 was qualified as estimated as a result of biased-low recovery of the associated CCV (i.e., %R value was less than the lower control limit of 80-120%).

- Benzo(b)fluoranthene, di-n-octylphthalate, and/or benzo(a)anthracene results for six water samples that were affected by biased-low CCV recovery, and were qualified as estimated.

- PCB Aroclors results in sediment sample SED-EVE-01-NS-140527 were affected by biased-low CCV recovery, and were qualified as estimated.

Data usability affected by outlying CS1, ICV, and CCV results was summarized in **Table 3-3**.

3.1.3 Blanks

Four types of blanks - method blanks, calibration blanks (for metals and inorganic constituents only), equipment rinsate blanks, and trip blanks were evaluated. Presence of target analytes in method (preparation) blanks indicated potential false-positive effects on sample results by sample preparation and analytical procedures. Detections of an analyte in calibration blanks indicate potential false–positive effects caused by the analytical system. Detections in rinsate blanks indicate potential contamination introduced during sample collection. Trip blanks monitor potential contamination introduced during sample transportation. Any detections found in blanks may skew the accuracy of associated measurements.

- TKN was detected in selected method blanks and/or calibration blanks at levels greater than their MDLs but less than their MRLs. Six stormwater samples were affected and their TKN results qualified as estimated.
- *bis*(2-Ethylehxyl)phthalate, diethylphthalate, di-*n*-octylphthalate, and naphthalene were occasionally present in method blanks; affected data were qualified as estimated at their reported values, or as non-detects at their MRLs.
- *bis*(2-Ethylehxyl)phthalate, particle size at Phi scale <1, and particle size at Phi scale 1-2 were frequently detected in rinsate blanks. Affected sample results were qualified as estimated.

Data qualified due to detections in method blanks and calibration blanks are summarized in **Table 3-4**.

3.1.4 Laboratory Control Sample Recovery

- Diesel and lube oil results for 7 water samples were qualified as estimated due to low recovery of LCS and LCSD.
- Benz(a)pyrene, *bis*(2-ethylehxyl)phthalate, butylethylphthalate, and/or diethylphthalate for up to 6 stormwater samples were qualified as estimated as a result of low-bias LCS/LCSD recovery.

Data affected by biased LCS and LCSD recovery are summarized in **Table 3-5**.

3.1.5 Matrix Spike and MS Duplicate Recovery

The %R values for MS and MSD analyses indicate levels of potential effects on a given analytical system resulting from the nature of a sample.

- The %R values for TKN and nitrate+nitrite in selected MS analyses performed on water samples were outside the control limits; TKN results for five samples were affected and therefore qualified as estimated.
- The %R values for copper and zinc in a number of the MS/MSD analyses performed on water samples were outside the control limits (75-125%). Copper and zinc results for the samples associated with these MS/MSD pairs were qualified as estimated.

Sample results affected by outlying MS and/or MSD recovery are summarized in **Table 3-6**.

3.1.6 Surrogate Spike Recovery

Surrogate spike recovery indicates the efficiency of sample extraction.

- The surrogate spike %R values for diesel and lube oil analysis in one sample were less than the LCL; the diesel and lube oil results for the sample were qualified as estimated.
- Surrogate spike %R values for SVOCs were less than the LCL in two water samples. SVOCs results for both samples were qualified as estimated.
- Surrogate spike %R values for Dichlobenil and Diuron analyses in four water samples were less than the LCL. Dichlobenil and Diuron results in the samples were qualified as estimated.
- Surrogate spike %R values for PCB Aroclors in one sediment sample were less than their LCLs. All Aroclor results in this sample were qualified as estimated.

Data usability affected by outlying surrogate spike recovery are summarized in **Table 3-7**.

3.2 Precision

Precision is defined as the degree of mutual agreement among independent measurements as the result of repeated application of the same process under similar conditions. Analytical precision is evaluated via the relative percent difference (RPD) values of LCS/LCSD analyses, MS/MSD analyses, and concentrations obtained from the two analytical columns for dual column methodologies. In addition, the level of variability for field duplicates represents the combined precision of sample collection and analysis procedures, as well as sample homogeneity.

3.2.1 Laboratory Duplicates

The RPD or concentration difference values for an LCS/LCSD, and MS/MSD pair, or a laboratory duplicate analyses indicate the variability (imprecision) resulting from the sample matrix and/or analytical system. Notable anomalies relative to laboratory duplicate analyses are discussed below:

- TKN, fecal coliform, total recoverable zinc, diesel, lube oil benzo(a)fluoranthene, and diethylphthalate were qualified as estimated in a number of water samples due to the elevated variability (RPD value was >20%) for the laboratory duplicate analyses.

3.2.2 Field Duplicates

Field duplicate results are indicative of the precision of sample collection, handling, preparation and analysis in combination, as well as sample homogeneity.

- Fecal coliform, TSS, total recoverable cadmium, selected particle size fractions, and *bis*(2-ethylehxyl)phthalate showed significant variability (RPD >20%) in various field duplicate pairs. Affected results were qualified as estimated.

- Selected PAHs and phthalates in the sediment field duplicate pair showed significant variability (RPD >35%). Affected results were qualified as estimated.

Data qualified as a result of outlying laboratory and field duplicate variability are presented in **Table 3-8.**

3.3 Representativeness

Representativeness is the level of confidence that the analytical data reflect the actual field condition. Representativeness is ensured by maintaining sample integrity during collection, preparation, and analysis. The evaluation of associated method and field blanks also assists in identifying artifacts that may skew the representativeness of the samples. As part of this data quality assessment, the correlation between total and dissolved metal concentrations for each metal/sample was evaluated.

No anomalies were identified in sample preservation, handling, preparation, and analysis that affected data representativeness, except for the QC anomalies affecting accuracy (Section 3.1) and precision (Section 3.2) as discussed above.

Metals results were considered "uncorrelated" and the usability of the results affected if the "total" concentration for a metal was less than its "dissolved" concentration in a sample and the concentration difference was beyond experimental errors (i.e., RPD value was >10%, or concentration difference value was >RL). No "uncorrelated" metals results were found.

3.4 Comparability

Comparability is the confidence with which one data set can be compared to another data set. Using standard methods throughout the data generation processes ensures the comparability of data generated in separate sampling days or events.

All samples collected during monitoring year 2014 were analyzed using standardized analytical methodologies. Data generated in monitoring years 2014 are expected to be comparable to data generated in monitoring years 2012 and 2013. This will hold true for data collected in the future as long as the same or equivalent sampling protocols and analytical methodologies are applied to future sample collection activities and laboratory analysis.

3.5 Sensitivity

Sensitivity depicts the level of ability for an analytical system (*i.e.,* sample preparation and instrumental analysis) to detect a target component in a given sample matrix with a defined level of confidence. Factors affecting the sensitivity of an analytical system include: analytical system background (*e.g.,* laboratory artifact or method blank contamination), sample matrix (*e.g.,* mass spectrometry ion ratio change, co-elution of peaks, or baseline elevation), and instrument instability.

To evaluate if the analytical sensitivity achieved the project expectation, sample-specific PQLs were compared against the RL goals set forth in the QAPP. In addition, sample results were compared to detections of target analytes in method blanks to identify potential effects of laboratory background on sensitivity.

The blank-related effects are discussed above in Section 3.1. Sample results affected by the detections in the blanks were qualified as non-detects at the standard PQLs, which sufficed the project PQL goals.

3.5.1 Sample Matrix Interference

The presence of target or non-target chemicals or subjects in samples may affect the ability of an analytical system to accurately quantitate the target analyte at the expected sensitivity.

- Selected PAHs and phthalates in four water and two sediment samples showed biased-low recovery of selected internal standards. These results were qualified as estimated.

- As noted by the laboratory, detections of selected PAHs and phthalates in a great number of samples – particularly benzo(a)pyrene (13 water samples) and benzo(a)anthracene (five water samples) could not be definitively identified and accurately quantitated because the ion abundance ratios for these detections did not meet the method criteria for compound identification. These results were qualified as estimated.

- Zinc results for two sediment samples were qualified as estimated due to the elevated %R values in the associated interference check samples. The results were qualified as estimated.

Qualified data are presented in **Table 3-9**.

3.5.2 Sample-Specific Quantitation Limits

The RLs for semi-volatile organic compounds (SVOCs) in sediment samples were raised three to eight times from the project-expected RLs. This range of elevations resulted from the required dilution of sample extracts to overcome the oily nature of the samples. The reported sample-specific MRLs were considered the best-possible MRLs given the conditions of the samples. No further actions were feasible other than noting the incident in this document.

3.6 Completeness and Data Usability

Completeness is defined as the percentage of usable data divided by the total amount of data collected. Data qualified (R)[1] and target analytes that were not analyzed or reported by the laboratory were counted as unusable data and factored in the completeness determination.

3.6.1 Overall Data Completeness

A total of 3297 data points (including field duplicates and rinsate blanks) were collected, within which 47 of the data points were qualified (R) and rejected. Among the reject data, 38 data points were pH results. These pH data were qualified unusable because the laboratory analyses were performed well past the required holding time. Since pH testing is required to be performed immediately upon sampling, all pH results should be reported from the field measurements made during the sample collection. The overall analytical data completeness for WSDOT's NPDES Stormwater Monitoring Program, during monitoring year 2014 was calculated at 98.6 percent, achieving the project goal of 95 percent.

[1] R - The data are unusable due to deficiencies in the ability to analyze the sample and meet QC criteria.

REFERENCES

United States Environmental Protection Agency (EPA) 2009. *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use*, January 13 2009, EPA 540-R-08-005.

EPA 2014a. *Contract Laboratory Program (CLP) National Functional Guidelines for Inorganic Superfund Data Review*. Office of Superfund Remediation and Technical Innovation. August 2014. EPA 540-R-013-001.

EPA 2014b. *CLP National Functional Guidelines for Organic Superfund Data Review*. Office of Superfund Remediation and Technical Innovation. August 2014. EPA 540-R-014-002.

Washington Department of Transportation (WSDOT) 2014a. *Quality Assurance Project Plan for Baseline Monitoring of WSDOT Highway Run-off.* Working draft, March 2014.

WSDOT 2014b. *Stormwater Monitoring: Chemical Data Validation Guidance and Criteria, Version 1.2*. Pyron Environmental, Inc., December 10, 2014.

19

TABLES

20

Table 1-1 Sample Analysis Schedule

Stormwater					
Parameter	**Analytical Method**	**Number of Field Samples**	**Number of Field Duplicates**	**Number of Rinsate Blanks**	**Analytical Laboratory**
pH	SM 4500 H-B	41	4	15	
Total Chloride	EPA 300.0	45	2	6	**Samples collected 10/8/2013 – 4/9/2014:** Washington State Department of Ecology, Manchester Environmental Laboratory (MEL), Manchester, WA **Samples collected 5/8/2014 – 9/24/2014:** AmTest Laboratories, Inc. (AmTest), Kirkland, Washington
Total Suspended Solids (TSS)	SM 2540 D	95	11	5	
Nitrate/Nitrite	EPA 353.2/SM 4500 NO_3-I	84	8	12	
Ortho-phosphate (OP)	SM 4500 P-E/G	53	5	15	
Total Phosphorus (TP)	SM 4500 P-F/H	38	9	6	
Total Recoverable & Dissolved Metals (Cd, Cu, Pb, Zn)	EPA 200.8	100[(A)]	11	17	
Hardness	SM 2340B	93	13	16	
TPH-Diesel & Motor Oil	NWTPH-Dx	35	4	2	
TPH-Gasoline	NWTPH-Gx	66	7	7	
Polycyclic Aromatic Hydrocarbons (PAHs)	SW8270D-SIM	42	4	6	
Phthalates	SW8270D-SIM	42	4	6	
Diuron & Dichlobenil	SW8270D	4	1	1	
Glyphosate (non-aquatic formula)	EPA 547	44	5	6	TestAmerica Laboratories, Inc. (TAL), Savannah, GA Anatek Labs, Inc. , Moscow, ID
Total Kjeldahl Nitrogen (TKN)	USEPA 351.2/SM 4500 N_{org}-B	43	8	0	TAL – Denver, CO TAL – Nashville, TN
Surfactant (MBAS)	SM5540C	1	0	0	AmTest - Kirkland, Washington
Fecal Coliform	SM 9222 D	56	7	5	
Particle Size Distribution (PSD)	ASTM D3977-97/TAPE	98	10	14	Analytical Resources, Inc. (ARI) – Tukwila, WA

Sediment					
Parameter	**Analytical Method**	**Number of Samples**	**Number of Field Duplicates**	**Number of Rinsate Blanks**	**Analytical Laboratory**
Grain Size	ASTM D422	5	1	0	AmTest - Kirkland, Washington
Total Solids	SM 2540G	5	2	0	
Total Organic Carbon (TOC)	PSEP Protocols	4	1	0	
Metals (Cd, Cu, Pb, Zn)	EPA 200.8/SW6020A	4	1	0	
TPH-Diesel & Motor Oil	NWTPH-Dx	3	1	0	
Diuron	SW8321A	1	1	0	
SVOCs (SMS compounds)	SW8270D-SIM	4	1	0	
PCB Aroclors	SW8082A	3	1	0	
Glyphosate	EPA 547	1	0	0	Anatek Labs, Inc., Moscow, ID

Notes:

[A]– The number was based on dissolved zinc analysis; the number of samples for other metals species might be less than this number as samples might be analyzed for selected metals than the full suit total and dissolved cadmium, copper, lead, and zinc.

ASTM – American Society of Testing and Materials

EPA Methods – *USEPA Methods for Chemical Analysis of Water and Wastes,* EPA–600/4-79-020, March 1983 Revision

NWTPH - *Analytical Methods for Petroleum Hydrocarbons,* ECY 97-602, Washington State Department of Ecology, June 1997

SM – *Standard Methods for the Examination of Water and Wastewater*, American Public Health Association, 20th Edition, 1995

SW Methods – *USEPA Test Methods for Evaluating Solid Waste, Physical/Chemical Methods,* SW-846, Third Edition, December 1996

PCB – Polychlorinated biphenyls

PSEP – Puget Sound Estuary Program

SIM – Selective ion monitoring

SMS – Washington State Sediment Management Standards

TAPE – Guidance for Evaluating Emerging Stormwater Treatment Technologies, Technology Assessment Protocol – Ecology, 2008

TPH – Total petroleum hydrocarbon

Table 3-1 Quality Control Parameters Corresponding to Measurement Quality Objectives

MQOs	QC Parameters
Precision	**RPD or Concentration Difference Values of:** LCS/LCSD MS/MSD (or Laboratory Duplicate) Dual Column Confirmation
Accuracy	Holding Time **%RPD, %R, %D, or %D$_r$ Values of:** Calibration Verification (CS1, ICV, CCV) Surrogate Spikes Internal Standards LCS and LCSD MS and MSD Interference Check Sample for Metals Analyzed with ICP Methodologies Serial Dilution for Metals Analyzed with ICP Methodologies **Results of:** Instrument and Calibration Blanks (ICB/CCB) Method (Preparation) Blanks Trip Blanks
Representativeness	Results of All Blanks Sample Integrity Holding Times
Comparability	Sample-specific PQLs Sample Collection Methodologies Sample Preparation and Analytical Methodologies
Completeness	Data Qualifiers Laboratory Deliverables and Analyte Lists Requested/Reported Valid Results Number of Rejected Results
Sensitivity	Sample-specific MDLs and PQLs

Notes:

%R – Percent recovery
%D – Percent difference
%D$_r$ – Percent drift
%RPD – Percent relative percent difference
CCB – Continuing calibration blank
CCV – Continuing calibration verification
CS1 – First (lowest) initial calibration standard
ICB – Initial calibration blank
ICP – Inductively coupled plasma
ICV – Initial calibration verification
LCS – Laboratory control sample
LCSD – Laboratory control sample duplicate
MDL – Method detection limit
MQOs – Measurement quality objectives
MS – Matrix spike
MSD – Matrix spike duplicate
PQL – Practical quantitation limit
RPD – Relative percent difference

Table 3-2 Data Affected by Sample Preservation and Holding Time Anomalies

Field Sample ID	Laboratory Sample ID	Sample Matrix	Analyte	Qualifier	Reason Code
PIL-07-NC-140523	14-A007709	W	Hardness (CaCO3)	J	Temp
PIL-06-DC-140523	14-A007708	W	Nitrate + Nitrite	J	Temp
PIL-07-NC-140523	14-A007709	W	Nitrate + Nitrite	J	Temp
PIN-01-NC-140903	14-A014147	W	Nitrate + Nitrite	J	Temp
PIL-06-NC-140523	14-10344-YL78A	W	Particle Size, Phi <1 (>500 um)	J	Temp
PIL-07-NC-140523	14-10345-YL78B	W	Particle Size, Phi <1 (>500 um)	J	Temp
PIL-07-DC-140523	14-10346-YL78C	W	Particle Size, Phi <1 (>500 um)	J	Temp
EVE-01-NC-140628	14-13096-YQ33A	W	Particle Size, Phi <1 (>500 um)	UJ	Temp
PIL-06-NC-140523	14-10344-YL78A	W	Particle Size, Phi >10 (<1.0 um)	J	Temp
PIL-07-NC-140523	14-10345-YL78B	W	PH	J	Temp
PIL-07-DC-140523	14-10346-YL78C	W	Particle Size, Phi >10 (<1.0 um)	J	Temp
EVE-01-NC-140628	14-13096-YQ33A	W	Particle Size, Phi >10 (<1.0 um)	J	Temp
PIL-06-NC-140523	14-10344-YL78A	W	Particle Size, Phi 1-2 (250-500 um)	J	Temp
PIL-07-NC-140523	14-10345-YL78B	W	Particle Size, Phi 1-2 (250-500 um)	J	Temp
PIL-07-DC-140523	14-10346-YL78C	W	Particle Size, Phi 1-2 (250-500 um)	UJ	Temp
EVE-01-NC-140628	14-13096-YQ33A	W	Particle Size, Phi 1-2 (250-500 um)	J	Temp
PIL-06-NC-140523	14-10344-YL78A	W	Particle Size, Phi 2 to 3 (125-250 um)	UJ	Temp
PIL-07-NC-140523	14-10345-YL78B	W	Particle Size, Phi 2 to 3 (125-250 um)	J	Temp
PIL-07-DC-140523	14-10346-YL78C	W	Particle Size, Phi 2 to 3 (125-250 um)	J	Temp
EVE-01-NC-140628	14-13096-YQ33A	W	Particle Size, Phi 2 to 3 (125-250 um)	UJ	Temp
PIL-06-NC-140523	14-10344-YL78A	W	Particle Size, Phi 3 to 4 (62.5-125 um)	J	Temp
PIL-07-NC-140523	14-10345-YL78B	W	Particle Size, Phi 3 to 4 (62.5-125 um)	J	Temp
PIL-07-DC-140523	14-10346-YL78C	W	Particle Size, Phi 3 to 4 (62.5-125 um)	J	Temp
EVE-01-NC-140628	14-13096-YQ33A	W	Particle Size, Phi 3 to 4 (62.5-125 um)	UJ	Temp
PIL-06-NC-140523	14-10344-YL78A	W	Particle Size, Phi 4-8 (3.9-62.5 um)	J	Temp
PIL-07-NC-140523	14-10345-YL78B	W	Particle Size, Phi 4-8 (3.9-62.5 um)	J	Temp
PIL-07-DC-140523	14-10346-YL78C	W	Particle Size, Phi 4-8 (3.9-62.5 um)	J	Temp
EVE-01-NC-140628	14-13096-YQ33A	W	Particle Size, Phi 4-8 (3.9-62.5 um)	J	Temp
PIL-06-NC-140523	14-10344-YL78A	W	Particle Size, Phi 8-10 (1.0-3.9 um)	J	Temp
PIL-07-NC-140523	14-10345-YL78B	W	Particle Size, Phi 8-10 (1.0-3.9 um)	J	Temp
PIL-07-DC-140523	14-10346-YL78C	W	Particle Size, Phi 8-10 (1.0-3.9 um)	J	Temp
EVE-01-NC-140628	14-13096-YQ33A	W	Particle Size, Phi 8-10 (1.0-3.9 um)	J	Temp
PIL-06-DC-140523	14-A007708	W	Total Nitrogen (TKN)	J	Temp
PIL-07-NC-140523	14-A007709	W	Total Nitrogen (TKN)	J	Temp
PIN-01-NC-140903	14-A014147	W	Total Nitrogen (TKN)	J	Temp
PIL-06-DC-140523	14-A007708	W	Total Phosphorus	J	Temp
PIL-07-NC-140523	14-A007709	W	Total Phosphorus	J	Temp
PIN-01-NC-140903	14-A014147	W	Total Phosphorus	J	Temp

24

Field Sample ID	Laboratory Sample ID	Sample Matrix	Analyte	Qualifier	Reason Code
PIL-07-NC-140523	14-A007709	W	Total Suspended Solids	J	Temp
PIN-01-NC-140903	14-A014147	W	Total Suspended Solids	J	Temp
PIN-01-NG-140617	14-A009327	W	Fecal Coliform	R	HT
SR9-01-NC-140508	14-A006979	W	pH	R	HT
SR9-01-NC-140508	14-A006979	W	pH	R	HT
EVE-04-NC-140508	14-A006980	W	pH	R	HT
EVE-04-NC-140508	14-A006980	W	pH	R	HT
SR9-01-NC-140523	14-A007703	W	pH	R	HT
PIL-06-NC-140523	14-A007707	W	pH	R	HT
PIL-07-NC-140523	14-A007709	W	pH	R	HT
EVE-06-NC-140613	14-A008770	W	pH	R	HT
EVE-03-NC-140613	14-A008771	W	pH	R	HT
SR9-01-NC-140613	14-A008772	W	pH	R	HT
PIL-07-NC-140613	14-A008774	W	pH	R	HT
PIL-04-NC-140613	14-A008775	W	pH	R	HT
PIL-04-NC-140613	14-A008775	W	pH	R	HT
PIL-04-DC-140613	14-A008776	W	pH	R	HT
PIL-04-DC-140613	14-A008776	W	pH	R	HT
EVE-01-NC-140613	14-A008777	W	pH	R	HT
PIL-08-NC-140613	14-A008781	W	pH	R	HT
PIL-03-NC-140613	14-A008782	W	pH	R	HT
PIL-03-NC-140613	14-A008782	W	pH	R	HT
EVE-02-NC-140613	14-A008784	W	pH	R	HT
PIL-06-NC-140613	14-A008785	W	pH	R	HT
EVE-05-NC-140613	14-A008786	W	pH	R	HT
PIL-01-NC-140613	14-A008787	W	pH	R	HT
EVE-04-NC-140613	14-A008788	W	pH	R	HT
EVE-04-DC-140613	14-A008789	W	pH	R	HT
PIN-01-NC-140614	14-A008790	W	pH	R	HT
EVE-01-NC-140628	14-A009719	W	pH	R	HT
SR9-01-NC-140723	14-A011425	W	pH	R	HT
EVE-01-NC-140723	14-A011427	W	pH	R	HT
EVE-04-NC-140723	14-A011428	W	pH	R	HT
PIL-01-NC-140723	14-A011430	W	pH	R	HT
SR9-01-NC-140813	14-A012671	W	pH	H	HT
PIL-01-NC-140813	14-A012673	W	pH	H	HT
PIL-01-NC-140902	14-A013985	W	pH	H	HT
PIN-01-NC-140903	14-A014147	W	pH	R	HT
EVE-04-NC-140924	14-A015398	W	pH	R	HT
SR9-01-NC-140924	14-A015399	W	pH	R	HT

Field Sample ID	Laboratory Sample ID	Sample Matrix	Analyte	Qualifier	Reason Code
EVE-01-NC-140924	14-A015405	W	pH	R	HT
EVE-01-NC-140628	14-A009719	W	Nitrate + Nitrite	J	HT
SR9-01-NC-140813	14-A012671	W	Nitrate + Nitrite	J	HT
PIL-01-NC-140813	14-A012673	W	Nitrate + Nitrite	J	HT
518-03-NC-140107	1401018-05	W	*Ortho*-Phosphate	UJ	HT
518-02-NC-140107	1401018-07	W	*Ortho*-Phosphate	J	HT
PIL-02-DC-140107	1401018-16	W	*Ortho*-Phosphate	J	HT
PIL-08-NC-140314	1403050-01	W	*Ortho*-Phosphate	J	HT
PIL-07-NC-140314	1403050-03	W	*Ortho*-Phosphate	J	HT
PIL-06HNC-140314	1403050-05	W	*Ortho*-Phosphate	J	HT
EVE-04-NC-140508	14-10424-YL99A	W	Particle Size, Phi <1 (>500 um)	J	HT
EVE-04-NC-140508	14-10424-YL99A	W	Particle Size, Phi >10 (<1.0 um)	J	HT
EVE-04-NC-140508	14-10424-YL99A	W	Particle Size, Phi 1-2 (250-500 um)	J	HT
EVE-04-NC-140508	14-10424-YL99A	W	Particle Size, Phi 2 to 3 (125-250 um)	R	HT
EVE-04-NC-140508	14-10424-YL99A	W	Particle Size, Phi 3 to 4 (62.5-125 um)	R	HT
EVE-04-NC-140508	14-10424-YL99A	W	Particle Size, Phi 4-8 (3.9-62.5 um)	J	HT
EVE-04-NC-140508	14-10424-YL99A	W	Particle Size, Phi 8-10 (1.0-3.9 um)	J	HT
SR9-01-NC-140723	14-A011425	W	Dissolved Cadmium	H	HT
PIL-01-NC-140723	14-A011430	W	Dissolved Cadmium	H	HT
PIL-01-DC-140723	14-A011431	W	Dissolved Cadmium	H	HT
SR9-01-NC-140813	14-A012671	W	Dissolved Cadmium	H	HT
PIN-01-NC-140903	14-A014147	W	Dissolved Cadmium	R	HT
EVE-04-NC-140924	14-A015398	W	Dissolved Cadmium	H	HT
SR9-01-NC-140924	14-A015399	W	Dissolved Cadmium	H	HT
EVE-01-NC-140924	14-A015405	W	Dissolved Cadmium	H	HT
EVE-01-NC-140628	14-A009719	W	Dissolved Copper	H	HT
SR9-01-NC-140723	14-A011425	W	Dissolved Copper	H	HT
EVE-01-NC-140723	14-A011427	W	Dissolved Copper	H	HT
EVE-04-NC-140723	14-A011428	W	Dissolved Copper	H	HT
EVE-04-DC-140723	14-A011429	W	Dissolved Copper	H	HT
PIL-01-NC-140723	14-A011430	W	Dissolved Copper	H	HT
PIL-01-DC-140723	14-A011431	W	Dissolved Copper	H	HT
SR9-01-NC-140813	14-A012671	W	Dissolved Copper	H	HT
PIL-01-NC-140813	14-A012673	W	Dissolved Copper	H	HT
PIL-01-NC-140902	14-A013985	W	Dissolved Copper	H	HT
PIN-01-NC-140903	14-A014147	W	Dissolved Copper	R	HT
EVE-04-NC-140924	14-A015398	W	Dissolved Copper	H	HT
SR9-01-NC-140924	14-A015399	W	Dissolved Copper	H	HT
EVE-01-NC-140924	14-A015405	W	Dissolved Copper	H	HT
SR9-01-NC-140723	14-A011425	W	Dissolved Lead	H	HT

Field Sample ID	Laboratory Sample ID	Sample Matrix	Analyte	Qualifier	Reason Code
PIL-01-NC-140723	14-A011430	W	Dissolved Lead	H	HT
PIL-01-DC-140723	14-A011431	W	Dissolved Lead	H	HT
SR9-01-NC-140813	14-A012671	W	Dissolved Lead	H	HT
PIN-01-NC-140903	14-A014147	W	Dissolved Lead	R	HT
EVE-04-NC-140924	14-A015398	W	Dissolved Lead	H	HT
SR9-01-NC-140924	14-A015399	W	Dissolved Lead	H	HT
EVE-01-NC-140924	14-A015405	W	Dissolved Lead	H	HT
EVE-01-NC-140628	14-A009719	W	Dissolved Zinc	H	HT
SR9-01-NC-140723	14-A011425	W	Dissolved Zinc	H	HT
EVE-01-NC-140723	14-A011427	W	Dissolved Zinc	H	HT
EVE-04-NC-140723	14-A011428	W	Dissolved Zinc	H	HT
EVE-04-DC-140723	14-A011429	W	Dissolved Zinc	H	HT
PIL-01-NC-140723	14-A011430	W	Dissolved Zinc	H	HT
PIL-01-DC-140723	14-A011431	W	Dissolved Zinc	HJ	HT
SR9-01-NC-140813	14-A012671	W	Dissolved Zinc	H	HT
PIL-01-NC-140813	14-A012673	W	Dissolved Zinc	H	HT
PIL-01-NC-140902	14-A013985	W	Dissolved Zinc	H	HT
PIN-01-NC-140903	14-A014147	W	Dissolved Zinc	R	HT
EVE-04-NC-140924	14-A015398	W	Dissolved Zinc	H	HT
SR9-01-NC-140924	14-A015399	W	Dissolved Zinc	H	HT
EVE-01-NC-140924	14-A015405	W	Dissolved Zinc	H	HT
PIN-01-NG-140603	14-A008651	W	Gasoline	J	HT
PIN-01-NG-140617	14-A009327	W	Gasoline	J	HT
GEI-01-NG-140617	14-A009328	W	Gasoline	J	HT
SR9-01-NC-140723	14-A011425	W	Acenaphthene	UJ	HT
EVE-01-NC-140723	14-A011427	W	Acenaphthene	UJ	HT
EVE-04-NC-140723	14-A011428	W	Acenaphthene	UJ	HT
PIL-01-NC-140723	14-A011430	W	Acenaphthene	UJ	HT
SR9-01-NC-140723	14-A011425	W	Acenaphthylene	UJ	HT
EVE-01-NC-140723	14-A011427	W	Acenaphthylene	UJ	HT
EVE-04-NC-140723	14-A011428	W	Acenaphthylene	UJ	HT
PIL-01-NC-140723	14-A011430	W	Acenaphthylene	UJ	HT
SR9-01-NC-140723	14-A011425	W	Anthracene	UJ	HT
EVE-01-NC-140723	14-A011427	W	Anthracene	UJ	HT
EVE-04-NC-140723	14-A011428	W	Anthracene	UJ	HT
PIL-01-NC-140723	14-A011430	W	Anthracene	UJ	HT
SR9-01-NC-140723	14-A011425	W	Benzo(a)anthracene	UJ	HT
EVE-01-NC-140723	14-A011427	W	Benzo(a)anthracene	UJ	HT
EVE-04-NC-140723	14-A011428	W	Benzo(a)anthracene	UJ	HT
PIL-01-NC-140723	14-A011430	W	Benzo(a)anthracene	UJ	HT

Field Sample ID	Laboratory Sample ID	Sample Matrix	Analyte	Qualifier	Reason Code
SR9-01-NC-140723	14-A011425	W	Benzo(a)pyrene	UJ	HT
EVE-01-NC-140723	14-A011427	W	Benzo(a)pyrene	UJ	HT
EVE-04-NC-140723	14-A011428	W	Benzo(a)pyrene	UJ	HT
PIL-01-NC-140723	14-A011430	W	Benzo(a)pyrene	UJ	HT
SR9-01-NC-140723	14-A011425	W	Benzo(b)fluoranthene	UJ	HT
EVE-01-NC-140723	14-A011427	W	Benzo(b)fluoranthene	UJ	HT
EVE-04-NC-140723	14-A011428	W	Benzo(b)fluoranthene	UJ	HT
PIL-01-NC-140723	14-A011430	W	Benzo(b)fluoranthene	UJ	HT
SR9-01-NC-140723	14-A011425	W	Benzo(g,h,i)perylene	UJ	HT
EVE-01-NC-140723	14-A011427	W	Benzo(g,h,i)perylene	UJ	HT
EVE-04-NC-140723	14-A011428	W	Benzo(g,h,i)perylene	UJ	HT
PIL-01-NC-140723	14-A011430	W	Benzo(g,h,i)perylene	UJ	HT
SR9-01-NC-140723	14-A011425	W	Benzo(k)fluoranthene	UJ	HT
EVE-01-NC-140723	14-A011427	W	Benzo(k)fluoranthene	UJ	HT
EVE-04-NC-140723	14-A011428	W	Benzo(k)fluoranthene	UJ	HT
PIL-01-NC-140723	14-A011430	W	Benzo(k)fluoranthene	UJ	HT
SR9-01-NC-140723	14-A011425	W	*bis*(2-Ethylhexyl) Phthalate	J	HT
EVE-01-NC-140723	14-A011427	W	*bis*(2-Ethylhexyl) Phthalate	J	HT
EVE-04-NC-140723	14-A011428	W	*bis*(2-Ethylhexyl) Phthalate	J	HT
PIL-01-NC-140723	14-A011430	W	*bis*(2-Ethylhexyl) Phthalate	J	HT
SR9-01-NC-140723	14-A011425	W	Butylbenzylphthalate	UJ	HT
EVE-01-NC-140723	14-A011427	W	Butylbenzylphthalate	UJ	HT
EVE-04-NC-140723	14-A011428	W	Butylbenzylphthalate	UJ	HT
PIL-01-NC-140723	14-A011430	W	Butylbenzylphthalate	UJ	HT
SR9-01-NC-140723	14-A011425	W	Chrysene	UJ	HT
EVE-01-NC-140723	14-A011427	W	Chrysene	UJ	HT
EVE-04-NC-140723	14-A011428	W	Chrysene	UJ	HT
PIL-01-NC-140723	14-A011430	W	Chrysene	UJ	HT
SR9-01-NC-140723	14-A011425	W	Dibenzo(ah)anthracene	UJ	HT
EVE-01-NC-140723	14-A011427	W	Dibenzo(ah)anthracene	UJ	HT
EVE-04-NC-140723	14-A011428	W	Dibenzo(ah)anthracene	UJ	HT
PIL-01-NC-140723	14-A011430	W	Dibenzo(ah)anthracene	UJ	HT
SR9-01-NC-140723	14-A011425	W	Diethylphthalate	UJ	HT
EVE-01-NC-140723	14-A011427	W	Diethylphthalate	UJ	HT
EVE-04-NC-140723	14-A011428	W	Diethylphthalate	UJ	HT
PIL-01-NC-140723	14-A011430	W	Diethylphthalate	UJ	HT
SR9-01-NC-140723	14-A011425	W	Dimethylphthalate	UJ	HT
EVE-01-NC-140723	14-A011427	W	Dimethylphthalate	UJ	HT
EVE-04-NC-140723	14-A011428	W	Dimethylphthalate	UJ	HT
PIL-01-NC-140723	14-A011430	W	Dimethylphthalate	UJ	HT

Field Sample ID	Laboratory Sample ID	Sample Matrix	Analyte	Qualifier	Reason Code
SR9-01-NC-140723	14-A011425	W	Di-*n*-butylphthalate	UJ	HT
EVE-01-NC-140723	14-A011427	W	Di-*n*-butylphthalate	UJ	HT
EVE-04-NC-140723	14-A011428	W	Di-*n*-butylphthalate	UJ	HT
PIL-01-NC-140723	14-A011430	W	Di-*n*-butylphthalate	UJ	HT
SR9-01-NC-140723	14-A011425	W	Di-*n*-butylphthalate	UJ	HT
EVE-01-NC-140723	14-A011427	W	Di-*n*-butylphthalate	UJ	HT
EVE-04-NC-140723	14-A011428	W	Di-*n*-butylphthalate	UJ	HT
PIL-01-NC-140723	14-A011430	W	Di-*n*-butylphthalate	UJ	HT
SR9-01-NC-140723	14-A011425	W	Fluoranthene	UJ	HT
EVE-01-NC-140723	14-A011427	W	Fluoranthene	UJ	HT
EVE-04-NC-140723	14-A011428	W	Fluoranthene	UJ	HT
PIL-01-NC-140723	14-A011430	W	Fluoranthene	UJ	HT
SR9-01-NC-140723	14-A011425	W	Fluorene	UJ	HT
EVE-01-NC-140723	14-A011427	W	Fluorene	UJ	HT
EVE-04-NC-140723	14-A011428	W	Fluorene	UJ	HT
PIL-01-NC-140723	14-A011430	W	Fluorene	UJ	HT
SR9-01-NC-140723	14-A011425	W	Indeno(123-cd)pyrene	UJ	HT
EVE-01-NC-140723	14-A011427	W	Indeno(123-cd)pyrene	UJ	HT
EVE-04-NC-140723	14-A011428	W	Indeno(123-cd)pyrene	UJ	HT
PIL-01-NC-140723	14-A011430	W	Indeno(123-cd)pyrene	UJ	HT
SR9-01-NC-140723	14-A011425	W	Naphthalene	UJ	HT
EVE-01-NC-140723	14-A011427	W	Naphthalene	UJ	HT
EVE-04-NC-140723	14-A011428	W	Naphthalene	UJ	HT
PIL-01-NC-140723	14-A011430	W	Naphthalene	UJ	HT
SR9-01-NC-140723	14-A011425	W	Phenanthrene	UJ	HT
EVE-01-NC-140723	14-A011427	W	Phenanthrene	UJ	HT
EVE-04-NC-140723	14-A011428	W	Phenanthrene	UJ	HT
PIL-01-NC-140723	14-A011430	W	Phenanthrene	UJ	HT
SR9-01-NC-140723	14-A011425	W	Pyrene	UJ	HT
EVE-01-NC-140723	14-A011427	W	Pyrene	UJ	HT
EVE-04-NC-140723	14-A011428	W	Pyrene	UJ	HT
PIL-01-NC-140723	14-A011430	W	Pyrene	UJ	HT
SED-SR9-01-NS-140610	14-A008659	S	Grain Size PHI +1.0	J	Temp
SED-SR9-01-NS-140610	14-A008659	S	Grain Size PHI +10.0	UJ	Temp
SED-SR9-01-NS-140610	14-A008659	S	Grain Size PHI +2.0	J	Temp
SED-SR9-01-NS-140610	14-A008659	S	Grain Size PHI +3.0	J	Temp
SED-SR9-01-NS-140610	14-A008659	S	Grain Size PHI +4.0	J	Temp
SED-SR9-01-NS-140610	14-A008659	S	Grain Size PHI +5.0	J	Temp
SED-SR9-01-NS-140610	14-A008659	S	Grain Size PHI +6.0	J	Temp
SED-SR9-01-NS-140610	14-A008659	S	Grain Size PHI +7.0	J	Temp

Field Sample ID	Laboratory Sample ID	Sample Matrix	Analyte	Qualifier	Reason Code
SED-SR9-01-NS-140610	14-A008659	S	Grain Size PHI +8.0	J	Temp
SED-SR9-01-NS-140610	14-A008659	S	Grain Size PHI +9.0	J	Temp
SED-SR9-01-NS-140610	14-A008659	S	Grain Size PHI > +10.0	J	Temp
SED-SR9-01-NS-140610	14-A008659	S	Grain Size PHI 0	J	Temp
SED-SR9-01-NS-140610	14-A008659	S	Grain Size PHI -1.0	J	Temp
SED-SR9-01-NS-140610	14-A008659	S	Grain Size PHI -2.0	UJ	Temp
SED-SR9-01-NS-140610	14-A008659	S	Grain Size PHI -2.25	J	Temp
SED-SR9-01-NS-140610	14-A008659	S	Total Organic Carbon	J	Temp
SED-SR9-01-NS-140610	14-A008659	S	Total Solids	J	Temp
SED-SR9-01-NS-140610	14-A008659	S	Arsenic	J	Temp
SED-SR9-01-NS-140610	14-A008659	S	Cadmium	J	Temp
SED-SR9-01-NS-140610	14-A008659	S	Copper	J	Temp
SED-SR9-01-NS-140610	14-A008659	S	Lead	J	Temp
SED-SR9-01-NS-140610	14-A008659	S	Zinc	J	Temp
SED-SR9-01-NS-140610	14-A008659	S	Diesel	J	Temp
SED-SR9-01-NS-140610	14-A008659	S	Heavy Oil	J	Temp
SED-SR9-01-NS-140610	14-A008659	S	Acenaphthene	UJ	Temp
SED-SR9-01-NS-140610	14-A008659	S	Acenaphthylene	J	Temp
SED-SR9-01-NS-140610	14-A008659	S	Anthracene	J	Temp
SED-SR9-01-NS-140610	14-A008659	S	Benzo(a)anthracene	J	Temp
SED-SR9-01-NS-140610	14-A008659	S	Benzo(a)pyrene	UJ	Temp
SED-SR9-01-NS-140610	14-A008659	S	Benzo(b)fluoranthene	UJ	Temp
SED-SR9-01-NS-140610	14-A008659	S	Benzo(g,h,i)perylene	J	Temp
SED-SR9-01-NS-140610	14-A008659	S	Benzo(k)fluoranthene	UJ	Temp
SED-SR9-01-NS-140610	14-A008659	S	*bis*(2-Ethylhexyl)phthalate	J	Temp
SED-SR9-01-NS-140610	14-A008659	S	Butylbenzylphthalate	J	Temp
SED-SR9-01-NS-140610	14-A008659	S	Chrysene	J	Temp
SED-SR9-01-NS-140610	14-A008659	S	Dibenzo(ah)anthracene	UJ	Temp
SED-SR9-01-NS-140610	14-A008659	S	Diethylphthalate	UJ	Temp
SED-SR9-01-NS-140610	14-A008659	S	Dimethylphthalate	UJ	Temp
SED-SR9-01-NS-140610	14-A008659	S	Di-*n*-butylphthalate	J	Temp
SED-SR9-01-NS-140610	14-A008659	S	Di-*n*-octylphthalate	UJ	Temp
SED-SR9-01-NS-140610	14-A008659	S	Fluoranthene	J	Temp
SED-SR9-01-NS-140610	14-A008659	S	Fluorene	UJ	Temp
SED-SR9-01-NS-140610	14-A008659	S	Indeno(123-cd)pyrene	J	Temp
SED-SR9-01-NS-140610	14-A008659	S	Naphthalene	J	Temp
SED-SR9-01-NS-140610	14-A008659	S	Phenanthrene	J	Temp
SED-SR9-01-NS-140610	14-A008659	S	Pyrene	J	Temp
SED-Pin-01-NS-140624	14-A009447	S	Diuron	UJ	HT
SED-Pin-01-DS-140624	14-A009448	S	Diuron	UJ	HT

30

Field Sample ID	Laboratory Sample ID	Sample Matrix	Analyte	Qualifier	Reason Code
SED-EVE-01-NS-140527	14-A007711	S	Total Organic Carbon	J	HT
SED-EVE-01-DS-140527	14-A007712	S	Total Organic Carbon	J	HT
SED-PIL-01-NS-140527	14-A007714	S	Total Organic Carbon	J	HT

Notes:

Temp – The temperature of the cooler containing this sample arrived at the analytical laboratory exceeding the control criteria (>6°C) and the analysis was determined affected by the raised cooler temperature.

H – The filtration of the sample was required within 15 minutes of collection, which was not technically feasible. Sample was filtered immediately upon arrival at the laboratory and the reported results were usable without further qualifying.

HT – The preparation or analysis of the sample was performed past the method required holding time.

J – The analyte was detected in the sample and the reported value was considered as estimated.

UJ – The analyte was not detected in the sample, and the reported quantitation limit associated with this analyte was considered as estimated.

W – Water

31

Table 3-3 Data Affected by Calibration Verification Outliers

Field Sample ID	Laboratory Sample ID	Sample Matrix	Analyte	Qualifier	Comment
LAK-01-NC-131008	13-A015110	W	Surfactants	J	CCV biased low
PIN-01-NC-131116	1311048-08	W	Dichlobenil	J	CCV biased low
EVE-01-NC-140107	1401018-06	W	Benzo(b)fluoranthene	UJ	CCV biased low
EVE-04-NC-140107	1401018-12	W	Benzo(b)fluoranthene	UJ	CCV biased low
PIL-01-NC-140107	1401018-21	W	Benzo(b)fluoranthene	UJ	CCV biased low
EVE-04-NC-140317	1403052-03	W	Di-*n*-octyl Phthalate	J	CCV biased low
PIL-01-NC-140319	1403069-01	W	Benz[a]anthracene	J	CCV biased low
EVE-01-NC-140319	1403069-02	W	Benz[a]anthracene	J	CCV biased low
SED-EVE-01-NS-140527	14-A007711	S	PCB-1016	UJ	CCV biased low
SED-EVE-01-NS-140527	14-A007711	S	PCB-1221	UJ	CCV biased low
SED-EVE-01-NS-140527	14-A007711	S	PCB-1232	UJ	CCV biased low
SED-EVE-01-NS-140527	14-A007711	S	PCB-1242	UJ	CCV biased low
SED-EVE-01-NS-140527	14-A007711	S	PCB-1248	UJ	CCV biased low
SED-EVE-01-NS-140527	14-A007711	S	PCB-1254	UJ	CCV biased low
SED-EVE-01-NS-140527	14-A007711	S	PCB-1260	UJ	CCV biased low
SED-EVE-01-NS-140527	14-A007711	S	PCB-1260	UJ	CCV biased low

Notes:

CCV biased low – The continuing calibration verification (CCV) percent difference (%D) values (±10% for inorganics, ±20% for organics) was less than the lower control limit.

J – The analyte was detected in the sample and the reported value was considered as estimated.

S – Sediment

UJ – The analyte was not detected in the sample, and the reported quantitation limit associated with this analyte was considered as estimated.

W – Water

32

Table 3-4 Data Affected by Detections in Blanks

Field Sample ID	Laboratory Sample ID	Analyte	Original Result	Qualified Result	Unit	Comment
SR9-01-A008	580-35871-1	Nitrogen, Total Kjeldahl	0.90 J	1.0 U	mg/L	MB,CB
EV-01-VEP-A002	580-35871-4	Nitrogen, Total Kjeldahl	0.91 J	1.0 U	mg/L	MB,CB
PIL-01-VEP-A026	580-37130-3	Nitrogen, Total Kjeldahl	0.84 J	1.0 U	mg/L	MB,CB
EV-04-MEP-A014	580-37130-1	Nitrogen, Total Kjeldahl	1.5	1.5 J	mg/L	MB,CB
PIL-01-VEP-A032	580-37270-1	Nitrogen, Total Kjeldahl	0.99 J	1.0 U	mg/L	MB,CB
PIL-01-VEP-A050	580-37300-8	Nitrogen, Total Kjeldahl	1.1	1.1 J	mg/L	MB,CB
EV-01-VEP-A050	1305079-06	Benzo(a)anthracene	0.026	0.026 J	µg/L	MB
PINES-01-A031	1306051-02	*bis*(2-Ethylhexyl) Phthalate	0.24	0.24 J	µg/L	MB
SR9-01-A004	1307055-02	*bis*(2-Ethylhexyl) Phthalate	0.27	0.27 U	µg/L	MB
EV-01-VEP-A004	1307055-05	*bis*(2-Ethylhexyl) Phthalate	0.25	0.25 U	µg/L	MB
EV-04-MEP-A004	1307055-09	*bis*(2-Ethylhexyl) Phthalate	0.38	0.38 U	µg/L	MB
SR9-01-A032	1303082-01	Diethyl phthalate	0.23	0.23 J	µg/L	MB
SR9-01-A036	1303082-02	Diethyl phthalate	0.23	0.23 J	µg/L	MB
EV-01-VEP-A032	1304068-06	Diethyl phthalate	0.33	0.33 J	µg/L	MB
EV-01-VEP-A036	1304068-07	Diethyl phthalate	0.33	0.33 J	µg/L	MB
SR9-01-A050	1304068-05	Diethyl phthalate	0.27	0.27 J	µg/L	MB
PINES-01-A020	1304078-04	Diethyl phthalate	0.3	0.3 J	µg/L	MB
SR9-01-A056	1304078-02	Diethyl phthalate	0.25	0.25 J	µg/L	MB
PINES-01-A004	1306051-04	Di-*n*-Butylphthalate	0.46	0.46 J	µg/L	MB
EV-01-VEP-A032	1304068-06	Di-*n*-Butylphthalate	1.3	1.3 J	µg/L	MB
EV-01-VEP-A036	1304068-07	Di-*n*-Butylphthalate	1.3	1.3 J	µg/L	MB
EV-04-MEP-A044	1304078-01	Di-*n*-Butylphthalate	1.1	1.1 J	µg/L	MB
PINES-01-A014	1304079-02	Di-*n*-Butylphthalate	1.1	1.1 J	µg/L	MB
PINES-01-A018	1304079-03	Di-*n*-Butylphthalate	1.1	1.1 J	µg/L	MB
EV-01-VEP-A002	1211042-05	Indeno(1,2,3-cd)pyrene	0.041	0.041 J	µg/L	MB
SR9-01-A008	1211042-06	Naphthalene	0.017	0.017 J	µg/L	MB
EV-01-VEP-A002	1211042-05	Naphthalene	0.016	0.016 J	µg/L	MB
SR9-01-A004	1307055-02	Naphthalene	0.011	0.011 U	µg/L	MB
SR9-01-NC-140317	1403052-01	*bis*(2-Ethylhexyl)phthalate	2.5	2.5 J	ug/L	EB
SR9-01-NC-140319	1403069-04	*bis*(2-Ethylhexyl)phthalate	3.7	3.7 J	ug/L	EB
SR9-01-NC-140408	1404050-19	*bis*(2-Ethylhexyl)phthalate	2.1	2.1 J	ug/L	EB
EVE-01-NC-140422	1404066-11	*bis*(2-Ethylhexyl)phthalate	2.9	2.9 J	ug/L	EB
SR9-01-NC-140508	14-A006979	bis(2-Ethylhexyl)phthalate	3.64	3.64 J	ug/L	EB

Field Sample ID	Laboratory Sample ID	Analyte	Original Result	Qualified Result	Unit	Comment
SR9-01-NC-140508	14-A006979	*bis*(2-Ethylhexyl)phthalate	3.64	3.64 J	ug/L	EB
SR9-01-NC-140508	14-A006979	*bis*(2-Ethylhexyl)phthalate	3.64	3.64 J	ug/L	EB
SR9-01-NC-140523	14-A007703	*bis*(2-Ethylhexyl)phthalate	2.6	2.6 J	ug/L	EB
SR9-01-NC-140613	14-A008772	*bis*(2-Ethylhexyl)phthalate	1.26	1.26 J	ug/L	EB
EVE-01-NC-140613	14-A008777	*bis*(2-Ethylhexyl)phthalate	4.39	4.39 J	ug/L	EB
EVE-01-NC-140628	14-A009719	*bis*(2-Ethylhexyl)phthalate	2.56	2.56 J	ug/L	EB
SR9-01-NC-140723	14-A011425	*bis*(2-Ethylhexyl)phthalate	4	4 J	ug/L	EB
SR9-01-NC-140813	14-A012671	*bis*(2-Ethylhexyl)phthalate	3.77	3.77 J	ug/L	EB
SR9-01-NC-140924	14-A015399	*bis*(2-Ethylhexyl)phthalate	3.59	3.59 J	ug/L	EB
EVE-04-NC-140508	14-10424-YL99A	Particle Size, Phi <1	0.65	0.65 J	mg/L	EB
EVE-04-NC-140508	14-10424-YL99A	Particle Size, Phi <1	0.65	0.65 J	mg/L	EB
EVE-04-NC-140508	14-10424-YL99A	Particle Size, Phi <1	0.65	0.65 J	mg/L	EB
EVE-01-NC-140613	14-11957-YO50E	Particle Size, Phi <1	7.55	7.55 J	mg/L	EB
EVE-04-NC-140613	14-11966-YO50N	Particle Size, Phi <1	3.74	3.74 J	mg/L	EB
EVE-04-NC-140613	14-11966-YO50N	Particle Size, Phi <1	3.74	3.74 J	mg/L	EB
EVE-01-NC-140723	14-15489-YU26A	Particle Size, Phi <1	14.33	14.33 J	mg/L	EB
EVE-04-NC-140723	14-15490-YU26B	Particle Size, Phi <1	3.35	3.35 J	mg/L	EB
EVE-01-NC-140129	14-1877-XW93F	Particle Size, Phi <1	4.75	4.75 J	mg/L	EB
EVE-04-NC-140129	14-1878-XW93G	Particle Size, Phi <1	3.57	3.57 J	mg/L	EB
EVE-04-NC-140924	14-20422-ZC57A	Particle Size, Phi <1	2.81	2.81 J	mg/L	EB
EVE-01-NC-140924	14-20423-ZC57B	Particle Size, Phi <1	5.99	5.99 J	mg/L	EB
EVE-04-NC-140317	14-4544-YD11D	Particle Size, Phi <1	1.01	1.01 J	mg/L	EB
EVE-04-NC-140107	14-479-XT95E	Particle Size, Phi <1	1.57	1.57 J	mg/L	EB
EVE-01-NC-140107	14-484-XT95J	Particle Size, Phi <1	2.84	2.84 J	mg/L	EB
EVE-01-NC-140319	14-5244-YE02D	Particle Size, Phi <1	1.83	1.83 J	mg/L	EB
EVE-01-NC-140319	14-5244-YE02D	Particle Size, Phi <1	1.83	1.83 J	mg/L	EB
EVE-04-NC-140408	14-6678-YG03B	Particle Size, Phi <1	1.66	1.66 J	mg/L	EB
EVE-04-NC-140408	14-6678-YG03B	Particle Size, Phi <1	1.66	1.66 J	mg/L	EB
EVE-01-NC-140422	14-7726-YH80D	Particle Size, Phi <1	2.31	2.31 J	mg/L	EB
EVE-01-NC-140422	14-7726-YH80D	Particle Size, Phi <1	2.31	2.31 J	mg/L	EB
EVE-04-NC-140422	14-7727-YH80E	Particle Size, Phi <1	4.10	4.10 J	mg/L	EB
EVE-04-NC-140422	14-7727-YH80E	Particle Size, Phi <1	4.10	4.10 J	mg/L	EB
EVE-04-NC-140508	14-10424-YL99A	ParticleSize, Phi 1-2	0.87	0.87 J	mg/L	EB
EVE-04-NC-140508	14-10424-YL99A	ParticleSize, Phi 1-2	0.87	0.87 J	mg/L	EB
EVE-04-NC-140508	14-10424-YL99A	ParticleSize, Phi 1-2	0.87	0.87 J	mg/L	EB

Field Sample ID	Laboratory Sample ID	Analyte	Original Result	Qualified Result	Unit	Comment
EVE-01-NC-140613	14-11957-YO50E	ParticleSize, Phi 1-2	2.31	2.31 J	mg/L	EB
EVE-04-NC-140613	14-11966-YO50N	ParticleSize, Phi 1-2	1.46	1.46 J	mg/L	EB
EVE-04-NC-140613	14-11966-YO50N	ParticleSize, Phi 1-2	1.46	1.46 J	mg/L	EB
EVE-01-NC-140628	14-13096-YQ33A	ParticleSize, Phi 1-2	1.7	1.7 J	mg/L	EB

Notes:

CB – Analyte was detected in initial and/or continuing calibration blanks and the sample result was affected.
EB – Analyte was detected in rinsate blanks and the sample result was affected.
J – The analyte was detected in the sample and the reported value was considered as estimated.
MB – The analyte was detected in method blank and sample result was affected.
mg/L – Milligram per liter
U – The analyte was not detected at or above the associated quantitation limit.
µg/L – Microgram per liter

Table 3-5 Data Affected by Laboratory Control Sample Outliers

Field Sample ID	Laboratory Sample ID	Sample Matrix	Analyte	Qualifier	Comment
EVE-01-NG-131118	1311048-01	W	Diesel	UJ	LCS %R <LCL
EVE-01-DG-131118	1311048-02	W	Diesel	UJ	LCS %R <LCL
EVE-04-NG-131118	1311048-03	W	Diesel	UJ	LCS %R <LCL
EVE-04-DG-131118	1311048-04	W	Diesel	UJ	LCS %R <LCL
SR9-01-NG-131118	1311048-05	W	Diesel	UJ	LCS %R <LCL
SR9-01-DG-131118	1311048-06	W	Diesel	UJ	LCS %R <LCL
PIN-01-NG-131116	1311048-07	W	Diesel	UJ	LCS %R <LCL
EVE-01-NG-131118	1311048-01	W	Lube Oil	J	LCS %R <LCL
EVE-01-DG-131118	1311048-02	W	Lube Oil	J	LCS %R <LCL
EVE-04-NG-131118	1311048-03	W	Lube Oil	J	LCS %R <LCL
EVE-04-DG-131118	1311048-04	W	Lube Oil	J	LCS %R <LCL
SR9-01-NG-131118	1311048-05	W	Lube Oil	J	LCS %R <LCL
SR9-01-DG-131118	1311048-06	W	Lube Oil	J	LCS %R <LCL
PIN-01-NG-131116	1311048-07	W	Lube Oil	J	LCS %R <LCL
SR9-01-NC-140613	14-A008772	W	Benzo(a)pyrene	UJ	LCS %R <LCL
SR9-01-DC-140613	14-A008773	W	Benzo(a)pyrene	UJ	LCS %R <LCL
PIL-01-NC-140613	14-A008787	W	Benzo(a)pyrene	UJ	LCS %R <LCL
PIN-01-NC-140614	14-A008790	W	Benzo(a)pyrene	UJ	LCS %R <LCL
EVE-01-BC-140701	14-A009735	W	*bis*(2-Ethylhexyl)phthalate	J	LCS %R <LCL
SR9-01-NC-140613	14-A008772	W	Butylbenzylphthalate	UJ	LCS %R <LCL
SR9-01-DC-140613	14-A008773	W	Butylbenzylphthalate	UJ	LCS %R <LCL
PIL-01-NC-140613	14-A008787	W	Butylbenzylphthalate	UJ	LCS %R <LCL
PIN-01-NC-140614	14-A008790	W	Butylbenzylphthalate	UJ	LCS %R <LCL
SR9-01-NC-140613	14-A008772	W	Diethylphthalate	UJ	LCS %R >UCL
SR9-01-DC-140613	14-A008773	W	Diethylphthalate	UJ	LCS %R <LCL
PIL-01-NC-140613	14-A008787	W	Diethylphthalate	UJ	LCS %R <LCL
PIN-01-NC-140614	14-A008790	W	Diethylphthalate	J	LCS %R <LCL
PIN-01-NC-131116	1311048-08	W	Pyrene	J	LCS %R <LCL

Notes:

%R – Percent recovery

J – The analyte was detected in the sample and the reported value was considered as estimated.

LCL – Lower control limit

LCS – Laboratory control sample

UCL – Upper control limit

UJ – The analyte was not detected in the sample, and the reported quantitation limit associated with this analyte was considered as estimated.

W – Water

Table 3-6 Data Affected by Matrix Spike Outliers

Field Sample ID	Laboratory Sample ID	Sample Matrix	Analyte	Qualifier	Comment
EVE-04-NC-140508	14-A006980	W	Total Phosphorus	J	Matrix spike %R >UCL
SR9-01-NC-140508	14-A006979	W	Total Phosphorus	J	Matrix spike %R >UCL
EVE-04-NC-140508	14-A006980	W	Nitrate + Nitrite	J	Matrix spike %R <LCL
SR9-01-NC-140508	14-A006979	W	Nitrate + Nitrite	J	Matrix spike %R <LCL
EVE-02-NC-140613	14-A008784	W	Nitrate + Nitrite	J	Matrix spike %R <LCL
518-01-NC-140107	580-41893-10	W	Nitrogen, Total Kjeldahl	J	Matrix spike %R >UCL
518-01-DC-140107	580-41893-11	W	Nitrogen, Total Kjeldahl	J	Matrix spike %R >UCL
518-02-NC-140107	580-41893-12	W	Nitrogen, Total Kjeldahl	J	Matrix spike %R >UCL
518-03-NC-140107	580-41893-13	W	Nitrogen, Total Kjeldahl	J	Matrix spike %R >UCL
PIL-01-NC-140129	580-42142-10	W	Nitrogen, Total Kjeldahl	J	Matrix spike %R >UCL
PIL-08-NC-140314	1403050-01	W	Zinc	J	Matrix spike %R >UCL
PIL-07-NC-140314	1403050-03	W	Zinc	J	Matrix spike %R >UCL
PIL-06HNC-140314	1403050-05	W	Zinc	J	Matrix spike %R >UCL
SR9-01-NC-140317	1403052-01	W	Zinc	J	Matrix spike %R >UCL
EVE-04-NC-140317	1403052-03	W	Zinc	J	Matrix spike %R >UCL
EVE-03-NC-140316	1403052-05	W	Zinc	J	Matrix spike %R >UCL
SED-EVE-01-NS-140527	14-A007711	S	Copper	J	Matrix spike %R <LCL
SED-EVE-01-DS-140527	14-A007712	S	Copper	J	Matrix spike %R <LCL
SED-PIL-01-NS-140527	14-A007714	S	Copper	J	Matrix spike %R <LCL

Notes:

%R – Percent recovery

J – The analyte was detected in the sample and the reported value was considered as estimated.

LCL – Lower control limit

S – Sediment

UCL – Upper control limit

W – Water

Table 3-7 Data Affected by Surrogate Spike Recovery Outliers

Field Sample ID	Laboratory Sample ID	Sample Matrix	Analyte	Qualifier	Comment
EVE-04-NG-140218	1402028-04	W	Diesel	UJ	Surrogate spike %R <LCL
EVE-04-NG-140218	1402028-04	W	Lube Oil	J	Surrogate spike %R <LCL
EVE-04-DC-140317	1403052-04	W	Anthracene	J	Surrogate spike %R <LCL
EVE-04-DC-140317	1403052-04	W	Benz[a]anthracene	J	Surrogate spike %R <LCL
EVE-04-DC-140317	1403052-04	W	Benzo(a)pyrene	J	Surrogate spike %R <LCL
EVE-04-DC-140317	1403052-04	W	Benzo(b)fluoranthene	J	Surrogate spike %R <LCL
EVE-04-DC-140317	1403052-04	W	Benzo(g,h,i)perylene	J	Surrogate spike %R <LCL
EVE-04-DC-140317	1403052-04	W	Benzo(k)fluoranthene	J	Surrogate spike %R <LCL
EVE-04-DC-140317	1403052-04	W	*bis*(2-Ethylhexyl) phthalate	J	Surrogate spike %R <LCL
EVE-04-DC-140317	1403052-04	W	Chrysene	J	Surrogate spike %R <LCL
EVE-04-DC-140317	1403052-04	W	Di-*n*-Butylphthalate	UJ	Surrogate spike %R <LCL
EVE-04-DC-140317	1403052-04	W	Fluoranthene	J	Surrogate spike %R <LCL
EVE-04-DC-140317	1403052-04	W	Fluorene	J	Surrogate spike %R <LCL
EVE-04-DC-140317	1403052-04	W	Indeno(1,2,3-cd)pyrene	UJ	Surrogate spike %R <LCL
EVE-04-DC-140317	1403052-04	W	Naphthalene	J	Surrogate spike %R <LCL
EVE-04-DC-140317	1403052-04	W	Phenanthrene	J	Surrogate spike %R <LCL
EVE-04-DC-140317	1403052-04	W	Pyrene	J	Surrogate spike %R <LCL
EVE-01-NC-140319	1403069-02	W	Benz[a]anthracene	J	Surrogate spike %R <LCL
EVE-01-NC-140319	1403069-02	W	Benzo(a)pyrene	J	Surrogate spike %R <LCL
EVE-01-NC-140319	1403069-02	W	Benzo(b)fluoranthene	J	Surrogate spike %R <LCL
EVE-01-NC-140319	1403069-02	W	Benzo(g,h,i)perylene	J	Surrogate spike %R <LCL
EVE-01-NC-140319	1403069-02	W	Benzo(k)fluoranthene	J	Surrogate spike %R <LCL
EVE-01-NC-140319	1403069-02	W	*bis*(2-Ethylhexyl) phthalate	J	Surrogate spike %R <LCL
EVE-01-NC-140319	1403069-02	W	Chrysene	J	Surrogate spike %R <LCL
EVE-01-NC-140319	1403069-02	W	Fluoranthene	J	Surrogate spike %R <LCL
EVE-01-NC-140319	1403069-02	W	Indeno(1,2,3-cd)pyrene	J	Surrogate spike %R <LCL
EVE-01-NC-140319	1403069-02	W	Naphthalene	J	Surrogate spike %R <LCL
EVE-01-NC-140319	1403069-02	W	Phenanthrene	J	Surrogate spike %R <LCL
EVE-01-NC-140319	1403069-02	W	Pyrene	J	Surrogate spike %R <LCL
PIN-01-NC-131116	1311048-08	W	Dichlobenil	J	Surrogate spike %R <LCL
PIN-01-NC-131116	1311048-08	W	Diuron	UJ	Surrogate spike %R <LCL
PIN-01-BC-140416	1404062-03	W	Dichlobenil	UJ	Surrogate spike %R <LCL
PIN-01-BC-140416	1404062-03	W	Diuron	UJ	Surrogate spike %R <LCL

Field Sample ID	Laboratory Sample ID	Sample Matrix	Analyte	Qualifier	Comment
PIN-01-NC-140424	1404070-02	W	Dichlobenil	UJ	Surrogate spike %R <LCL
PIN-01-NC-140424	1404070-02	W	Diuron	UJ	Surrogate spike %R <LCL
PIN-01-DC-140424	1404070-03	W	Dichlobenil	UJ	Surrogate spike %R <LCL
PIN-01-DC-140424	1404070-03	W	Diuron	UJ	Surrogate spike %R <LCL
SED-EVE-01-NS-140527	14-A007711	S	PCB-1016	UJ	Surrogate spike %R <LCL
SED-EVE-01-NS-140527	14-A007711	S	PCB-1221	UJ	Surrogate spike %R <LCL
SED-EVE-01-NS-140527	14-A007711	S	PCB-1232	UJ	Surrogate spike %R <LCL
SED-EVE-01-NS-140527	14-A007711	S	PCB-1242	UJ	Surrogate spike %R <LCL
SED-EVE-01-NS-140527	14-A007711	S	PCB-1248	UJ	Surrogate spike %R <LCL
SED-EVE-01-NS-140527	14-A007711	S	PCB-1254	UJ	Surrogate spike %R <LCL
SED-EVE-01-NS-140527	14-A007711	S	PCB-1260	UJ	Surrogate spike %R <LCL

Notes:

%R – Percent recovery

J – The analyte was detected in the sample and the reported value was considered as estimated.

LCL – Lower control limit

S – Sediment

UCL – Upper control limit

UJ – The analyte was not detected in the sample, and the reported quantitation limit associated with this analyte was considered as estimated.

W – Water

Table 3-8 Data Affected by Precision Outliers

Field Sample ID	Laboratory Sample ID	Sample Matrix	Analyte	Qualifier	Comment
EVE-05-BC-140918	14-A015137	W	Total Nitrogen (TKN)	J	Laboratory Duplicate
EVE-04-NG-140613	14-A008671	W	Fecal Coliform	J	Laboratory Duplicate
SR9-01-NG-140319	14-A003655	W	Fecal Coliform	J	Laboratory Duplicate
EVE-01-NG-140319	14-A003656	W	Fecal Coliform	J	Laboratory Duplicate
EVE-04-NG-140319	14-A003657	W	Fecal Coliform	J	Laboratory Duplicate
PIL-01-NG-140319	14-A003658	W	Fecal Coliform	J	Laboratory Duplicate
PIL-08-NC-140314	1403050-01	W	Zinc	J	Laboratory Duplicate
PIL-07-NC-140314	1403050-03	W	Zinc	J	Laboratory Duplicate
PIL-06HNC-140314	1403050-05	W	Zinc	J	Laboratory Duplicate
SR9-01-NC-140317	1403052-01	W	Zinc	J	Laboratory Duplicate
EVE-04-NC-140317	1403052-03	W	Zinc	J	Laboratory Duplicate
EVE-03-NC-140316	1403052-05	W	Zinc	J	Laboratory Duplicate
EVE-01-NG-131118	1311048-01	W	Diesel	UJ	Laboratory Duplicate
EVE-01-DG-131118	1311048-02	W	Diesel	UJ	Laboratory Duplicate
EVE-04-NG-131118	1311048-03	W	Diesel	UJ	Laboratory Duplicate
EVE-04-DG-131118	1311048-04	W	Diesel	UJ	Laboratory Duplicate
SR9-01-NG-131118	1311048-05	W	Diesel	UJ	Laboratory Duplicate
SR9-01-DG-131118	1311048-06	W	Diesel	UJ	Laboratory Duplicate
PIN-01-NG-131116	1311048-07	W	Diesel	UJ	Laboratory Duplicate
EVE-01-NG-131118	1311048-01	W	Lube Oil	J	Laboratory Duplicate
EVE-01-DG-131118	1311048-02	W	Lube Oil	J	Laboratory Duplicate
EVE-04-NG-131118	1311048-03	W	Lube Oil	J	Laboratory Duplicate
EVE-04-DG-131118	1311048-04	W	Lube Oil	J	Laboratory Duplicate
SR9-01-NG-131118	1311048-05	W	Lube Oil	J	Laboratory Duplicate
SR9-01-DG-131118	1311048-06	W	Lube Oil	J	Laboratory Duplicate
PIN-01-NG-131116	1311048-07	W	Lube Oil	J	Laboratory Duplicate
LAK-01-NC-131008	1310054-02	W	Dichlobenil	J	Laboratory Duplicate
SR9-01-NC-140508	14-A006979	W	Benzo(b)fluoranthene	UJ	Laboratory Duplicate
SR9-01-NC-140508	14-A006979	W	Benzo(b)fluoranthene	UJ	Laboratory Duplicate
EVE-04-NC-140508	14-A006980	W	Benzo(b)fluoranthene	UJ	Laboratory Duplicate
EVE-04-NC-140508	14-A006980	W	Benzo(b)fluoranthene	UJ	Laboratory Duplicate
SR9-01-NC-140613	14-A008772	W	Diethylphthalate	UJ	Laboratory Duplicate
SR9-01-DC-140613	14-A008773	W	Diethylphthalate	UJ	Laboratory Duplicate
PIL-01-NC-140613	14-A008787	W	Diethylphthalate	UJ	Laboratory Duplicate
PIN-01-NC-140614	14-A008790	W	Diethylphthalate	J	Laboratory Duplicate
SR9-01-NG-140523	14-A007596	W	Fecal Coliform	J	Field Duplicate
SR9-01-DG-140523	14-A007597	W	Fecal Coliform	J	Field Duplicate
EVE-04-NG-140613	14-A008671	W	Fecal Coliform	J	Field Duplicate

Field Sample ID	Laboratory Sample ID	Sample Matrix	Analyte	Qualifier	Comment
EVE-04-DG-140613	14-A008672	W	Fecal Coliform	J	Field Duplicate
PIL-04-NC-140613	14-A008775	W	Total Suspended Solids	J	Field Duplicate
PIL-04-DC-140613	14-A008776	W	Total Suspended Solids	J	Field Duplicate
EVE-04-NC-140613	14-A008788	W	Total Suspended Solids	J	Field Duplicate
EVE-04-DC-140613	14-A008789	W	Total Suspended Solids	J	Field Duplicate
PIL-01-NC-140723	14-A011430	W	Cadmium	J	Field Duplicate
PIL-01-DC-140723	14-A011431	W	Cadmium	J	Field Duplicate
PIL-03-NC-140613	14-11960-YO50H	W	Particle Size, Phi <1	J	Field Duplicate
PIL-03-NC-140613	14-11960-YO50H	W	Particle Size, Phi 1-2	J	Field Duplicate
PIL-03-DC-140613	14-11961-YO50I	W	Particle Size, Phi <1	J	Field Duplicate
PIL-03-DC-140613	14-11961-YO50I	W	Particle Size, Phi 1-2	J	Field Duplicate
PIL-07-NC-140523	14-10345-YL78B	W	Particle Size, Phi 1-2	J	Field Duplicate
PIL-07-NC-140523	14-10345-YL78B	W	Particle Size, Phi 2 to 3	J	Field Duplicate
PIL-07-NC-140523	14-10345-YL78B	W	Particle Size, Phi 8-10	J	Field Duplicate
PIL-07-DC-140523	14-10346-YL78C	W	Particle Size, Phi 1-2	UJ	Field Duplicate
PIL-07-DC-140523	14-10346-YL78C	W	Particle Size, Phi 2 to 3	J	Field Duplicate
PIL-07-DC-140523	14-10346-YL78C	W	Particle Size, Phi 8-10	J	Field Duplicate
PIL-01-NC-140902	14-18242-YZ22A	W	Particle Size, Phi <1	J	Field Duplicate
PIL-01-DC-140902	14-18243-YZ22B	W	Particle Size, Phi <1	J	Field Duplicate
SR9-01-NG140523	14-A007700	W	Diesel	J	Field Duplicate
SR9-01-NG140523	14-A007700	W	Heavy Oil	J	Field Duplicate
SR9-01-DG-140523	14-A007702	W	Diesel	J	Field Duplicate
SR9-01-DG-140523	14-A007702	W	Heavy Oil	J	Field Duplicate
PIL-01-NC-140813	14-A012673	W	*bis*(2-Ethylhexyl)phthalate	J	Field Duplicate
PIL-01-DC-140813	14-A012674	W	*bis*(2-Ethylhexyl)phthalate	J	Field Duplicate
SED-EVE-01-NS-140527	14-A007711	S	*bis*(2-Ethylhexyl)phthalate	J	Field Duplicate
SED-EVE-01-NS-140527	14-A007711	S	Di-*n*-octylphthalate	UJ	Field Duplicate
SED-EVE-01-NS-140527	14-A007711	S	Anthracene	UJ	Field Duplicate
SED-EVE-01-NS-140527	14-A007711	S	Benzo(k)fluoranthene	J	Field Duplicate
SED-EVE-01-DS-140527	14-A007712	S	*bis*(2-Ethylhexyl)phthalate	J	Field Duplicate
SED-EVE-01-DS-140527	14-A007712	S	Di-*n*-octylphthalate	J	Field Duplicate
SED-EVE-01-DS-140527	14-A007712	S	Anthracene	J	Field Duplicate
SED-EVE-01-DS-140527	14-A007712	S	Benzo(k)fluoranthene	J	Field Duplicate

Notes:

J – The analyte was detected in the sample and the reported value was considered as estimated.

Field Duplicate - The relative percent difference (RPD) or concentration difference value for the analysis of the field duplicates did not meet the project control criteria

Laboratory Duplicate – The RPD or concentration difference value for the duplicate analysis of the field sample, laboratory control sample, or matrix spike did not meet the project control criteria.

S – Sediment

UJ – The analyte was not detected in the sample, and the reported quantitation limit associated with this analyte was considered as estimated.

Table 3-9 Data Affected by Sample Matrix Interference

Field Sample ID	Laboratory Sample ID	Sample Matrix	Analyte	Qualifier	Comment
EVE-04-NC-140508	14-A006980	W	Benzo(a)pyrene	UJ	Internal Standard
EVE-04-NC-140508	14-A006980	W	Benzo(b)fluoranthene	UJ	Internal Standard
EVE-04-NC-140508	14-A006980	W	Benzo(g,h,i)perylene	UJ	Internal Standard
EVE-04-NC-140508	14-A006980	W	Benzo(k)fluoranthene	UJ	Internal Standard
EVE-04-NC-140508	14-A006980	W	Dibenzo(ah)anthracene	UJ	Internal Standard
EVE-04-NC-140508	14-A006980	W	Di-*n*-octylphthalate	UJ	Internal Standard
EVE-04-NC-140508	14-A006980	W	Indeno(123-cd)pyrene	UJ	Internal Standard
SR9-01-NC-140613	14-A008772	W	*bis*(2-Ethylhexyl)phthalate	J	Internal Standard
EVE-04-NC-140613	14-A008788	W	*bis*(2-Ethylhexyl)phthalate	J	Internal Standard
PIL-01-DC-140813	14-A012674	W	Benzo(a)pyrene	R	Internal Standard
PIL-01-DC-140813	14-A012674	W	Benzo(b)fluoranthene	R	Internal Standard
PIL-01-DC-140813	14-A012674	W	Benzo(g,h,i)perylene	R	Internal Standard
PIL-01-DC-140813	14-A012674	W	Benzo(k)fluoranthene	R	Internal Standard
PIL-01-DC-140813	14-A012674	W	Dibenzo(ah)anthracene	R	Internal Standard
PIL-01-DC-140813	14-A012674	W	Di-*n*-octylphthalate	R	Internal Standard
PIL-01-DC-140813	14-A012674	W	Indeno(123-cd)pyrene	R	Internal Standard
SED-SR9-01-NS-140610	14-A008659	S	Benzo(a)anthracene	J	Internal Standard
SED-SR9-01-NS-140610	14-A008659	S	Benzo(a)pyrene	UJ	Internal Standard
SED-SR9-01-NS-140610	14-A008659	S	Benzo(b)fluoranthene	UJ	Internal Standard
SED-SR9-01-NS-140610	14-A008659	S	Benzo(g,h,i)perylene	J	Internal Standard
SED-SR9-01-NS-140610	14-A008659	S	Benzo(k)fluoranthene	UJ	Internal Standard
SED-SR9-01-NS-140610	14-A008659	S	*bis*(2-Ethylhexyl)phthalate	J	Internal Standard
SED-SR9-01-NS-140610	14-A008659	S	Butylbenzylphthalate	J	Internal Standard
SED-SR9-01-NS-140610	14-A008659	S	Chrysene	J	Internal Standard
SED-SR9-01-NS-140610	14-A008659	S	Dibenzo(ah)anthracene	UJ	Internal Standard
SED-SR9-01-NS-140610	14-A008659	S	Di-*n*-octylphthalate	UJ	Internal Standard
SED-SR9-01-NS-140610	14-A008659	S	Indeno(123-cd)pyrene	J	Internal Standard
SED-SR9-01-NS-140610	14-A008659	S	Pyrene	J	Internal Standard
SED-Pin-01-NS-140624	14-A009447	S	Benzo(a)pyrene	UJ	Internal Standard
SED-Pin-01-NS-140624	14-A009447	S	Benzo(b)fluoranthene	UJ	Internal Standard
SED-Pin-01-NS-140624	14-A009447	S	Benzo(g,h,i)perylene	J	Internal Standard
SED-Pin-01-NS-140624	14-A009447	S	Benzo(k)fluoranthene	UJ	Internal Standard
SED-Pin-01-NS-140624	14-A009447	S	Dibenzo(ah)anthracene	UJ	Internal Standard

Field Sample ID	Laboratory Sample ID	Sample Matrix	Analyte	Qualifier	Comment
SED-Pin-01-NS-140624	14-A009447	S	Di-*n*-octylphthalate	UJ	Internal Standard
SED-Pin-01-NS-140624	14-A009447	S	Indeno(123-cd)pyrene	J	Internal Standard
EVE-01-NC-140107	1401018-06	W	Butyl benzyl phthalate	J	Ion Abundance
EVE-01-NC-140107	1401018-06	W	Diethyl phthalate	J	Ion Abundance
PIL-01-NC-140107	1401018-21	W	Diethyl phthalate	J	Ion Abundance
PIL-06HNC-140314	1403050-05	W	Benzo(a)pyrene	J	Ion Abundance
PIL-06HNC-140314	1403050-05	W	Benzo(k)fluoranthene	J	Ion Abundance
PIL-06HNC-140314	1403050-05	W	Indeno(1,2,3-cd)pyrene	J	Ion Abundance
SR9-01-NC-140317	1403052-01	W	Benzo(a)pyrene	J	Ion Abundance
EVE-04-NC-140317	1403052-03	W	Anthracene	J	Ion Abundance
EVE-04-NC-140317	1403052-03	W	Benzo(a)pyrene	J	Ion Abundance
EVE-04-NC-140317	1403052-03	W	Di-*n*-octyl Phthalate	J	Ion Abundance
EVE-04-DC-140317	1403052-04	W	Anthracene	J	Ion Abundance
EVE-04-DC-140317	1403052-04	W	Benzo(a)pyrene	J	Ion Abundance
PIL-01-NC-140319	1403069-01	W	Benzo(a)pyrene	J	Ion Abundance
EVE-01-NC-140319	1403069-02	W	Benz[a]anthracene	J	Ion Abundance
EVE-01-NC-140319	1403069-02	W	Benzo(a)pyrene	J	Ion Abundance
EVE-01-DC-140319	1403069-03	W	Benzo(a)pyrene	J	Ion Abundance
SR9-01-NC-140319	1403069-04	W	Anthracene	J	Ion Abundance
SR9-01-NC-140319	1403069-04	W	Benzo(a)pyrene	J	Ion Abundance
PIN-01-NC-140417	1404062-01	W	Benz[a]anthracene	J	Ion Abundance
PIN-01-NC-140417	1404062-01	W	Benzo(a)pyrene	J	Ion Abundance
SR9-01-NC-140422	1404066-02	W	Benzo(a)pyrene	J	Ion Abundance
EVE-04-NC-140422	1404066-08	W	Benz[a]anthracene	J	Ion Abundance
EVE-04-NC-140422	1404066-08	W	Benzo(a)pyrene	J	Ion Abundance
EVE-01-NC-140422	1404066-11	W	Benz[a]anthracene	J	Ion Abundance
EVE-01-NC-140422	1404066-11	W	Benzo(a)pyrene	J	Ion Abundance
SR9-01-NC-140423	1404069-02	W	Benz[a]anthracene	J	Ion Abundance
SR9-01-NC-140423	1404069-02	W	Benzo(a)pyrene	J	Ion Abundance
SED-SR9-01-NS-140610	14-A008659	S	Zinc	J	ICS %R >UCL
SED-Pin-01-NS-140624	14-A009447	S	Zinc	J	ICS %R >UCL

Notes:

Primary causes preventing accurate compound identification included: (1) matrix interference where non-target chemical/subject affected chromatographic resolution of the target compound; and (2) ion abundance ratio for the reported detection that did not meet method criteria for compound identification.

ICS – Interference check sample

Internal Standard – The internal standard %R value was less than the lower control limit (LCL).
Ion Abundance – The mass spectrometry ion abundance ratios did not meet the method requirements for a compound identification.
J – The analyte was detected in the sample and the reported value was considered as estimated.
R – The reported result was rejected and could not be used.
S – Sediment
UCL – Upper control limit
UJ – The analyte was not detected in the sample, and the reported quantitation limit associated with this analyte was considered as estimated.
W – Water