ADDENDUM FOR 2005/2006 SAMPLING SEASON

WSDOT Stormwater Characterization/Water Quality Management Effectiveness Monitoring

Prepared for

Washington State Department of Transportation

March 2007

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Prepared for

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1.0 Project Overview/Description

This addendum identifies changes to the sampling program that was developed by Tetra Tech (2003) for the Washington State Department of Transportation (WSDOT) Stormwater Characterization and Water Quality Management Effectiveness Monitoring. This addendum identifies revisions to the following sections of the sampling program to reflect new procedures that will be implemented during the 2005/2006 wet season:

- Project Goals and Objectives (Section 1.1)
- Project Roles and Responsibilities (Section 1.2)
- General Scope of Monitoring Activities (Section 1.3)
- Monitoring Stations (Section 2.0)
- Reporting Limits (Section 4.2)
- Field Equipment Operation and Maintenance (Section 5.0)
- Storm Selection Criteria (Section 6.2)
- Sampler Programming (Section 6.5)
- Sample Collection Methods (Section 7.1)
- Analytical Methods (Section 8.2)
- Audits and Reports (Section 10.0)
- Data Review and Evaluation (Section 11.0)
- References (Section 12.0)

These revised sections were prepared by Herrera Environmental Consultants, Inc. (Herrera) to reflect new objectives, procedures, and monitoring locations for the sampling program that have been identified by WSDOT since the previous monitoring season (i.e., 2004/2005). (A previous QAPP addendum was also produced by Tetra Tech [2004] to describe revisions that were implemented in advance of the 2004/2005 wet season.) The revised sections for the document are presented below.

1.1 Description of Project Goals and Objectives

The monitoring activities described in this plan are designed to fulfill the monitoring requirements of the NPDES Phase I permit. The specific goal of this monitoring effort is to characterize potential water quality impacts from highway corridors through the measurement of Event Mean Concentrations (EMC) and loads for representative pollutants in highway stormwater runoff. Additionally, this project will evaluate the effectiveness of Best Management Practices (BMPs) that are used to treat highway runoff based on sampling that will be conducted at representative facilities to compare influent and effluent pollutant EMCs and loads. Finally, additional monitoring will also be performed at selected rural highway sites (average daily traffic [ADT] < 20,000) in the Seattle and Olympia area with the goal of characterizing pollutant concentrations in direct highway runoff, highway run-on from adjacent lands, and runoff at the boundary for WSDOT right-of-ways.

1.2 Description of Project Roles and Responsibilities

The following personnel will be responsible for the duties described:

WSDOT Project Manager: Richard Tveten, Environmental Services Office, Water Quality Program

- Coordinate with contractors
- Review and comment on plans and reports
- Oversee project progress
- Oversee lead agency project personnel.

WSDOT Project Scientist: Sarah Burdick, Environmental Services Office, Water Quality Program

- Coordinate with field sampling team
- Assist with field site set up
- Provide ongoing equipment support.

Herrera Principal-in-Charge: Wally Trial, PhD

- Provide technical oversight of Herrera team
- Provide final review of Herrera reports.

Herrera Project Manager: John Lenth

- Coordinate with WSDOT and Envirovision Project Manager (Joy Michaud)
- Develop monitoring plan and QAPP
- Coordinate with Aquatic Research Inc. for laboratory analyses
- Perform detailed analysis of sampling data
- Oversee monitoring and report development
- Final data quality overview.

Herrera Project Scientists: Dylan Ahearn, PhD, Matt Brennan, Gus Kays, David Yu, Rebecca Dugopolski

- Assist with field site set-up of BMP and rural sites
- Assist with long term maintenance of equipment
- Collect flow, rainfall, and water quality data at sample sites
- Track quality assurance including preliminary review of field and laboratory data
- Document sample collection procedures and QA/QC measures
- Maintain records

- Maintain communications with WSDOT staff
- Data Management
- Assist with development of draft and final reports.

Envirovision Project Manager: Joy Michaud

- Coordinate with WSDOT and Herrera Project Managers
- Oversee monitoring and reporting of rural sites in Olympia area
- Coordinate with Aquatic Research Inc. for laboratory analyses
- Perform detailed analysis of sampling data.

Envirovision Project Scientist: Daron Knight

- Assist with field site set up of rural sites
- Assist with long term maintenance of equipment
- Collect water quality data at sample sites
- Track quality assurance including preliminary review of field and laboratory data
- Document sample collection procedures and QA/QC measures
- Maintain records
- Maintain communications with WSDOT staff
- Data Management
- Assist with development of draft and final reports.

Analytical Laboratory Quality Assurance Officer: Steve Lazoff, Aquatic Research, Inc.

- Track samples and results in the laboratory
- Provide properly cleaned sample bottles with appropriate preservatives
- Evaluate laboratory compliance with project QAPP and laboratory QA Plan
- Report discrepancies to Herrera Project Manager
- Transmit laboratory results to Herrera Project Manager.

1.3 General Scope of Monitoring Activities

Monitoring for this project will be implemented over the period from October 2005 through September 2006. During this period, up to 12 storm events will be targeted for sampling during the wet season (October through April) for BMP evaluations. If possible, up to four additional storm events will also be targeted for sampling during the dry season (May through September). This monitoring will be implemented at up to 10 BMP sites representing a variety of treatment technologies (e.g., wet ponds, swales, ditches). Separate inlet and outlet monitoring stations will be established in association with each BMP site to characterize influent and effluent EMC and loadings.

To characterize pollutant concentrations in rural highway runoff, six storm events will be targeted for sampling during the wet season (October through April) and two storm events will be targeted during the dry season (May through September). This sampling will occur at up to 10 sites that will be selected to represent a variety of soil types and drainage configurations.

Data from the sampling described above will be forwarded to WSDOT for inclusion in the 2006 NPDES Annual Report. The monitoring activities described herein may also extend beyond the monitoring period identified above depending on data variability, and the development of revised NPDES reporting requirements as stipulated in the pending re-issuance of WSDOT's permit.

1.4 Project Organization/Schedule

This section has remained unchanged. See original QAPP (Tetra Tech 2003).

2.0 Monitoring Sites

2.1 NPDES Phase I Stormwater BMP Effectiveness and Runoff Characterization Monitoring Sites and Rural Monitoring Sites

To satisfy phase I NPDES permit requirements, 10 sites have been selected to represent a broad spectrum of BMP types. Both influent (untreated) and effluent (treated) runoff will be monitored to evaluate BMP effectiveness in reducing pollutant concentrations and loadings. The monitoring will target the latest BMPs to determine the effectiveness of facilities built in accordance with recent, more protective design criteria. The ADT levels will tend to be higher than the average for State highways, because recent construction activities have largely focused on reducing congestion on highly traveled routes. Site selection criteria were based on the following criteria that are presented in decreasing order of importance: 1) proximity to Seattle or Olympia, Washington, 2) accessibility and security for maintaining sampling equipment, and 3) reliability of defining a highway specific source area.

The site locations with BMPs selected for the current wet season are described in Table 2.1 and in more detail in Appendix A. Figure 2.1 shows the approximate locations of sites in the Seattle vicinity, and Figure 2.2 shows the approximate locations of sites in the Vancouver vicinity. A detailed description of each of the sites can be found in Section 2.2. These sites experience weather conditions typical of Western Washington: rainfall is the primary form of precipitation, and occurs chiefly between October and March, and storms are generally of low intensity and long duration.

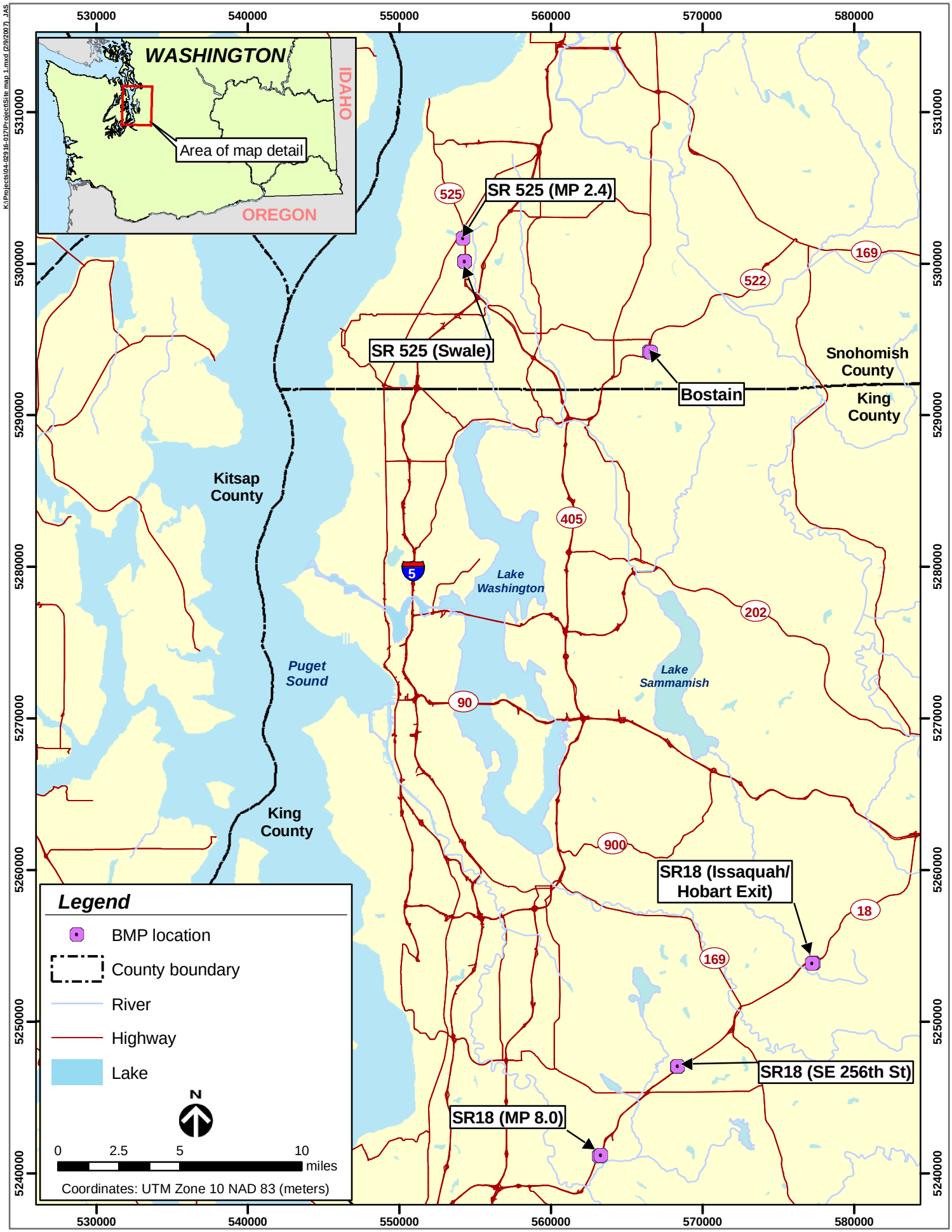

Figure 2.1. Vicinity map for Seattle.

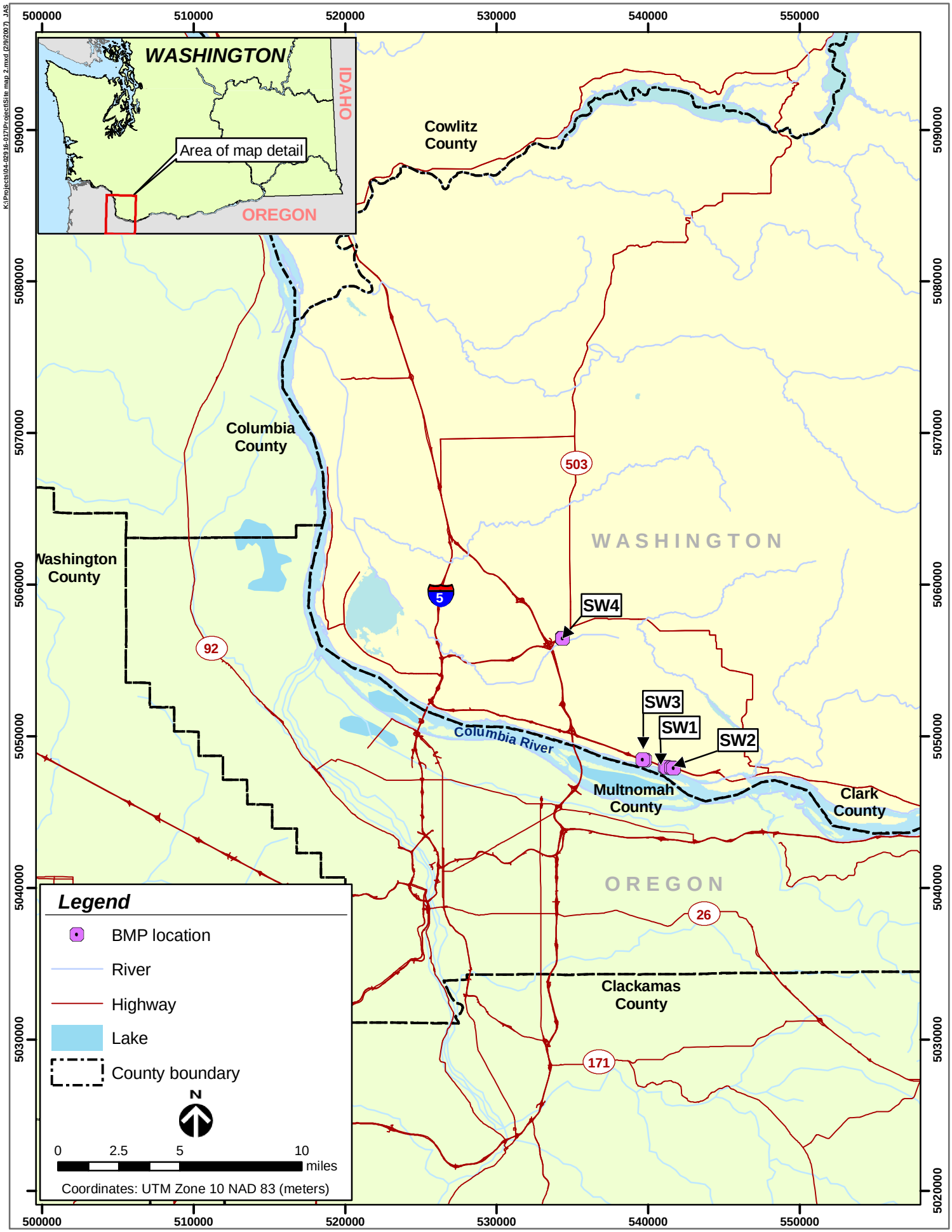

Figure 2.2. Vicinity map for Vancouver.

Table 2.1. Stormwater BMP effectiveness and runoff characterization monitoring sites.

Site Number and Location	ADT	BMP tested	Number of Samplers	Purpose
Seattle Area Sites				
1) SR 522 at Bostain Rd (Pond)	20,000-39,999	Wet pond	2	Test effectiveness at reducing pollutant concentrations
2) SR 525 at Milepost 1.5 (Swale/Pond)	40,000-59,999	Pond with adjoining bioswale	2	Test effectiveness at reducing pollutant concentrations
3) SR 525 at Milepost 2.4 (Pond)	40,000-59,999	Wet pond	2	Test effectiveness at reducing pollutant concentrations
4)SR18 at Milepost 8.04 (Pond)	20,000-39,999	Wet pond	2	Test effectiveness at reducing pollutant concentrations
5)SR18 at Issaquah/Hobart Exit (Swale/Ditch)	1,700	Bioswale/ditch	2	Test effectiveness at reducing pollutant concentrations
6)SR18 at SE 256th St (Swale)	2,400	Bioswale	2	Test effectiveness at reducing pollutant concentrations
Vancouver Area Sites				
7) SR14 near SE 192nd (Swale) – SW 1	40,000-59,999	Bioswale	2	Test effectiveness at reducing pollutant concentrations
8) SR14 near SE 192nd (Swale/Pond) – SW 2	20,000-39,999	Pond with adjoining bioswale	2	Test effectiveness at reducing pollutant concentrations
9) SR14 between SE 192nd and SE 164th (Swale/Pond) – SW 3	40,000-59,999	Bioswale followed by detention pond	2	Test effectiveness at reducing pollutant concentrations
10) SR 500 112th Ave/Gher Rd off ramp (Pond) – SW 4	18,000	Wet detention pond	2	Test effectiveness at reducing pollutant concentrations

Ten rural sites were selected for monitoring to meet the following objectives: 1) assess nutrient and metals concentrations in runoff from rural highways for comparison to existing data compiled by WSDOT from high ADT highways; 2) assess the potential influence of run-on from the surrounding landscape on highway runoff quality; and 3) assess the potential treatment benefits of non-engineered ditches within WSDOT's right-of-way. Sites were selected based on their proximity to Seattle and Olympia, overall accessibility, and representativeness with regard to the land use and drainage configurations that were targeted through this sampling.

The site locations with BMPs selected for the current wet season are described in Table 2.2. The approximate locations of these sampling stations are shown on Figure 2.3. A detailed description of each of the sites can be found in Section 2.2. These sites experience weather conditions typical of Western Washington: rainfall is the primary form of precipitation, and occurs chiefly between October and March, and storms are generally of low intensity and long duration.

Table 2.2. Rural runoff characterization monitoring sites

Site Number and Name	Location	ADT	Purpose
Seattle Area Sites			
1) York Drain	SR 524 at York Road	5,000-9,999	Monitor road runoff quality
2) York Run-On	SR 524 at York Road	5,000-9,999	Monitor "run-on" into roadside ditch from power transfer station
3) Outlook Drain	SR 96 at Outlook Ridge Homes	10,000-19,999	Monitor road runoff quality
4) Outlook Ditch	SR 96 at Outlook Ridge Homes	10,000-19,999	Monitor effect of ditch at treating road runoff
5) Outlook Run-On	SR 96 at Outlook Ridge Homes	10,000-19,999	Monitor "run-on" into roadside ditch from church parking lot
6) Outlook Exit ROW	SR 96 at Outlook Ridge Homes	10,000-19,999	Monitor water leaving roadside ditch into small stream
Olympia Area Sites			
7) Maytown	Hwy 121 near I-5	0-1,999	Monitor road runoff quality
8) Skookumchuck	SR 507, between Centralia and Bucoda	2,000-4,999	Monitor road runoff quality
9) Shaw Road	Shaw Road and SR 507	5,000-9,999	Monitor "run-on" into ROW from Shaw Road
10) Hwy 702	Hwy 702, just west of Hwy 7	2,000-4,999	Monitor road runoff quality

2.2 Detailed Site Descriptions

BMP sites

Site 1 – Wet Pond on SR 522 at Bostain Road

This wet pond is located on the east side of SR 522 (milepost 16.3) just south of the intersection of Paradise Road and SR 522 (see Figure 2.1 and A1-c). ADT at this site is 20,000-39,999. The pond receives runoff from a 22.84 acre drainage basin with 16.06 and 6.78 acres of impervious and pervious surface area, respectively. The pond is accessed from northbound SR 522 by turning right at the intersection of Paradise Road and Maltby Road (MP 16.5), taking the first right onto Bostain Road, and then traveling for a distance of approximately 0.25 miles to a gated entry on the east side of the road. Two automated samplers will be installed in association with the pond to collect samples at the inlet and outlet. Discharge at the inlet station will be measured using an ISCO area velocity (AV) sensor. Discharge at the outlet station will be measured using an ISCO pressure transducer installed in the flow control structure for the wet pond. A rating table developed for the flow control structure will be used to convert water level measurements from the pressure transducer to estimates of discharge. A rain gauge will also be installed at both the inlet and outlet stations to facilitate triggering of the automated samplers in response to rain events. Details on the programming and specific locations of this equipment are provided in Appendix A.

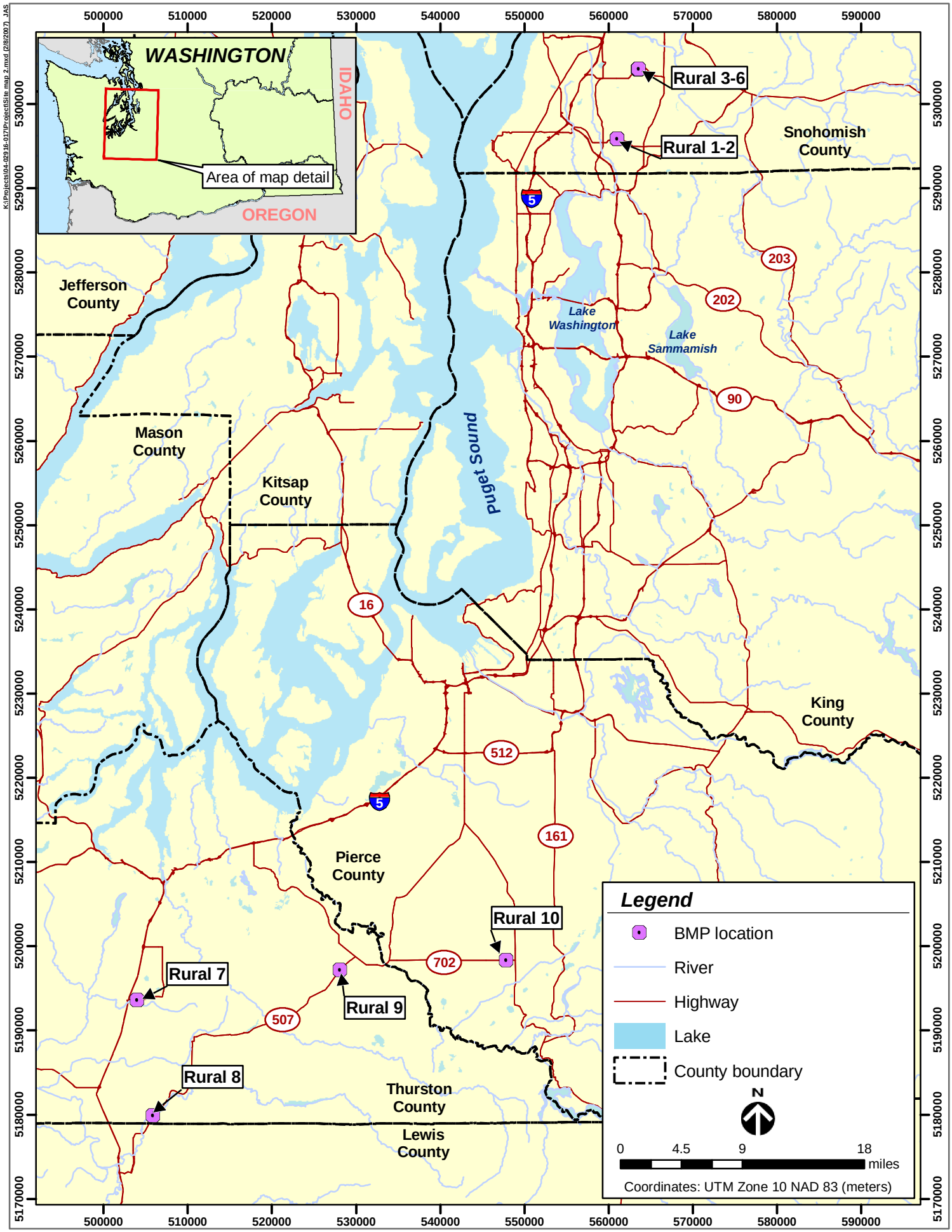

Figure 2.3. Vicinity map for rural sites.

Site 2 – Pond on SR 525 at Milepost 1.5

This pond is located near milepost 1.5 on westbound SR 525 (see Figure 2.1 and A2-c). ADT at this site is 40,000-59,999. This pond receives runoff from a 2.36 acre drainage basin with 1.56 and 0.80 acres of impervious and pervious surface area, respectively. Two automated samplers will be installed in association with the pond to collect samples at the inlet and outlet. An ISCO bubble flow meter will be installed in pond's inlet pipe to continuously measure water levels. These measurements will be converted to estimates of discharge using the Manning's equation. Discharge at the outlet station will be measured using an ISCO bubble flow meter installed in the flow control structure for the pond. A rating table developed for the flow control structure will be used to convert water level measurements from the pressure transducer to estimates of discharge. A rain gauge will also be installed at both the inlet and outlet stations to facilitate triggering of the automated samplers in response to rain events. Details on the programming and specific locations of this equipment are provided in Appendix A.

Site 3 – Pond on SR 525 at Milepost 2.4

This pond is located near milepost 2.4 on westbound SR 525 (see Figure 2.1 and A3-c). ADT at this site is 40,000-59,999. This pond receives runoff from a 1.78 acre drainage basin with 1.21 and 0.57 acres of impervious and pervious surface area, respectively. Two automated samplers will be installed in association with the pond to collect samples at the inlet and outlet. Discharge at the inlet station will be measured using an ISCO area velocity (AV) sensor. Discharge at the outlet station will be measured using an ISCO bubble flow meter installed in the flow control structure for the wet pond. A rating table developed for the flow control structure will be used to convert water level measurements from the pressure transducer to estimates of discharge. A rain gauge will also be installed at both the inlet and outlet stations to facilitate triggering of the automated samplers in response to rain events. Details on the programming and specific locations of this equipment are provided in Appendix A.

Site 4 – Pond on SR 18 at Milepost 8.04

This wet pond is located on the south side of SR 18 at milepost 8.04 (see Figure 2.1 and A4-c). ADT at this site is 20,000-39,999. The pond receives runoff from a 10.6 acre drainage basin with 6.56 and 4.05 acres of impervious and pervious surface area, respectively. Two automated samplers will be installed in association with the pond to collect samples at the inlet and outlet. Discharge at the inlet and outlet stations will also be measured using ISCO area velocity (AV) sensors. Finally, a rain gauge will be installed at both the inlet and outlet stations to facilitate triggering of the automated samplers in response to rain events. Details on the programming and specific locations of this equipment are provided in Appendix A.

Site 5 – Swale/Ditch on SR 18 at Issaquah/Hobart Exit

This site is a roadside ditch located adjacent to the east-bound entrance ramp to SR 18 (milepost 20.46) at the Issaquah/Hobart Road interchange (see Figure 2.1 and A5-c). ADT at this site is 1700. The ditch is approximately 200 feet in length and receives runoff from a 3.76 acre

drainage basin with 1.16 and 2.60 acres of impervious and pervious surface area, respectively. This ditch was not designed specifically as a stormwater treatment bioswale; rather, it was only designed to provide conveyance for stormwater runoff. Two automated samplers will be installed in association with the ditch to collect samples at the inlet and outlet. Discharge at the inlet station will be measured using an ISCO AV sensor installed at the outlet of the pipe that conveys stormwater into the ditch. Discharge at the outlet station will be measured using an ISCO bubble flow meter installed in a 1.5-foot H-flume. A rain gauge will also be installed at both the inlet and outlet stations to facilitate triggering of the automated samplers in response to rain events. Details on the programming and specific locations of this equipment are provided in Appendix A.

Site 6 – Swale on SR 18 at SE 256th Street

This swale is located near the junction of 186th Avenue SE and SE 256th Street (near SR18 milepost 13.13) (see Figure 2.1 and A6-c). ADT at this site is 2400. The swale is approximately 180 feet in length and discharges to a dry pond at its down-gradient end. It receives runoff from a 3.47 acre drainage basin with 0.58 and 2.89 acres of impervious and pervious surface area, respectively. The swale is accessed from SR 18 by taking the SE 256th Street exit west to 186th Avenue SE. The swale is down a steep slope at the northeast corner of 186th Avenue SE and SE 256th Street. Two automated samplers will be installed in association with the swale to collect samples at the inlet and outlet. An ISCO bubble flow meter will be installed in the pipe that conveys stormwater into the swale. The water level measurement from this meter will be converted to estimates of discharge using the Manning's equation. Discharge at the swale's outlet will be measured using an ISCO bubble flow meter installed in a 1.5-foot H-flume. A rain gauge will also be installed at both the inlet and outlet stations to facilitate triggering of the automated samplers in response to rain events. Details on the programming and specific locations of this equipment are provided in Appendix A.

Site 7 – Swale on SR 14 near SE 192nd Avenue – SW 1

This structure is located on the shoulder of eastbound SR 14 (milepost 10.45) near SE 192nd Avenue east of Vancouver (see Figure 2.2 and A7-c). ADT at this site is 40,000-59,999. The surface drainage area is 15.98 acres (9.0 acres impervious surface, 6.98 acres pervious surface) with untreated runoff from six lanes of traffic, an on- and off-ramp, road edge, and median shoulders directed via a series of catch basins and cross culverts to the inlet located on the south side of the highway. Two automated samplers will be used to collect samples at the inlet and outlet. The inlet is located at the western end of the swale, and the outlet is located where the swale transitions to a detention pond. The inlet flow will be monitored using an ISCO AV sensor in the 24-inch outfall pipe. The outlet flow will be monitored using a V-notch weir and an ISCO bubble flow meter. This site can be accessed from two locations: 1) the shoulder of the SE 192nd Avenue eastbound on-ramp (walk downhill from the guardrail) and 2) at the roadside pull-off on the shoulder of the SE 192nd Avenue eastbound on-ramp.

Site 8 – Swale/Pond on SR 14 near SE 192nd Avenue – SW 2

This structure is located on the shoulder of eastbound SR 14 (milepost 10.39) near SE 192nd Avenue east of Vancouver (see Figure 2.2 and A8-c). ADT at this site is 20,000-49,999. The surface drainage area is 1.36 acres (1.36 acres impervious surface, 0 acres pervious surface) with untreated runoff from four lanes of traffic, road edge, and median shoulders directed via a series of catch basins and cross culverts to the inlet located on the south side of the highway. Two automated samplers will be used to collect samples at the inlet and outlet. The inlet flow is monitored using an area-velocity meter in the 12-inch outfall pipe. The outlet flow is monitored using a bubbler in the pond control structure. This site can be accessed from two locations: 1) the roadside pull-off on the shoulder of the SE 192nd Avenue eastbound on-ramp (inlet station) 2) the shoulder of SR 14 at the east end of the guard rail where the SE 192nd Avenue eastbound off-ramp lane ends (outlet station).

Site 9 – Swale/Pond on SR 14 between SE 192nd Avenue and SE 164th Avenue – SW 3

This site is located on the shoulder of westbound SR 14 (milepost 9.14) between the SE 192nd Avenue and SE 164th Avenue interchanges east of Vancouver (see Figure 2.2 and A9-c). ADT at this site is 40,000-59,999. The surface drainage area is 3.68 acres (3.16 acres impervious surface, 0.52 acres pervious surface) with untreated runoff from six lanes of traffic, road edge, and median shoulders directed via a series of catch basins, roadside ditches and cross culverts to the inlet located on the north side of the highway. Two automated samplers will be used to collect samples at the inlet and outlet. The inlet flow will be monitored using a 0.75-foot H-flume and ISCO bubble flow meter. The outlet flow will be monitored using an ISCO pressure transducer in the pond control structure. A rating table developed for the flow control structure will be used to convert water level measurements from the pressure transducer to estimates of discharge. This site can be accessed from the Rinker quarry which is just north of SR 14 (the quarry entrance requires a site safety form). To access the site, take the SE 164th Avenue exit from SR 14, and turn south to Evergreen Highway. Follow the highway east for approximately 2 miles and turn left onto a steep road with a sign stating “Quarry traffic only”. Follow the quarry road until you pass under SR 14. Turn left and follow the dirt road until you are in the vicinity of the large billboard; walk over the berm towards the highway to access the site. The site can also be accessed from the highway just before the 164th exit; however, there is not a pull-off area so it requires parking on the shoulder.

Site 10 – Pond on SR 500 112th Ave/Gher Road off ramp – SW 4

This structure is located immediately south of the eastbound 112th Avenue/Gher Road off ramp from SR 500 (milepost 62.24) and immediately west of 112th Avenue in Vancouver (see Figure 2.2 and A10-c). ADT at this site is 18,000. The surface drainage area is 0.79 impervious acres consisting of four lanes of traffic. Two automated samplers will be used to collect samples at the inlet and outlet. The inlet is located at the catch basin immediately upstream of the pond inlet on the north side of the pond. The inlet flow will be monitored using an area-velocity meter in the 12-inch storm drain. The outlet flow will be monitored using a bubbler and an assumed stage discharge relationship based on the pond outlet structure. This site can be accessed from two

locations: 1) the shoulder of the eastbound 112th Avenue/Gher Road off-ramp at the inlet, and 2) the WSDOT SW Region parking lot south of the pond (walk up 112th Avenue to the outlet).

Rural Site

Site 1 - York Drain - SR 524 at York Road

This site is located approximately 660 feet west of York Road on the south side of SR 524 (see Figure 2.1 and A-R1). Monitoring will take place in a drain located approximately 50 feet west (and uphill) from a power transfer station on the south side of SR 524. This drain receives runoff from an approximately 980 foot section of curbed highway that extends up a gentle slope to the west until it reaches a grade break. Land use in the immediate vicinity consists of one newly completed and two older single-family housing developments. However, land use in the area is being rapidly converted from rural residential to suburban with many new housing developments going in along the SR 524 corridor to the east of the site. Both passive samples (Nalgene 2007) and grab samples will be used to characterize highway runoff (i.e., edge of pavement) quality at this site.

Site 2 - York Run-On - SR 524 at York Road

This site is located approximately 660 feet west of York Road on the south side of SR 524 (See Figure 2.1 and A-R2), and approximately 30 feet from Site 1 (see description immediately above). This site will be used to assess run-on to the highway from a gravel parking lot associated with the power transfer station on the south side of SR 524. Stormwater from this lot drains via a pipe into the roadside ditch along the south side of SR 524. Because of the rocky substrate in the ditch, it will be impractical to use passive samplers (Nalgene 2007) at this location. Therefore, grab samples will be collected from the pipe before flow reaches the roadside ditch.

Site 3 - Outlook Drain – SR 96 at Outlook Ridge Homes (2.4 mi from SR 9)

This site is located approximately 260 feet downhill and northeast of the entrance to Outlook Ridge Homes on the north side of SR 96 (See Figure 2.1 and A-R3). A drain at this location collects runoff from approximately 330 feet of curbing along SR 96. The land use associated with this site is predominantly rural; however, some suburban development is also present in surrounding areas. Both passive samples (Nalgene 2007) and grab samples will be used to characterize highway runoff (i.e., edge of pavement) quality at this site.

Site 4 - Outlook Ditch – SR 96 at Outlook Ridge Homes (2.4 miles from SR 9)

This site is located in a ditch approximately 100 feet down gradient from Site 3 on the north side of SR 96 (See Figure 2.1 and A-R4). It receives all the flow from the drain associated with site 3, some sheet flow from the highway, and interflow from a residence to the north (single family home with large yard). Both passive samples (Nalgene 2007) and grab samples will be used at this site to characterize runoff quality at the boundary for WSDOT's right-of-way.

Site 5 - Outlook Run-On – SR 96 across from Outlook Ridge Homes (2.4 miles from SR 9)

This site is located approximately 260 feet downhill and northeast of the entrance to Outlook Ridge Homes on the south side of SR 96 (See Figure 2.1 and A-R5). This site will be used to assess run-on to the highway from a church parking lot and surrounding rural areas. Stormwater from this lot drains via a 6 inch pipe into the roadside ditch for SR 96. Because of the rocky substrate in the ditch, it will be impractical to use passive samplers (Nalgene 2007) at this location. Therefore, grab samples will be collected from the pipe before flow reaches the roadside ditch.

Site 6 - Outlook Exit ROW – SR 96 across from Outlook Ridge Homes (2.4 miles from SR 9)

This site is located approximately 400 feet downhill and northeast of the entrance to Outlook Ridge Homes on the south side of SR 96 (See Figure 2.1 and A-R6), and approximately 130 feet downhill from Site 4 (see description above). A roadside ditch at this location receives runoff from the same ditch that was identified in association with Site 4. This site also receives some sheet flow from SR 96, and interflow from an adjacent hill slope to the south. This site is located approximately 30 feet up gradient from ditch's confluence with a stream that flows under SR 96; therefore, sampling at this site will be performed to characterize runoff quality at the edge of WSDOT's right-of-way. Because of the rocky substrate in the ditch, it will be impractical to use passive samplers (Nalgene 2007) at this location. Instead grab samples will be used to characterize runoff quality.

Site 7 - Maytown – Hwy 121 near I-5

This site is located on Hwy 121, about 0.7 miles east of I-5. There is a pull off at the 2nd bridge after I-5, and the sampler is located below the bridge (see Figures 2.3 and A-R7). One passive sampler (Nalgene 2007) catches runoff from a bridge via a scupper. It collects runoff from about 363 square feet of untreated area from one lane of traffic and concrete shoulder. There are concrete curbs on either side of the bridge, but significant channeling is not apparent. This site has an ADT rating of 0 – 1999. The road is crowned, and flow seems to be dispersed quite evenly among the 6 scuppers on the bridge. The edge of the road along the bridge is bounded by cement curbs, channeling surface water to drain via the scuppers. The surrounding area is forested with a large floodplain, and the small town of Maytown about 0.5 miles to the east. River height changes dramatically in heavy rains. There are no major topographical features in the immediate monitoring area, except for the stream channel that is Beaver Creek. The soil along the area is a Norma silt loam. This is a very deep, poorly drained soil located in depressions on till plains. The overall area consists of soils from glacial uplands, of the Alderwood – Everett association.

Site 8 - Skookumchuck – SR 507, between Centralia and Bucoda

This site is located on SR 507, between Centralia and Bucoda, on the more northerly bridge over the Skookumchuck River (see Figures 2.3 and A-R8). One passive sampler placed in a stormwater drain collects runoff from the bridge. The sampled runoff area is approximately

7,040 square feet of pavement, encompassing most of the northern half of the bridge. The area is bounded by cement curbs, channeling all flow along one side of the roadway, into the runoff drain. This site has an ADT rating of 2000 – 4999. The collector drains the surface runoff from a bridge. Immediately after the bridge, the road curves, and has a contoured embankment. Most of the water from the roadway between the middle of the bridge and the collector drains to the collector. On the down-slope side of the road, there is a cement curb channeling all water to the drain. The immediate area is an agricultural flood plain of the Skookumchuck River. Usually pasture land, the area can become inundated and flooded in periods of high rain. The roadway is sloped in a manner that directs flow down-slope towards the drain. The eastern side is curbed, so there is some channeling in high rains. SR 507 meanders from Centralia to just north of Roy, passing through Bucoda, Tenino, Rainier, and Yelm. The majority of the land is hilly farm/ranch land, with several wetlands, interspersed forested area, and many roadside treatment ditches. This site is in an area fairly representative of SR 507 as a whole. The soils consist of the Chehalis – Newberg association, which are very deep, well drained, nearly level soils. The floodplain is bounded by soils from sedimentary uplands and glacial drift plains, from the Melbourne – Centralia association. The immediate soil is a Newberg fine sandy loam.

Site 9 - Shaw Road – Shaw Road and SR 507

This site is located at the southeast corner of Shaw Road and SR 507, on the southern edge of Yelm (see Figures 2.3 and A-R9). The area that drains to the sampler is about 50,000 square feet, and encompasses some flow from SR 507, and some from Shaw Road and the immediate area uphill. A passive sampler collects sheet flow from Shaw Road and SR 507. The flow from the pavement is somewhat channeled, and as it leaves the pavement, it is caught by plastic sheeting that guides it to the passive sampler. This site has an ADT rating of 5000 – 9999. This site, catching runoff at the southeast corner of SR 507 and Shaw Road receives sheet flow from SR 507 and Shaw Road. Shaw Road inclines sharply and immediately away from the collection point. There is significant sheet flow from Shaw Road and the small strip of forested/grass land between Shaw Road and SR 507 that flows down into the collection point. SR 507 slopes slightly to the south, and the runoff from the east side of the crowned highway immediately north of the collector runs alongside the road to the collection point. The surrounding area is forested, with several dwellings just east of SR 507. The ditch is vegetated with brown straw-like grass, and in heavy rain, produces overland flow. The overland flow goes into the ditch at the point of collection and there can be steady surface flow through the ditch for about 675 feet where the flow meets a wetland with standing water. Along the way, there are several other inlets that produce significant flow in times of heavy precipitation, but are inactive the majority of the time. Parts of the ditch host standing water and significant amounts of filamentous algae. This site currently collects runoff from Shaw Road and other property as it is entering WSDOT ROW. Consequently, it is representative of a run-on situation. The flow comes from Shaw Road, and a small strip of forested area.

The soils here are primarily soils from glacial uplands. The site is host to Spanaway gravelly sand loam, which is very deep, excessively well drained soil on terraces. These have formed from glacial outwash and volcanic ash.

Site 10 - Hwy 702 – Hwy 702, just west of Hwy 7

This site is located on Hwy 702, just west of Hwy 7, near the mailbox of 1314 350th Street (see Figures 2.3 and A-R10). One passive sampler is in place to collect untreated runoff at the bottom of a small hill. The runoff area is approximately 884 square feet. The runoff is generally channeled to a slight depression in the edge of the pavement where it flows onto plastic sheeting, directing it to the passive sampler. This site has an ADT rating of 2000-4999. The road is crowned, but lengthwise it slopes down towards the collector from the east, and then gently back up to the west. A small portion of the road gradually pools runoff towards the edge of the road, where a 2.5-foot-wide paved shoulder directs the flow to the plastic collection sheeting. On the south side of the road there is forested land with some concentrated hydrophytic vegetation. On the north side of the road is a residence with some horses. This ditch is vegetated, with a steep embankment on either side, containing ferns and shrubs to the south and the roadway to the north. The flow runs off the road at the collection point and goes into a heavily vegetated ditch. Flow here appears to infiltrate immediately, likely seeping to the wetland area directly south of the road.

3.0 Analytical Constituents

Analytical parameters and methods, detection limits and units, and holding times for samples collected during stormwater characterization and rural runoff monitoring are summarized in Table 3.1. Aquatic Research, Inc. (ARI) of Seattle, Washington will perform laboratory analysis and QA checks for all samples collected from sites in the Seattle and Olympia vicinity. Samples collected at BMP sites in the Vancouver vicinity will be sent to North Creek Analytical Laboratory in Tigard, Oregon for analysis. Each laboratory will perform analyses for hardness, total suspended solids, total phosphorous, total and dissolved copper, total and dissolved zinc, total petroleum hydrocarbons (TPH), and fecal coliform bacteria. Analytical procedures used by both laboratories will follow U.S. EPA approved methods (American Public Health Association 1998; U.S. EPA 1983; U.S. EPA 1984). These methods provide detection limits that are below the state and federal regulatory criteria or guidelines, and will enable a direct comparison of the analytical results for these criteria.

4.0 Data Quality Objectives (DQOs)

4.1 Analytical Reporting Limits

This section has remained unchanged. See original QAPP (Tetra Tech 2003).

4.2 Analytical Precision, Accuracy, and Completeness

The reporting limits for the sample analyses are presented in Table 4.2, and are selected to provide accurate results that can be used for regulatory comparison.

Table 3.1. Water quality parameters and analytical methods for WSDOT 2005/2006 stormwater characterization monitoring. [1,2]

Analyte	Method Type	Method Number [a] USEPA or Standard Methods	Holding Time[b]	Preservation	Reporting Limit/ Resolution	Units
Hardness	Titrimetric; Colorimetric; Calculation	SM18 2340B	6 Months	Cool, 4°C	2	mg/L
Total Suspended Solids	Gravimetric	160.2	7 days	Cool, 4°C	0.5	mg/L
Total Phosphorus	Colorimetric	365.1	28 days	Cool, 4°C	0.002	mg/L
Copper (dissolved and total)	Graphite Furnace Atomic Absorption	220.2	6 Months	Cool, 4°C	1	µg/L
Zinc (dissolved and total)	Inductively Coupled Plasma (ICP)/Atomic Emission Spectrometry	200.7			5	
Total Petroleum Hydrocarbons - Diesel	Gas Chromatography/ Flame Ionization Detection	NWTPH-Dx[c]	Extract – 14 days; Analyze – 40 days	Cool, 4°C	0.05	mg/L
Total Petroleum Hydrocarbons - Oil					0.10	
Fecal Coliform	Membrane Filter	SM 9222D	24 hours [d]	Cool, 4°C	2 min., $2 \cdot 10^6$ max.	cfu/100 mL

1. The 18th edition of Standard Methods for the Examination of Water and Wastewater (APHA 1998) is the current legally adopted version in the Code of Federal Regulations (CFR). However, the 20th edition provides additional guidance on certain key items. For this reason the 20th edition is referenced in this table as the best available guidance.
2. All USEPA 1600 series methods (U.S. EPA 1983) require equipment handling, bottle preparation, sample collection (grab or composite) and sample handling according to USEPA method 1669 protocols.

a Equivalent Standard Method can be substituted.
b Holding time specified in USEPA guidance or referenced in Standard Methods for equivalent method.
c Washington State Department of Ecology methods, (Ecology 2007) includes silica gel extract cleanup step.
d The 8-hour holding time includes the 2-hour delivery and 6-hour set-up time allowances described in Standard Methods 18th edition (APHA 1998). All efforts should be made to analyze samples within 6 hours of sampling to conform to the currently adopted edition of Standard Methods.

Table 4.2. Measurement quality objectives

Analyte	Precision [a]		Accuracy [b]	Bias [c]	Reporting Limit/ Resolution	Units
	Laboratory	Field				
Hardness	± 25 %	± 35 %	± 25 %	± 25 %	2	mg/L
Total Suspended Solids	± 25 %	± 35 %	± 25 %	± 25 %	0.5	mg/L
Phosphorus	± 25 %	± 35 %	± 25 %	± 25 %	0.002	mg/L
Copper	± 25 %	± 35 %	± 10 %	± 25 %	1	µg/L
Zinc					5	
TPH (diesel)	± 25 %	± 35 %	± 25 %	± 25 %	0.05	mg/L
TPH (motor oil)					0.10	
Fecal Coliform	± 40 %	± 40 %	± 25 %	± 25 %	2 min., $2 \cdot 10^6$ max.	cfu/100 mL

[a] Based on laboratory and field duplicate analyses.
[b] Based on laboratory control sample, reference material, and spike sample recoveries.
[c] Based on overall laboratory QC results.

5.0 Field Equipment Operation and Maintenance

Each monitoring site utilizes an automated sampler (ISCO Model 6700 or a 6712) housed in a protective metal box and a tipping bucket rain gauge mounted on a pole. The automated samplers are connected to both the rain gauge and a flow-measuring device, either a flow transducer or a bubbler line.

When a rain gauge records 0.04 inches of rain within 2 hours, it will activate the sampler. After a pre-specified amount of water has passed by, a sample aliquot will be collected. This will continue until a maximum of 30 aliquots have been collected. In this way, a flow-weighted composite sample will be collected at each of the sites. Because both spring and winter storm events will be targeted, the qualifying conditions and sample collection regimes will vary and are purposely designed to be flexible enough to meet different “typical” storm events. Each of the sampling sites will be checked prior to anticipated storm events to ensure proper equipment functioning. The procedures for regular maintenance are described in the manufacturer’s instructions and summarized below.

5.1 Equipment Calibration/Maintenance and Cleaning

At a minimum, all equipment shall be calibrated, maintained and cleaned according to the manufacturers specifications. Instruction manuals for the ISCO 6700 and 6712 Portable Samplers, bubbler modules, rain gauges, and associated solar panel and power supplies are available at WSDOT EAO and Herrera Environmental Consultants offices as reference materials. These manuals should be reviewed thoroughly by all field personnel prior to any fieldwork.

All of the ISCO 6700 and 6712 portable samplers were calibrated by the manufacturer prior to use and installation at the monitoring sites. Volumes of sample collected will be compared to sampling program records to verify the accuracy of sample collection. The bubbler module is calibrated by measuring the depth of the water and adjusting the reading to match. Calibration of the bubbler modules can also be conducted by immersing the line in a container of water and adjusting the reading. The rain gauges are factory calibrated and need no adjustments.

Maintenance of equipment will be conducted on a routine basis during pre-storm checks and while collecting samples. Maintenance procedures and frequencies are summarized in Table 5.1 below.

Table 5.1. Equipment maintenance schedule.

Equipment	Item	Procedure	Frequency
Rain Gauge	Level Check	Verify level with bubble indicator	Monthly
Battery/Solar Panel	Available power	Check amperage; clean terminals; check connections	Weekly/per visit; as required
Sampler	Sample tubing	Check integrity; verify no obstructions at opening	Monthly; per visit
	Humidity Indicator	Check surface indicator	Every visit
Bubbler module	Desiccant	Check color – when pink, exchange for new desiccant	Every visit
	Tubing	Check for obstructions	Every visit

6.0 Monitoring Preparation and Logistics

6.1 Weather Tracking

This section has remained unchanged. See original QAPP (Tetra Tech 2003).

6.2 Storm Selection Criteria

The following conditions will be established to serve as guidelines in defining the acceptability of a storm event for sampling:

- Target Storm Depth: A **minimum of 0.25 inches of precipitation over a 24 hour period** or greater. (Note: While the goal is to target larger storms, samples from storms as small as 0.15 inches over 24 hours may be accepted as long as the other specified criteria are met.)

- Antecedent conditions: A period of **at least 24 hours preceding the event with less than 0.02 inches** of precipitation.

- End of Storm: A continuous **6-hour period with no measurable rainfall**.

These criteria apply to all inlet and outlet stations except those associated with outlets for wet ponds. Because of the flow attenuation that occurs in wet ponds, significant discharge may be observed at outflow stations well after the 6-hour criteria for defining that the end of a storm has passed. Therefore, the end of storm for these types of facilities will be defined as the point after the last rains when the falling limb of the hydrograph transitions back to steady, base flow conditions (usually 12- to 24-hours). Because of these considerations, there will also be instances when the inlet flow for a wet pond ends while the outlet flow continues through the arrival of the next storm. In these instances, sampling at the outlet station will be terminated at the onset of the second storm to ensure that the influent and effluent samples both reflect runoff from the same event. Finally, there may be instances when the automated samplers continue sampling through the end of one storm and into the next. In these cases, the associated hydrologic data from each storms will be grouped and considered as one storm.

6.3 Sample Bottle Order

This section has remained unchanged. See original QAPP (Tetra Tech 2003).

6.4 Sample Bottle Labeling

This section has remained unchanged. See original QAPP (Tetra Tech 2003).

6.5 Sampler Programming

Programming considerations for the automated sampling systems are based on project specific and location specific considerations. Common programming parameters are listed below in Table 6.1, and location specific programming parameters are presented in Table 6.2 and Appendix A.

Table 6.1. Common sampler programming parameters

Data Interval – 5 minutes
Number of Sample Bottles – One
Sample Bottle Size – 9.4 Liters
One part program
Once enabled, stay enabled
Pauses and resumes = 0
No sample at start
Run continuously? = No
Sample at start? = No
Sample at enable? = No
Number of samples = 30
Sample volume = 300 ml (30 x 300 = 9L)
Enable: Inlet: Rain, >0.04-inch/2 hrs
Units: Length = feet; Volume = cf; Flow = cfs

Table 6.2. Location specific program parameters

Location	Inlet/ Outlet	Program Parameter				
		Slope (rise/run)	Roughness	Sample Line Length	Diameter (feet)	Phone Number (sampler modem)
Seattle Area Sites						
1) SR 522 at Bostain Rd (Pond)	IN	N/A	N/A	38	2	N/A
	OUT	N/A	N/A	38	2	(360) 951-2397
2) SR 525 at Milepost 1.5 (Swale/Pond)	IN	N/A	N/A	22.5	1.5	N/A
	OUT	N/A	N/A	31	1.5	N/A
3) SR 525 at Milepost 2.4 (Pond)	IN	0.0026	0.011	34	1.5	N/A
	OUT	N/A	N/A	37	1	N/A
4) SR18 at Milepost 8.04 (Pond)	IN	N/A	N/A	18	1.5	N/A
	OUT	N/A	N/A	25	1.5	N/A
5) SR18 at Issaquah/Hobart Exit (Swale/Ditch)	IN	0.0429	0.012	19	1.5	N/A
	OUT	0.0 (H-flume)	N/A	14	1.5 (H-flume)	N/A
6) SR18 at SE 256th Street (Swale)	IN	0.0171	0.013	23	1.5	N/A
	OUT	0.0 (H-flume)	N/A	32	1.5 (H-flume)	N/A
Vancouver Area Sites						
7) SR14 near SE 192nd (Swale)	IN	N/A	N/A	40	2	N/A
	OUT	N/A	N/A	33	1.5 (V-notch)	N/A
8) SR14 near SE 192nd (Swale/Pond)	IN	N/A	N/A	22	1	N/A
	OUT	N/A	N/A	30	N/A	N/A
9) SR14 between SE 192nd and SE 164th (Swale/Pond)	IN	0.0 (H-flume)	N/A	32	0.75 (H-flume)	N/A
	OUT	N/A	N/A	43	N/A	N/A
10) SR 500 112th Avenue/Gher Road off ramp (Pond)	IN	0.0759	0.012	40	1	N/A
	OUT	N/A	N/A	26	N/A	N/A

N/A = Not applicable.

7.0 Sample Collection, Preservation, and Delivery

Sample collection methods for the sampling program are presented herein under separate sections for BMP effectiveness and runoff characterization monitoring, and the rural highway runoff monitoring.

7.1 Sample Collection Methods

BMP Sites

Automated samplers will be programmed to collect flow-weighted composite samples for the following parameters: total suspended solids, total phosphorus, hardness, copper (total and dissolved), and zinc (total and dissolved). The maximum number of anticipated samples for these parameters includes the collection of one replicate sample from one monitoring location during each storm event for a total of 21 samples to be submitted to the laboratory each event for each parameter.

Each automated sampler will be programmed to collect 300 mL sample aliquots at pre-set flow increments. Each sample aliquot will be collected into clean polyethylene or glass carboys. The flow increments used will vary by site and will be based on drainage area and by season to account for seasonal differences in storm event character. Samples will be collected over a **maximum of a 36-hour period**. Although the goal is to collect all samples over 24-hours, this additional time will allow for characterization of storms that begin slowly and develop into significant events over a longer timeframe. This will require some subjective assessment on the part of field staff to ensure that representative portions of the overall storm hydrograph and collection criteria are met.

After each targeted storm event, field staff will return to each site and make visual and operational checks of the system, transfer the carboy into a cooler with ice, replace it with an appropriately cleaned carboy, and turn the automated sampler off. The minimum number of composites that will constitute an acceptable sample will be eight. The possibility exists that not enough water volume will be collected to fill the sample bottles for a field duplicate. In these instances the sample bottles will be filled in the order of priority outlined below:

1. Total suspended solids (TSS) (1L)
2. Total Metals (500 mL)
3. Dissolved Metals (500 mL)
4. Hardness, phosphorus (500 mL).

Grab sampling will also be conducted for fecal coliform bacteria and total petroleum hydrocarbons (TPHs). The timing of this sample collection will be targeted to capture the rising limb of the storm hydrograph. Therefore, a second field visit will be made early in the storm to collect this sample which will be labeled and packed on ice, and then transported to the laboratory with the other samples immediately (within 2 hours) after the end of the storm event. The samples for NWTPH-Dx analysis will be collected only at those stations where a hydrocarbon sheen is observed in the water. For these samples, one field duplicate will be collected during each storm event and submitted to the laboratory for analysis.

The next step will be to review the data against monitoring goals as follows:

1. Check to ensure that a **minimum of eight samples** have been collected, then complete a visual check to ensure that appropriate sample volumes were collected [e.g., if eight samples were collected of 300 mL aliquots the total volume in the carboy should equal 2.4 liters].

2. Visually compare rain gage data with flow level data to check for inconsistencies.

3. Estimate the portion of the hydrograph that represents **approximately 75 percent of the storm** and determine whether the samples collected cover that period.

4. Calculate the storm depth over the sampling period and determine whether depth was **at least 0.15 inches to 0.25 inche**s.

5. If less than 0.25 inches, but greater than 0.15 inches have been recorded, check that at least 75 percent of the hydrograph was captured.

Rural Sites

Rural runoff monitoring will be targeted to collect runoff that is generated from storms producing between 0.15 and 0.25 inches of precipitation in a 24-hour period. As noted above, sampling locations for this monitoring were selected to characterize direct highway runoff, highway run-on from adjacent lands, and runoff at the boundary for WSDOT's right-of-way. In most cases, sample collection from these areas will be conducted with passive samplers. However, grab sampling will also be employed when site conditions make the use of passive samplers impractical. Passive samplers will be deployed in advance of a forecasted storm and then retrieved immediately following the actual event. To collect grab samples, field visits will be made during the storm event in an effort to capture runoff on the rising limb of the storm hydrograph. All samples from this monitoring will be analyzed for total suspended solids, total phosphorus, hardness, copper (total and dissolved), and zinc (total and dissolved). Samples will also be analyzed for fecal coliform bacteria in those instances when the passive sample can be promptly retrieved from the field and delivered to the laboratory in time to meet the holding-time requirements specified in Table 3.1. One field duplicate will be collected during each storm event and submitted to the laboratory for analysis.

7.2 Field Measurement Methods

This section has remained unchanged. See original QAPP (Tetra Tech 2003).

7.3 Field Equipment List

This section has remained unchanged. See original QAPP (Tetra Tech 2003).

7.4 Forms/Procedures for Documenting Sample Collection and Field Measurements

This section has remained unchanged. See original QAPP (Tetra Tech 2003).

7.5 Laboratory Communication Procedures

This section has remained unchanged. See original QAPP (Tetra Tech 2003).

7.6 Sample Shipping/Delivery, Chain of Custody

This section has remained unchanged. See original QAPP (Tetra Tech 2003).

8.0 Quality Control Procedures

8.1 Field Procedures for QC Sample Collection

This section has remained unchanged. See original QAPP (Tetra Tech 2003).

9.0 Laboratory Sample Preparation and Analysis

This section has remained unchanged. See original QAPP (Tetra Tech 2003).

10.0 Audits and Reports

Assessment of field sampling activities will occur throughout the project by the designated Task Manager. The site visit field form and discussions with field staff will be used after each sample collection event to make a determination on equipment operations, qualifying conditions, and sample acceptance. Modifications to sampler programming or monitoring design will be noted in the field log. Assessment of laboratory activities and any discrepancies identified will be conducted routinely by the analytical laboratory, and included in a case narrative accompanying the water quality results. The Task Manager will assess the QC information and water quality data for completeness. The WSDOT Project Manager will be advised of any QA issues that arise.

All monitoring data will be submitted to WSDOT in a format that will facilitate their incorporation in the NPDES Annual Report. Included will be a summary of the analytical findings from the monitoring period, any substantive deviations in the monitoring program from the procedures outlined in the associated planning documents, any QA problems and corrective actions, a spreadsheet containing all of the sample data, and an assessment of the completeness of the data for meeting project objectives. Flow data will also be evaluated and summarized to

identify potential changes in pollutant loading and concentrations associated with flow characteristics relative to BMP performance.

The data will be presented in a format that is compatible for subsequent use and inclusion in the stormwater facility inventory database, and also in tabular format for inclusion in the WSDOT NPDES reports. The technical memoranda for each of the monitoring activities will be provided to the designated WSDOT Water Quality Program representatives in draft form for review and comment. Upon receipt of comments, the documents will be transmitted in both electronic and hard copy formats as final versions.

In addition, the data collected as a part of this effort will undergo quality assurance review for accuracy as described in Section 11.0.

11.0 Data Review, Verification, and Validation

Three types of data will be generated during this project: rainfall, flow, and water quality. The data review, verification, and validation procedures for each data type are discussed below. Data review involves examination of the data for errors or omissions. Data verification involves examination of the QA/QC results for compliance with acceptance criteria. Data validation involves the examination of the complete data package to determine whether the procedures in the QAPP were followed.

Flow and rainfall measurements will be reviewed in the field for gross errors such as irregular spikes or drops. Flow and rainfall measurements will be verified by comparing the hyetograph and hydrograph for consistency and comparing the total amount of rainfall to total flow volume for consistency with previously collected data.

The second data review step entails reviewing rainfall and sample collection information against stated storm event and sample event criteria, and deciding whether to accept or reject a collected sample. The site visit log (Appendix B) contains a checklist for validation of storm and sample event criteria.

Water quality results will first be reviewed at the laboratory for errors or omissions. Laboratory QC results will then be reviewed by the laboratory to verify compliance with acceptance criteria. The laboratory will also validate the results by examining the completeness of the data package to determine whether method procedures and laboratory QA procedures were followed. The review, verification, and validation by the laboratory will be documented in a case narrative that accompanies the analytical results. Laboratory data will also be reviewed by project personnel to assess field QC results (i.e., field duplicates) and verify compliance with acceptance criteria.

The first step in the evaluation process will be determining that an adequate number of events have been monitored. The coefficient of variation (CV) of TSS will be used to quantify the

number of samples that provide a statistically valid representation of runoff conditions as described in Section 3.3.7.8 of WSDOT's Stormwater Management Plan.

When a statistically valid number of samples have been collected, site EMCs for the selected pollutants will be calculated as described in Section 3.3.7.8 of WSDOT's Stormwater Management Plan.

12.0 References

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APPENDIX A

Detailed Sampling Information and Site Location Information for the BMP and Rural Monitoring Sites

Site Number 1
SR 522 at Bostain Rd (Pond)
Wet Pond

BMP Location

Driving Directions	This wet pond is located on the east side of SR522 just south of the intersection of Paradise Rd. and SR522. The pond entrance gate is ~ 0.25 miles south of the Paradise Rd./Bostain Rd. inetrsection.
ADT	20,000-39,999
Drainage Area	22.84
Percent Impervious	70.3

Sample Site Location

Inlet/Outlet	Inlet	Outlet
Coordinates (UTM) N	5294204	5294181
Coordinates (UTM) E	566486	566593
Site map	Figure A1-c	Figure A1-c
Flow measurement location	Flow will be measured in a 2 foot diameter inlet pipe on the west end of the pond. An expansion ring with an attached AV sensor iss mounted ~2 feet from the mouth of the pipe.	Flow will be measured in a flow control vault on the southeast corner of the pond. A bubbler will be mounted in the vault and an orafice equation will be used to calcuate flow through the flow control structure.
Sample collection location	The intake line will be mounted on a stake in the pond at the point where the pipe empties into the pond. Sediment issues in the pipe will prevent mounting the intake on the bottom of the pipe with the flow gauge.	The intake line will be mounted in the flow control vault at the southeast corner of the pond.

Flow Measurement

Flow measurement method	Continuity equation	Rating curve (see table A1)
Flow meter	ISCO 750 acoustic doppler	ISCO 730 bubbler
Slope	N/A	N/A
Roughness	N/A	N/A

Sample Collection

Sample collection method	Autosampler (ISCO 6700)	Autosampler (ISCO 6712)
Tubing Length	38	38
Compositing	Flow-weighted 30 samples	Flow-weighted 30 samples
Sample Bottle Volume	9.4 liter	9.4 liter

Table A1. Bostain Out Rating Curve

Relative Stage (ft)	Total Q (cfs)
0.00	0.00
0.03	0.03
0.07	0.04
0.13	0.05
0.23	0.07
0.30	0.08
0.46	0.10
0.56	0.11
0.66	0.12
0.79	0.13
0.89	0.14
1.05	0.15
1.18	0.16
1.35	0.17
1.51	0.18
1.67	0.19
1.74	0.19
1.80	0.20
1.87	0.21
1.88	0.27
1.89	0.33
1.90	0.39
1.97	0.54
2.03	0.64
2.10	0.72
2.17	0.80
2.30	0.92
2.36	0.98
2.43	1.03
2.46	1.05
2.49	1.08
2.53	1.10
2.56	1.12
2.57	1.20
2.58	1.27
2.59	1.42
2.62	1.60
2.66	1.73
2.69	1.84
2.74	1.99
2.79	2.13
2.84	3.83
2.89	5.54
2.99	14.70

Figure A1-a. Bostain Pond Inlet

Figure A1-b. Bostain Pond Outlet

Figure A1-c. Aerial photo of Bostain Pond sampling area

Site Number 2
SR 525 at Milepost 1.5 (Swale/Pond)
Wet Pond/Wetland

BMP Location

Driving Directions	This wet pond/wetland is located near milepost 1.5 on westbound SR525. The pullout is ~ 0.19 mi north of the 164th St. SW overpass.
ADT	40,000-59,999
Drainage Area	1.78
Percent Impervious	67.9

Sample Site Location

Inlet/Outlet	Inlet	Outlet
Coordinates (UTM) N	5300175	5300162
Coordinates (UTM) E	554310	554323
Site map	Figure A2-c	Figure A2-c
Flow measurement location	Influent flow will be measured in a 1.5 foot diameter pipe in the northwest corner of the pond. An AV sensor is mounted on an expansion ring and placed ~2 feet from the mouth of the pipe.	Effluent flow will be measured in a flow control vault on the eastern edge of the pond. A bubbler will be mounted in the vault and an orafice equation will be used to calcuate flow through the flow control structure.
Sample collection location	The intake line will be mounted on a stake in the pond at the point where the pipe empties into the pond. Sediment issues in the pipe will prevent mounting the intake on the bottom of the pipe with the flow gauge.	The intake line will be mounted in the flow control vault on the eastern edge of the pond.

Flow Measurement

Flow measurement method	Continuity equation	Rating curve (see table A2)
Flow meter	ISCO 750 acoustic doppler	ISCO 730 bubbler
Slope	N/A	N/A
Roughness	N/A	N/A

Sample Collection

Sample collection method	Autosampler (ISCO 6700)	Autosampler (ISCO 6700)
Tubing Length	22.5	31
Compositing	Flow-weighted 30 samples	Flow-weighted 30 samples
Sample Bottle Volume	9.4 liter	9.4 liter

Table A2. MP1.5 Out Rating Curve

Relative Stage (ft)	Total Q (cfs)
0.00	0.000
0.03	0.002
0.07	0.003
0.10	0.004
0.13	0.005
0.16	0.005
0.20	0.006
0.23	0.006
0.26	0.006
0.30	0.007
0.33	0.007
0.36	0.008
0.39	0.008
0.43	0.008
0.46	0.009
0.49	0.009
0.52	0.009
0.56	0.009
0.59	0.010
0.62	0.010
0.66	0.010
0.69	0.010
0.72	0.011
0.75	0.011
0.79	0.011
0.82	0.011
0.85	0.012
0.89	0.012
0.92	0.012
0.95	0.012
0.98	0.012
1.02	0.013
1.05	0.013
1.08	0.013
1.12	0.013
1.15	0.013
1.18	0.014
1.21	0.014
1.25	0.014
1.28	0.014
1.31	0.014
1.35	0.015
1.38	0.015
1.41	0.015

Figure A2-a. MP1.5 Pond Inlet

Figure A2-b. MP1.5 Pond Outlet

Figure A2-c. Aerial photo of MP1.5 Pond sampling area

Site Number 3
SR 525 at Milepost 2.4 (Pond)
Wet Pond

BMP Location

Driving Directions	This pond is located near milepost 2.4 on westbound SR525. The pullout is just before the exit ramp for northbound highway 99.
ADT	40,000-59,999
Drainage Area	2.36
Percent Impervious	66

Sample Site Location

Inlet/Outlet	Inlet	Outlet
Coordinates (UTM) N	5301678	5301610
Coordinates (UTM) E	554211	554243
Site map	Figure A3-c	Figure A3-c
Flow measurement location	Influent flow will be measured in a 1.5 foot diameter pipe on the northwest side of the pond. A bubbler is mounted on an expansion ring and placed ~2 feet from the mouth of the pipe.	Effluent flow will be measured in a flow control vault on the southern end of the pond. A bubbler will be mounted in the vault and a rating curve will be used to convert vault stage to flow.
Sample collection location	The intake line will be mounted ~ 1 foot down pipe from the bubbler line on the bottom of the influent pipe.	The intake line will be mounted in the flow control vault on the southern edge of the pond.

Flow Measurement

Flow measurement method	Manning Equation	Rating curve (see Table A3)
Flow meter	ISCO 730 bubbler	ISCO 730 bubbler
Slope	0.0026	N/A
Roughness	0.011	N/A

Sample Collection

Sample collection method	Autosampler (ISCO 6700)	Autosampler (ISCO 6700)
Tubing Length	34	37
Compositing	Flow-weighted 30 samples	Flow-weighted 30 samples
Sample Bottle Volume	9.4 liter	9.4 liter

Table A3. MP2.4 Out Rating Curve

Relative Stage (ft)	Total Q (cfs)
0.00	0.000
0.05	0.005
0.10	0.010
0.15	0.016
0.20	0.021
0.25	0.026
0.30	0.043
0.35	0.060
0.40	0.063
0.45	0.063
0.50	0.063
0.55	0.063
0.60	0.064
0.65	0.064
0.70	0.064
0.75	0.064
0.80	0.064
0.85	0.064
0.90	0.064
0.95	0.064
1.00	0.065
1.05	0.065
1.10	0.065
1.15	0.069
1.20	0.075
1.25	0.082
1.30	0.088
1.35	0.095
1.40	0.101
1.45	0.108
1.50	0.114
1.55	0.121

Figure A3-a. MP2.4 Pond Inlet

Figure A3-b. MP2.4 Pond Outlet

Figure A3-c. Aerial photo of MP2.4 Pond sampling area

Site Number 4
SR18 at Milepost 8.04 (Pond)
Wet Pond

BMP Location

Driving Directions	This wet pond is located on the south side of SR18 at milepost 8.04. The site is accessed from eastbound SR18. The pullout is ~0.13 mi northeast of the SE 312th Way overpass.
ADT	20,000-39,999
Drainage Area	8.04
Percent Impervious	61.8

Sample Site Location

Inlet/Outlet	Inlet	Outlet
Coordinates (UTM) N	5241140	5241199
Coordinates (UTM) E	563202	563287
Site map	Figure A4-c	Figure A4-c
Flow measurement location	Influent flow will be measured in a 1.5 foot diameter pipe located in the bottom of a catch basin on the highway above the southwest corner of the pond. An AV sensor will be mounted in the pipe ~3 feet from the outlet of the catch basin.	Effluent flow will be measured in a 1.5 foot diameter pipe located on the northeast end of the pond. An AV sensor will be mounted ~2 feet from the outlet of the pipe. The outlet pipe discharges water into a swale.
Sample collection location	The intake line will be mounted adjacent to the flow meter.	The intake line will be mounted adjacent to the flow meter.

Flow Measurement

Flow measurement method	Continuity equation	Continuity equation
Flow meter	ISCO 750 acoustic doppler	ISCO 750 acoustic doppler
Slope	N/A	N/A
Roughness	N/A	N/A

Sample Collection

Sample collection method	Autosampler (ISCO 6700)	Autosampler (ISCO 6700)
Tubing Length	18	25
Compositing	Flow-weighted 30 samples	Flow-weighted 30 samples
Sample Bottle Volume	9.4 liter	9.4 liter

Figure A4-a. SR18 MP8.0 Pond Inlet

Figure A4-b.SR18 MP8.0 Pond Outlet

Figure A4-c. Aerial photo of SR18 MP8.0 Pond sampling area

Site Number 5
SR18 at Issaquah/Hobart Exit (Swale/Ditch)
Roadside Ditch

BMP Location

Driving Directions	This site is a roadside ditch located adjacent (north) to the east-bound entrance ramp to SR18 at the Issaquah/Hobart Road interchange. The influent site is monitored at the pipe ~ 0.07 mi west of 276th Ave SE. Effluent is measured ~200 feet downslope.
ADT	1,700
Drainage Area	3.76
Percent Impervious	30.9

Sample Site Location

Inlet/Outlet	Inlet	Outlet
Coordinates (UTM) N	5253890	5253872
Coordinates (UTM) E	577336	577282
Site map	Figure A5-c	Figure A5-c
Flow measurement location	Influent flow will be measured in a 1.5 foot diameter pipe located at the northeast end of the monitored section of the ditch. A bubbler line will be mounted to the bottom of the pipe ~2 feet from the end of the pipe.	Effluent flow will be measured 200 feet down the ditch (southwest) from the inlet in a 1.5 foot wide H-flume. A bubbler line will be mounted in the bottom of the flume to monitor stage.
Sample collection location	Due to low flow the intake line will be mounted in a small pool located 2 feet below the end of the pipe. If mounted on the base of the pipe the sampler would intake air during sampling.	The intake line will be mounted at the base of the temporay dam which will be installed to route flow through the H-flume.

Flow Measurement

Flow measurement method	Manning equation	Flume equation
Flow meter	ISCO 730 bubbler	ISCO 730 bubbler
Slope	0.0429	N/A
Roughness	0.012	N/A

Sample Collection

Sample collection method	Autosampler (ISCO 6700)	Autosampler (ISCO 6700)
Tubing Length	19	14
Compositing	Flow-weighted 30 samples	Flow-weighted 30 samples
Sample Bottle Volume	9.4 liter	9.4 liter

Figure A5-a. Issaquah/Hobart Ditch Inlet

Figure A5-b. Issaquah/Hobart Ditch Outlet

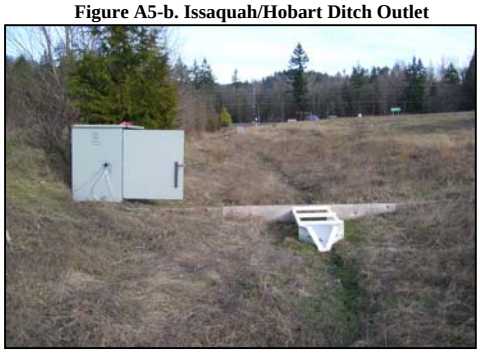


Figure A5-c. Aerial photo of Issaquah Hobart Ditch sampling area

Site Number 6
SR18 at SE 256th St (Swale)
Bio-Swale

BMP Location

Driving Directions	This swale is located northeast of the junction of 186th Avenue SE and SE 256th Street, approximately 0.14 mi west of SR18. The swale is accessed from SR18 by taking the SE 256th Street exit west to 186th Avenue SE.
ADT	2,400
Drainage Area	3.47
Percent Impervious	16.7

Sample Site Location

Inlet/Outlet	Inlet	Outlet
Coordinates (UTM) N	5247045	5247064
Coordinates (UTM) E	568335	568373
Site map	Figure A6-c	Figure A6-c
Flow measurement location	Influent flow will be measured in a 1.5 foot diameter pipe located at the western end of the swale. A bubbler line will be mounted to the bottom of the pipe ~2 feet from the end of the pipe.	Effluent flow will be measured 200 feet down the swale (east) from the inlet in a 1.5 foot wide H-flume. A bubbler line will be mounted in the bottom of the flume to monitor stage.
Sample collection location	Due tobedload issues the intake line will be mounted in a small pool located immediately below the end of the pipe. If mounted on the base of the pipe the sampler would intake bedload during sampling.	The intake line will be mounted at the base of the temporay dam which will be installed to route flow through the H-flume.

Flow Measurement

Flow measurement method	Manning equation	Flume equation
Flow meter	ISCO 730 bubbler	ISCO 730 bubbler
Slope	0.0171	N/A
Roughness	0.013	N/A

Sample Collection

Sample collection method	Autosampler (ISCO 6700)	Autosampler (ISCO 6700)
Tubing Length	23	32
Compositing	Flow-weighted 30 samples	Flow-weighted 30 samples
Sample Bottle Volume	9.4 liter	9.4 liter

Figure A6-a. 256th St Swale Inlet

Figure A6-b. 256th St Swale Outlet

Figure A6-c. Aerial photo of 256th St Swale sampling area

Site Number 7
SR14 near SE 192nd (Swale)
Bio-Swale

BMP Location

Driving Directions	This structure is located on the shoulder of eastbound SR14 near SE 192nd east of Vancouver. This site can be accessed from two locations: 1) the shoulder of the 192nd eastbound on-ramp (walk downhill from the guardrail) and 2) at the roadside pull-off on the shoulder of the 192nd eastbound on-ramp.
ADT	40,000-59,999
Drainage Area	15.98
Percent Impervious	56

Sample Site Location

Inlet/Outlet	Inlet	Outlet
Coordinates (UTM) N	5047994	5047985
Coordinates (UTM) E	541131	541222
Site map	Figure A7-c	Figure A7-c
Flow measurement location	Influent flow will be measured in a 2.0 foot diameter pipe located at the western end of the swale. An AV sensor will be mounted to the bottom of the pipe ~2 feet from the end of the pipe.	Effluent flow will be measured 300 feet down the swale (east) from the inlet in a 1.5 foot wide V-notch weir. A bubbler line will be mounted below the weir crest to monitor stage.
Sample collection location	The intake line will be mounted at the base of the 2.0 foot inlet pipe ~ 2 feet from the mouth of the pipe.	The intake line will be mounted at the base of the temporay dam which will be installed to route flow through the weir.

Flow Measurement

Flow measurement method	Continuity equation	Weir equation
Flow meter	ISCO 750 acoustic doppler	ISCO 730 bubbler
Slope	N/A	N/A
Roughness	N/A	N/A

Sample Collection

Sample collection method	Autosampler (ISCO 6700)	Autosampler (ISCO 6700)
Tubing Length	40	33
Compositing	Flow-weighted 30 samples	Flow-weighted 30 samples
Sample Bottle Volume	9.4 liter	9.4 liter

Figure A7-a. SR14a Swale Inlet

Figure A7-b. SR14a Swale Outlet

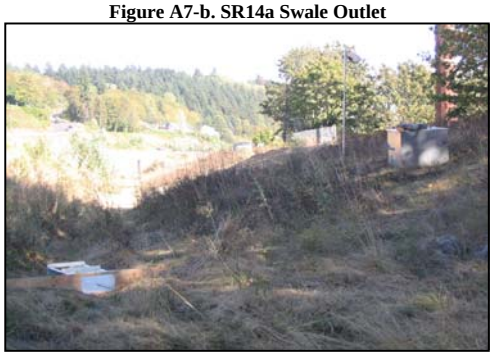
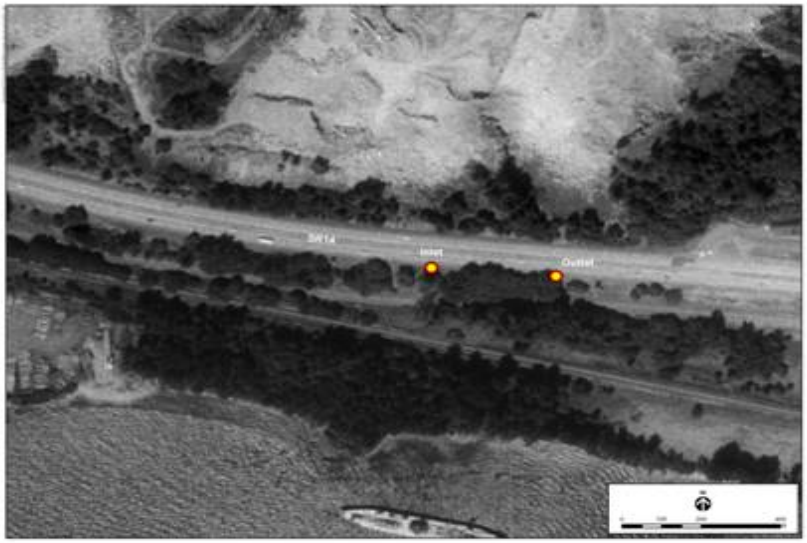


Figure A7-c. Aerial photo of SR14a Swale sampling area



Site Number 8
SR14 near SE 192nd (Swale/Pond)
Swale/Pond

BMP Location

Driving Directions	This structure is located on the shoulder of eastbound SR14 near SE 192nd east of Vancouver. This site can be accessed from two locations: 1) the roadside pull-off on the shoulder of the 192nd eastbound on-ramp (inlet station) 2) the shoulder of SR14 at the east end of the guard rail where the 192nd eastbound off-ramp lane ends (outlet station).
ADT	20,000-49,999
Drainage Area	1.36
Percent Impervious	100

Sample Site Location

Inlet/Outlet	Inlet	Outlet
Coordinates (UTM) N	5047951	5047924
Coordinates (UTM) E	541539	541674
Site map	Figure A8-c	Figure A8-c
Flow measurement location	Influent flow will be measured in a 1.0 foot diameter pipe located at the western end of the pond An AV sensor will be mounted to the bottom of the pipe ~2 feet from the end of the pipe.	Effluent flow will be measured in a flow control vault on the eastern edge of the pond. A bubbler will be mounted in the vault and an orafice equation will be used to calcuate flow through the flow control structure.
Sample collection location	The intake line will be mounted at the base of the 1.0 foot inlet pipe ~ 2 feet from the mouth of the pipe.	The intake line will be mounted in the flow control vault on the eastern edge of the pond.

Flow Measurement

Flow measurement method	Continuity equation	Orafice equation
Flow meter	ISCO 750 acoustic doppler	ISCO 730 bubbler
Slope	N/A	N/A
Roughness	N/A	N/A

Sample Collection

Sample collection method	Autosampler (ISCO 6700)	Autosampler (ISCO 6700)
Tubing Length	22	30
Compositing	Flow-weighted 30 samples	Flow-weighted 30 samples
Sample Bottle Volume	9.4 liter	9.4 liter

Figure A8-a. SR14 192nd Swale/Pond Inlet

Figure A8-b. SR14 192nd Swale/Pond Outlet

Figure A8-c. Aerial photo of SR14 192nd Swale/Pond sampling area

Site Number 9
SR14 between SE 192nd and SE 164th (Swale/Pond)
Swale/Pond

BMP Location

Driving Directions	This site is located on the shoulder of westbound SR14 between the SE 192nd and SE 164th interchanges east of Vancouver. The site can be accessed from the highway just before the 164th exit.
ADT	40,000-59,999
Drainage Area	3.68
Percent Impervious	86

Sample Site Location

Inlet/Outlet	Inlet	Outlet
Coordinates (UTM) N	5048430	5048470
Coordinates (UTM) E	539778	539652
Site map	Figure A9-c	Figure A9-c
Flow measurement location	Influent flow will be measured in a 0.75 foot H-flume located at the eastern end of the swale (which leads intoa pond). A bubbler line will be mounted in the flume to provide stage measurements for flow conversion.	Effluent flow will be measured in a flow control vault on the western edge of the pond (after the swale). A bubbler will be mounted in the vault and an orafice equation will be used to calcuate flow through the flow control structure.
Sample collection location	The intake line will be mounted at the base of the temporay dam which will be installed to route flow through the H-flume.	The intake line will be mounted in the flow control vault on the western edge of the pond.

Flow Measurement

Flow measurement method	Flume equation	Orafice equation
Flow meter	ISCO 730 bubbler	ISCO 720 pressure transducer
Slope	N/A	N/A
Roughness	N/A	N/A

Sample Collection

Sample collection method	Autosampler (ISCO 6700)	Autosampler (ISCO 6700)
Tubing Length	32	43
Compositing	Flow-weighted 30 samples	Flow-weighted 30 samples
Sample Bottle Volume	9.4 liter	9.4 liter

Figure A9-a.SR14 SE 164th Swale/Pond Inlet

Figure A9-b. SR14 SE 164th Swale/Pond Outlet

Figure A9-c. Aerial photo of SR14 SE 164th Swale/Pond sampling area

Site Number 10
SR 500 112th Ave/Gher Rd offramp (Pond)
Wet Pond

BMP Location

Driving Directions	This structure is located immediately south of the eastbound 112th Ave/Gher Rd offramp from SR-500 and immediately west of 112th Ave. in Vancouver. This site can be accessed from two locations: 1) the shoulder of the eastbound 112th Ave/Gher Rd off-ramp at the inlet, and 2) the WSDOT SW Region parking lot south of the pond (walk up 112th Ave to outlet).
ADT	18,000
Drainage Area	0.79
Percent Impervious	100

Sample Site Location

Inlet/Outlet	Inlet	Outlet
Coordinates (UTM) N	5056477	5056450
Coordinates (UTM) E	534328	534367
Site map	Figure A10-c	Figure A10-c
Flow measurement location	Influent flow will be measured in a 1.0 foot diameter pipe located at the northern end of the pond. An AV sensor will be mounted to the bottom of the pipe ~2 feet from the end of the pipe.	Effluent flow will be measured in a flow control vault on the southern edge of the pond. A bubbler will be mounted in the vault and an orafice equation will be used to calcuate flow through the flow control structure.
Sample collection location	The intake line will be mounted at the base of the 1.0 foot inlet pipe ~ 2 feet from the mouth of the pipe.	The intake line will be mounted in the flow control vault on the southern edge of the pond.

Flow Measurement

Flow measurement method	Continuity equation	Orafice equation
Flow meter	ISCO 750 acoustic doppler	ISCO 730 bubbler
Slope	N/A	N/A
Roughness	N/A	N/A

Sample Collection

Sample collection method	Autosampler (ISCO 6700)	Autosampler (ISCO 6700)
Tubing Length	40	26
Compositing	Flow-weighted 30 samples	Flow-weighted 30 samples
Sample Bottle Volume	9.4 liter	9.4 liter

Figure A10-a. SR500 Gner Rd Pond Inlet

Figure A10-b. SR500 Gner Rd Pond Outlet

Figure A10-c. Aerial photo of SR500 Gner Rd Pond sampling area

Rural Site Number 1
York Drain - SR524 at York Rd.
Edge-of-pavement Runoff

BMP Location

Driving Directions	This site is located approximately 660 feet west of York Road on the south side of SR 524. The drain is adjacent to an access road for a power transfer station.
ADT	5,000-9,999
Drainage Area	
Percent Impervious	

Sample Site Location

Coordinates (UTM) N	5295920
Coordinates (UTM) E	561003
Site map	Figure A-R1
Sample collection location	Samples will be collected in a passive sampler suspended from a storm drain grate on the south side of SR524.

Sample Collection

Sample collection method	Passive sampler
Tubing Length	N/A
Compositing	First 0.5 hour composite
Sample Bottle Volume	1 liter

Figure A-R1. Aerial photo of the York Drain Sampling area

Rural Site Number 2
York Run-on - SR524 at York Rd.
Run-on

BMP Location

Driving Directions	This site is located approximately 660 feet west of York Road on the south side of SR 524. A 4 inch drain pipe conveys water from an adjacent gravel parking lot into the right-of-way.
ADT	5,000-9,999
Drainage Area	
Percent Impervious	

Sample Site Location

Coordinates (UTM) N	5295916
Coordinates (UTM) E	561006
Site map	Figure A-R2
Sample collection location	Samples will be collected by hand from a 4-inch pipe that drains a gravel parking lot located on the south side of SR524.

Sample Collection

Sample collection method	Grab sample
Tubing Length	N/A
Compositing	N/A
Sample Bottle Volume	1 liter

Figure A-R2. Aerial photo of the York Run-on sampling area

Rural Site Number 3
Outlook Drain - SR96 at Outlook Ridge Homes
Edge-of-pavement Runoff

BMP Location

Driving Directions	This site is located approximately 260 feet downhill and northeast of the entrance to Outlook Ridge Homes on the north side of SR 96, approximatley 2.4 miles from SR9.
ADT	10,000-19,999
Drainage Area	
Percent Impervious	

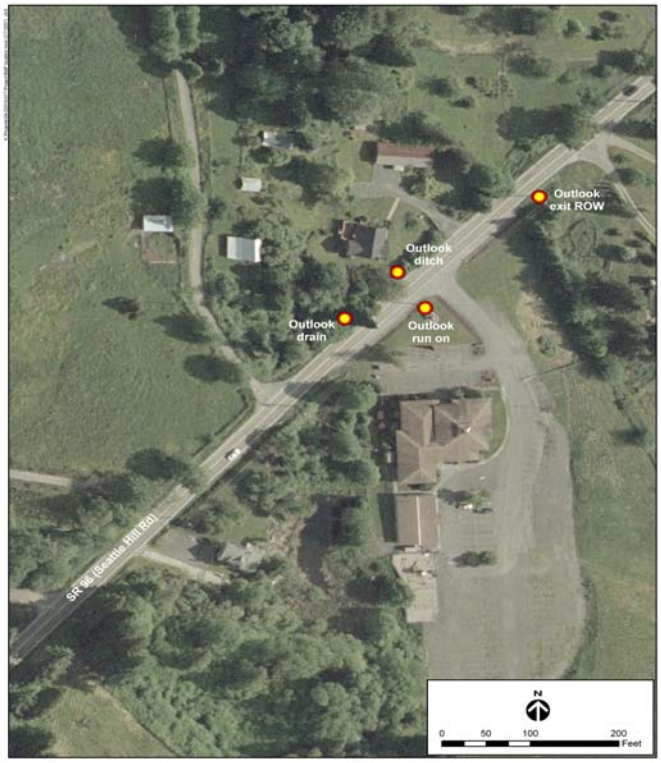
Sample Site Location

Coordinates (UTM) N	5304160
Coordinates (UTM) E	563520
Site map	Figure A-R3
Sample collection location	Samples will be collected in a passive sampler suspended from a storm drain grate on the north side of SR96.

Sample Collection

Sample collection method	Passive sampler
Tubing Length	N/A
Compositing	First 0.5 hour composite
Sample Bottle Volume	1 liter

Figure A-R3. Aerial photo of the Outlook Drain sampling area



Rural Site Number 4
Outlook Ditch - SR96 at Outlook Ridge Homes
Run off

BMP Location

Driving Directions	This site is located approximately 300 feet downhill and northeast of the entrance to Outlook Ridge Homes on the north side of SR 96, approximatley 2.4 miles from SR9.
ADT	10,000-19,999
Drainage Area	
Percent Impervious	

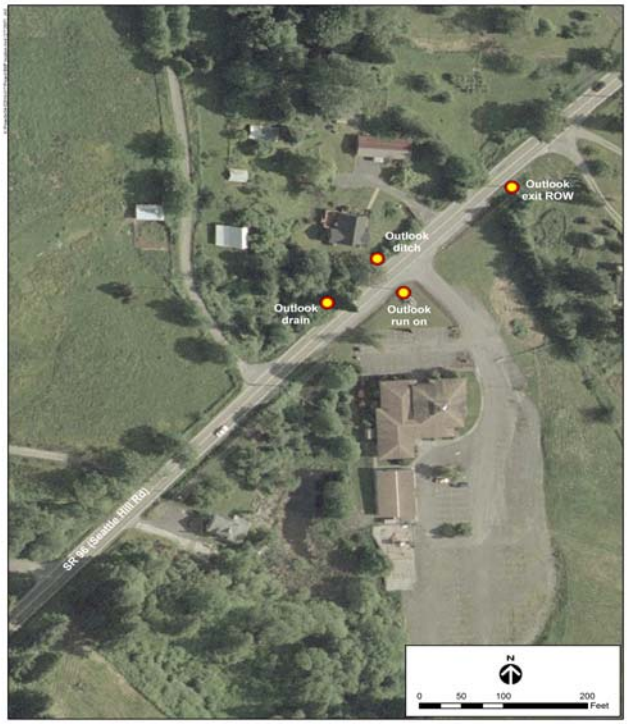
Sample Site Location

Coordinates (UTM) N	5304192
Coordinates (UTM) E	563552
Site map	Figure A-R4
Sample collection location	Samples will be collected in a passive sampler dug into the bottom of a ditch on the north side of SR96. The sample is represnetative of run off treated in a roadside ditch.

Sample Collection

Sample collection method	Passive sampler
Tubing Length	N/A
Compositing	First 0.5 hour composite
Sample Bottle Volume	1 liter

Figure A-R4. Aerial photo of the Outlook Ditch sampling area



Rural Site Number 5
Outlook Run-on - SR96 across from Outlook Ridge Homes
Run-on

BMP Location

Driving Directions	This site is located approximately 260 feet downhill and northeast of the entrance to Outlook Ridge Homes on the south side of SR 96, approximatley 2.4 miles from SR9.
ADT	10,000-19,999
Drainage Area	
Percent Impervious	

Sample Site Location

Coordinates (UTM) N	5304169
Coordinates (UTM) E	563549
Site map	Figure A-R5
Sample collection location	Samples will be collected by hand from a 4 inch pipe that drains a church parking lot on the south side of SR96.

Sample Collection

Sample collection method	Grab sample
Tubing Length	N/A
Compositing	N/A
Sample Bottle Volume	1 liter

Figure A-R5. Aerial photo of the Outlook Run-on sampling area

Rural Site Number 6
Outlook Exit ROW - SR96 across from Outlook Ridge Homes
Run off

BMP Location

Driving Directions	This site is located approximately 400 feet downhill and northeast of the entrance to Outlook Ridge Homes on the south side of SR 96, approximatley 2.4 miles from SR9.
ADT	10,000-19,999
Drainage Area	
Percent Impervious	

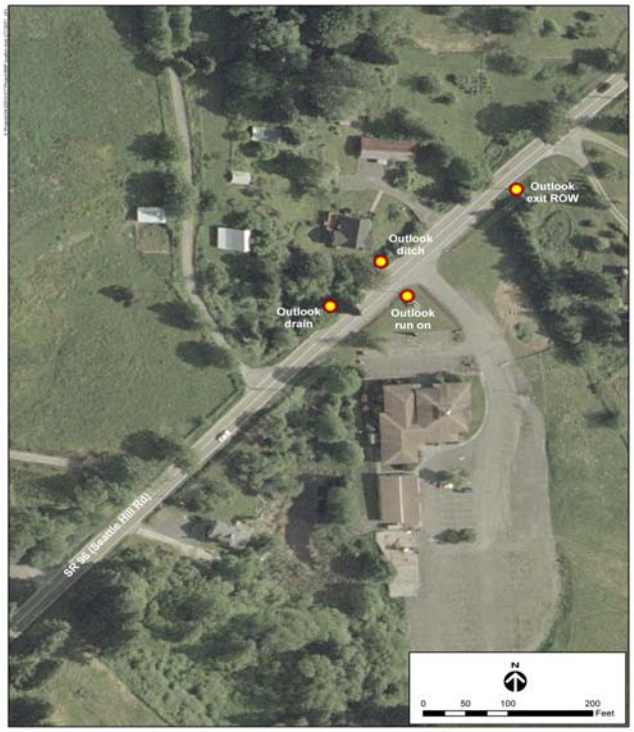
Sample Site Location

Coordinates (UTM) N	5304016
Coordinates (UTM) E	563581
Site map	Figure A-R6
Sample collection location	Samples will be collected by hand from a ditch upstream of the confluence with a small creek on the south side of SR96. The water at this site is primarlity from run-on from site 5.

Sample Collection

Sample collection method	Grab sample
Tubing Length	N/A
Compositing	N/A
Sample Bottle Volume	1 liter

Figure A-R6. Aerial photo of the Outlook Exit ROW sampling area



Rural Site Number 7
Maytown - Hwy 121 near I-5
Run off

BMP Location

Driving Directions	This site is located on Hwy 121, about 0.7 miles east of I-5. There is a pulloff at the 2nd bridge, and the sampler is located below the bridge.
ADT	0-1,999
Drainage Area	
Percent Impervious	

Sample Site Location

Coordinates (UTM) N	5193625
Coordinates (UTM) E	504015
Site map	Figure A-R7
Sample collection location	Samples will be collected by a passive sampler suspended below a bridge scupper.

Sample Collection

Sample collection method	Passive sampler
Tubing Length	N/A
Compositing	First 0.5 hour composite
Sample Bottle Volume	1 liter

Figure A-R7.Aerial photo of the Maytown sampling area

Rural Site Number 8
Skookumchuck - SR507 between Centralia and Bucoda - Hwy 121 near I-5
Run off

BMP Location

Driving Directions	This site is located on SR 507, between Centralia and Bucoda, on the more northerly bridge over the Skookumchuck River. There is a pulloff at the bridge, and the sampler is located below the bridge.
ADT	2,000-4,999
Drainage Area	
Percent Impervious	

Sample Site Location

Coordinates (UTM) N	5179949
Coordinates (UTM) E	505858
Site map	Figure A-R8
Sample collection location	Samples will be collected by a passive sampler suspended below a bridge scupper.

Sample Collection

Sample collection method	Passive sampler
Tubing Length	N/A
Compositing	First 0.5 hour composite
Sample Bottle Volume	1 liter

Figure A-R8. Aerial photo of the Skookumchuck sampling area

Rural Site Number 9
Shaw Rd. – Shaw Rd. and SR 507
Run on

BMP Location

Driving Directions	This site is located at the southeast corner of Shaw Rd. and SR 507, on the southern edge of Yelm.
ADT	5,000-9,999
Drainage Area	
Percent Impervious	

Sample Site Location

Coordinates (UTM) N	5197194
Coordinates (UTM) E	528096
Site map	Figure A-R9
Sample collection location	A passive sampler will collect sheet flow from Shaw Rd. and SR 507. The flow from the pavement is caught by plastic sheeting that guides it to the passive sampler.

Sample Collection

Sample collection method	Passive sampler
Tubing Length	N/A
Compositing	First 0.5 hour composite
Sample Bottle Volume	1 liter

Figure A-R9. Aerial photo of the Shaw Rd. sampling area

Rural Site Number 10
Hwy 702 – Hwy 702, just west of Hwy 7
Run off

BMP Location

Driving Directions	This site is located on Hwy 702, just west of Hwy 7, near the mailbox of 1314 350th St.
ADT	2,000-4,999
Drainage Area	
Percent Impervious	

Sample Site Location

Coordinates (UTM) N	5198350
Coordinates (UTM) E	547845
Site map	Figure A-R10
Sample collection location	A small portion of the road gradually pools water towards the edge of the road, where a 2.5 foot wide paved shoulder will lead the flow to the plastic collection sheeting and into the passive sampler.

Sample Collection

Sample collection method	Passive sampler
Tubing Length	N/A
Compositing	First 0.5 hour composite
Sample Bottle Volume	1 liter

Figure A-R10. Aerial photo of the Hwy 702 sampling area

APPENDIX B

Example Field Log Sheet

FIELD LOG SHEET and FLOW DATA VALIDATION

Field Staff:_____ Site:_____ Weather:_____

Maintenance Visit

Date/Time:

Sub Site:		**Sub Site:**		**Sub Site:**	
Time Correct?		Time Correct?		Time Correct?	
Autosampler Level:		Autosampler Level:		Autosampler Level:	
Measured Level:		Measured Level:		Measured Level:	
Data Downloaded?		Data Downloaded?		Data Downloaded?	
Volts:		Volts:		Volts:	
Volume Calibrated?		Volume Calibrated?		Volume Calibrated?	
Measured Velocity:		Measured Velocity:		Measured Velocity:	
Autosampler Velocity:		Autosampler Velocity:		Autosampler Velocity:	
Dessicant:		Dessicant:		Dessicant:	
Notes:		Notes:		Notes:	

Pre-Storm Visit

Date/Time:

Time Correct?		Time Correct?		Time Correct?	
Autosampler Level:		Autosampler Level:		Autosampler Level:	
Measured Level:		Measured Level:		Measured Level:	
Data Downloaded?		Data Downloaded?		Data Downloaded?	
Volts:		Volts:		Volts:	
Clean Bottles?		Clean Bottles?		Clean Bottles?	
Volume Calibrated?		Volume Calibrated?		Volume Calibrated?	
Pacing Adjusted?		Pacing Adjusted?		Pacing Adjusted?	
Program Started?		Program Started?		Program Started?	
Rain Gauge:		Rain Gauge:		Rain Gauge:	
Notes:		Notes:		Notes:	

Post-Storm Visit

Date/Time:

Sampling Complete?		Sampling Complete?		Sampling Complete?	
Date/Time End:		Date/Time End:		Date/Time End:	
# of Samples:		# of Samples:		# of Samples:	
Errors?		Errors?		Errors?	
Est. Sample Vol:		Est. Sample Vol:		Est. Sample Vol:	
Bottles Replaced?		Bottles Replaced?		Bottles Replaced?	
Data Downloaded?		Data Downloaded?		Data Downloaded?	
Sent to Lab?		Sent to Lab?		Sent to Lab?	
Sample Dupped?		Sample Dupped?		Sample Dupped?	
Volts:		Volts:		Volts:	
Grab Sample?		Grab Sample?		Grab Sample?	
Notes:		Notes:		Notes:	

Flow Data Validation

Storm Depth:		Storm Depth:		Storm Depth:	
% Storm Sampled:		% Storm Sampled:		% Storm Sampled:	
Ant. Dry Time:		Ant. Dry Time:		Ant. Dry Time:	
Storm Volume:		Storm Volume:		Storm Volume:	

QAPP targets for Storm Depth = 0.15 - 0.25 in; % Storm Sampled = >75%; Antecedent Dry Time = 24 hr with <0.02 in

Additional Notes: