DEPARTMENT OF
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Quality Assurance Project Plan for Status and Trends Monitoring of Small Streams in the Puget Lowlands Ecoregion

for Monitoring Conducted using Pooled RSMP Funds contributed by Western Washington Municipal Stormwater Permittees

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This template Quality Assurance Project Plan is available on the Department of Ecology's Regional Stormwater Monitoring Program (RSMP) website for National Pollutant Discharge Elimination System (NPDES) municipal stormwater permittees at http://www.ecy.wa.gov/programs/wq/stormwater/municipal/status.html.

Data for the RSMP will be available on Ecology's Environmental Information Management (EIM) website at www.ecy.wa.gov/eim/index.htm. Search Study ID, RSMP_PLES2015.

Contact information

Washington State Department of Ecology
Brandi Lubliner, RSMP Coordinator
PO Box 47600
Olympia, WA 98504-7710

Washington State Department of Ecology - www.ecy.wa.gov

- Headquarters, Olympia 360-407-6000
- Northwest Regional Office, Bellevue 425-649-7000
- Southwest Regional Office, Olympia 360-407-6300

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Approved by:

Signature: Signed — Date: 11/26/2014
Ecology's Water Quality Program, Program Development Services Section Manager

Signature: Signed — Date: 11/26/2014
Ecology's Stormwater Work Group Staff

Signature: Signed — Date: 11/26/2014
Ecology's RSMP Coordinator

Table of Contents

Page

List of Figures and Tables

Page

Figures

Tables

Introduction

Development of a Stormwater Monitoring Strategy for the Puget Sound Region

The Stormwater Work Group (SWG) is a coalition of federal, tribal, state, and local governments; business, environmental, and agricultural entities; and academic researchers. All SWG members have interests and a stake in the Puget Sound watershed. The SWG was convened by the Puget Sound Partnership (PSP) and the Washington State Department of Ecology (Ecology) in October 2008 to develop a regional stormwater monitoring strategy and to recommend monitoring requirements in National Pollutant Discharge Elimination System (NPDES) stormwater permits issued by Ecology. In 2012, the SWG became the first “topical workgroup” included in the Puget Sound Ecosystem Monitoring Program (PSEMP), an organization designed to coordinate regional monitoring efforts to assist in providing information to support Puget Sound recovery efforts.

An overall strategy for stormwater monitoring and assessment for the Puget Sound region was developed by the SWG in 2010 (SWG, 2010a). This strategy, summarized in Appendix A, included recommendations for status and trends monitoring in small streams and in the Puget Sound nearshore, with a focus on an integrated approach to quantify stormwater pollutant impacts in Puget Sound. The strategy also provided information to efficiently, effectively, and adaptively manage stormwater to reduce harm to the ecosystem.

The SWG recommended a specific NPDES municipal permittee-funded plan for monitoring the effects of stormwater under the permits in the Puget Sound region (SWG, 2010b). The resulting program, a subset of the overall strategy, is called the Regional Stormwater Monitoring Program (RSMP). Specifically, the RSMP includes status and trends monitoring of water quality and "watershed health" (physical habitat, sediment chemistry, and biological communities) in small streams in the Puget Sound lowlands; and of sediment quality, bacteria, and mussel contaminants in the marine nearshore of Puget Sound. All the RSMP status and trends monitoring follows a probabilistic design (SWG, 2010a) that is compatible with ongoing status and trends monitoring programs such as Ecology’s statewide monitoring program entitled *Status and Trends Monitoring for Watershed Health and Salmon Recovery* (WHSR) (Cusimano et al., 2006). Additional information about the experimental design, the goals, and the objectives for status and trends and other monitoring in the RSMP can be found in Appendix A of this report, in SWG (2010a and 2010b), and at the RSMP website www.ecy.wa.gov/programs/wq/stormwater/municipal/status.html.

Scope of this Quality Assurance Project Plan

Ecology issued NPDES municipal stormwater permits for Phase I and Phase II communities (Ecology, 2012a,b) effective August 2013 through July 2018 with specific programmatic requirements to manage stormwater discharges to and from municipal separate storm sewer systems. To fulfill an ongoing need to collect information that supports adaptive management of the permits' stormwater management requirements, all permittees located in Puget Sound were given two options to comply with the permits' Special Condition S8.B for status and trends monitoring.

Option 1: Pay a prescribed amount into a pooled fund to support RSMP Status and Trends monitoring. The permittee role is limited to providing permit-defined amounts of funding for coordinated implementation of monitoring at sites throughout the Puget Sound region.

Or

Option 2: Conduct their own status and trends monitoring at specific, assigned sites inside their jurisdictional boundaries, following the same protocols as those used for the RSMP.

Nearly all 81 of the 83 permittees located in the Puget Sound watershed officially selected the first option. The City of Redmond and Pierce County officially selected the second option.

The RSMP is funded by the municipal permittees that selected Option 1, and administered by the Washington State Department of Ecology (Ecology) under the direction of the Pooled Resources Oversight Committee (PRO-Committee) of the SWG.

This Quality Assurance Project Plan (QAPP) defines the permit-required small streams status and trends monitoring that will be conducted by the RSMP using the pooled funds contributed by the 81 permittees who chose the first option. This QAPP prepared for the Pooled Funds RSMP small streams monitoring contains the same site confirmation and sampling protocols as the "RSMP QAPP" developed for the two Option 2 permittees. The RSMP QAPPs were prepared in accordance with Ecology's QAPP guidelines (Lombard and Kirchmer, 2004) and are Ecology-approved.

An addendum to this QAPP will be written in 2015 to further describe the analysis and the process for a RSMP small streams data report.

Roles and Responsibilities

As the administrator of the RSMP, Ecology's RSMP coordinator has formed a small streams monitoring team made up of federal, state, and local government entities to conduct the monitoring for small streams in the Puget Sound lowlands. King County, Skagit County, United States Geological Survey (USGS) and the San Juan Conservation District will conduct the RSMP streams sampling. These entities are referred to as "RSMP Contractors" in this document. The RSMP contractors will conduct monitoring at suitable sites in small streams from January to December of 2015. The key dates for the monitoring activities including site confirmation, field and laboratory work, data entry into Ecology's Environmental Information Management (EIM) database, and submission of monitoring summary reports, are summarized in Table 1. Ecology and RSMP contractor responsibilities for activities detailed in this QAPP are listed in Table 2.

Table 1. Key dates for QAPP completion, monitoring activities, and reports for status and trends monitoring in small streams.

Due	Item	Description
June 30, 2014	Site selection and verification	USGS contract deliverable of confirmed sites to be monitored, including sufficient additional sites to sample if sampling attempted at any of the original sites is unsuccessful.
October 25, 2014	Draft RSMP Streams QAPP due	RSMP Coordinator edits QAPP based on comments from RSMP PRO-Committee or other key monitoring implementation reviewers.
November 30, 2014	RSMP Streams QAPP	Final RSMP Streams QAPP available; posted on RSMP website.
January - December 2015	Water quality sampling	RSMP streams monitoring team conducts water quality sampling at the required number of lowland stream sites.
July 1 - October 15, 2015	Watershed health sampling	RSMP streams monitoring team conducts watershed health (physical habitat, sediment chemistry, and biological) sampling at the required number of lowland stream sites.
June 30, 2015	Draft RSMP Streams QAPP addendum due	Addendum describing analysis and reporting approach and requirements submitted to PSEMP work groups (freshwater, stormwater and/or RSMP PRO-Committee).
September 15, 2015	QAPP Addendum review complete	PSEMP and key monitoring reviews provide review of QAPP addendum within 30 days.
November 30, 2015	Addendum to this QAPP complete	RSMP Coordinator finalizes addendum and posts to RSMP website.
December 31, 2016	Electronic data submittal due	All QA/QC'ed data submitted to Environmental Information Management (EIM) database.
March 31, 2016 and March 31, 2017	Permittees' stream monitoring reports due	Summary reports submitted to Ecology from Redmond and Pierce County.
December 30, 2017	RSMP Final Report	Final report on the status of small streams in the Puget Sound lowland ecoregion.

Table 2. Project staff and responsibilities.

Implementation of Stormwater Permit Monitoring		
Name/Contact	**Role**	**Responsibility**
Brandi Lubliner, PE brandi.lubliner@ecy.wa.gov Ecology - WQP 360-407-7140	RSMP Coordinator	RSMP Coordinator manages ongoing implementation and administration of the RSMP; develops QAPP; coordinates laboratory selection; and oversees contracts; verifies whether QAPP is followed and monitoring data are of known and acceptable quality; ensure adequate training of staff, complies with corrective action requirements.
Richard Dinicola, USGS	Site Verification	Confirmed small stream sites as suitable from the candidate site list.
Michael See, Skagit County Colin Elliott, King County Linda Lyshall, San Juan Conservation District Rich Sheibley, USGS	RSMP Stream Monitoring Team Contacts	RSMP Contractors will manage and oversee monitoring activities and sampling decisions; coordinate laboratory deliveries and equipment maintenance; and manage field teams.
Rick Haley, Skagit County Colin Elliott, King County Linda Lyshall, San Juan Conservation District Rich Sheibley, USGS	Monitoring Team Field Leads	RSMP Contractors will collect and process field samples, and oversee field assistants.
Colin Elliott, King County Environmental Laboratory	Laboratory Coordination	Coordinate supplies and sample delivery with field crews, laboratory analysis, laboratory QC, and delivery of results to the RSMP Coordinator.
Joel Bird, Nancy Rosenbower, and Leon Weiks, Ecology-Manchester Environmental Laboratory	Laboratory Coordination	Coordinate supplies and sample delivery with field crew, laboratory analysis, laboratory QC, and delivery of results to the RSMP Coordinator.
Ecology - WQP staff, Lacey, WA	EIM Data Review	Reviews and QAs data submitted by permittees and RSMP Contractors.
Ecology - EAP staff, Lacey, WA	Watershed health database coordinator	Reviews and QAs data submitted by permittees and RSMP Contractors.

EAP: Environmental Assessment Program
EIM: Environmental Information Management database
USGS: United States Geological Survey
WQP: Water Quality Program

Coordination and Training

The monitoring team members and staff will assist with coordination and procurement of equipment and supplies. Team members and staff will participate with field staff in a one-day field-based training for watershed health sampling. The training will be held in summer 2015 prior to conducting that sampling. This activity involves hands-on training at a field monitoring site to ensure comparability of results for both programs.

Sampling Site Selection and Evaluation

The sampling site selection and evaluation process described in this section of the QAPP concerns selecting suitable sites for inclusion in the RSMP based largely on a field visit to candidate sites before the sampling begins. Additional site suitability details that are considered on the day of sampling are described in the specific sections of this QAPP detailing the sampling methods.

Evaluation

RSMP sampling sites have been selected from a list of candidate sites referred to as the Master Sample Site list. With the exception of the sites within the jurisdictions of the City of Bellingham, unincorporated Pierce County, and the City of Redmond, the stream sites from the master list were evaluated for suitability by USGS under a contract using RSMP pooled funds.

Site evaluations, including a field visit to each candidate site, determined the suitability of each site for monitoring to meet the RSMP goals. Site suitability was determined by selection criteria related to accessibility, hydrologic and geomorphic characteristics (flow, physical features, and salinity), and location relative to a candidate sites' original coordinates.

Candidate sites for evaluation were selected from the Master Sample Site list generated for Puget Lowland ecoregion streams that drain to Puget Sound. Within that area, candidate sites were specified within each of the assessment regions: inside the Urban Growth Area (UGA) boundaries, and outside the UGA boundaries. Site evaluations began with the priority list of the initial 100 RSMP candidate sites, with 50 for each assessment region shown in the following "Site Lists" section. Desktop evaluation of candidate sites was performed in advance of the initial site evaluation visit, and will include comparing candidate site coordinates to existing information on such items as surficial geology, parcel/property ownership, NHD waterbody type, historical stream flow and/or water quality data, and aerial photographs. For all of the initial candidate sites deemed unsuitable for monitoring, additional candidate sites for the relevant assessment region were evaluated in the numerical order listed in the Master Sample Site list (from lowest to highest in the ORDER column).

Documentation of Site Evaluations

The initial RSMP site evaluation process was completed in June 2014 in advance of the sampling season by the USGS. A list of 50 suitable sites in each assessment category (inside and outside the UGA) was developed based on site visits. This list was further refined based on additional site visits by RSMP Contractors during summer low flow months. The final RSMP small stream sites that will be monitored using pooled funds are listed below in Tables 4-5.

All RSMP sites were evaluated using the same suitability criteria. This includes the Option 2 permittees and the sites in their jurisdictions, who supplied their list of final sites to the RSMP Coordinator in June 2014. Selected and rejected sites are available on the RSMP webpage www.ecy.wa.gov/programs/wq/stormwater/municipal/status.html.

Mid-Study Changes Affecting Site Suitability

If a site becomes unsuitable for sampling during the course of the study, the RSMP Coordinator will be notified. Reasons a site may be come unsuitable include, but are not limited to: a stream goes dry; the adjacent parcel(s) change ownership, and the new owner does not grant permission; or natural causes such as mudslides or animals make the site no longer safe to access.

If suitability conditions change prior to sampling a site for watershed health and sediment chemistry and the site is no longer suitable, then a new RSMP site needs to be identified from the list in order. If suitability conditions change after sampling the site for watershed health and sediment chemistry and the site is no longer suitable, sampling will simply discontinue for this round of RSMP sampling and conditions noted on the site lists.

Criteria for Selecting a Suitable Sampling Site

The process may need to continue through the sampling season as necessitated by potential changes in site conditions that affect suitability for sampling. Selection criteria for determining the suitability of a candidate site for monitoring to meet the RSMP goals are described below.

Accessibility Criteria

These criteria concern whether land owners permit access to a site , and if the site can be safely accessed and sampled throughout the year. A site may also be deemed unsuitable, or impracticable, for sampling certain if more than one hour is required to access the site from the nearest parking location.

Permission

If a candidate site is not obviously accessible through public property, property owners and/or tenants whose property will need to be accessed will, if feasible, be contacted prior to site evaluation. Parcel information gained from the desktop evaluation will be researched and a good faith effort to contact owners or tenants will be made. A site will be deemed unsuitable for sampling if permission has been denied by all land owners, tenants, or resource managers along the entire hydrologic reach (see *Location Criteria*, below). The Washington State Department of Natural Resources (WDNR, 2010) describes how to discern public and state-owned waters.

Safety

Overall safety conditions for access and sampling will be assessed prior to sampling, based on state and federal law and organizational policy. But it is ultimately the responsibility of the field crew at each time of arrival to decide if it is safe to enter the stream to conduct the sampling. Appropriate reasons for disqualifying a site from sampling may include:

- flow is too swift or too deep;
- route of entry is unstable;
- hostile people or animals are present.

Flow, Physical, and Salinity Criteria

These criteria concern the conditions of the stream and streambed with regard to the specific types of data desired for the RSMP. To be considered a suitable sampling site, the waterbody at the candidate site coordinates must be on a stream or small wadeable river, and not on a lake, pond, wetland, or estuary. Specifically, the waterbody must have:

- a net flow of water that is unidirectional;
- defined left and right banks readily discernible from mid-stream;
- uninterrupted surface-water flow for more than half the length of approximately 20 bankfull widths or a minimum of 150 meters surrounding the candidate site coordinates;
- perennial flow (as best as can be determined at the time of the site visit);
- flow in a natural channel that might have been highly modified, but was not constructed (such as canals, ditches, or pipelines);
- natural substrate on the channel bottom;
- freshwater, as defined by a water column with more than 95 percent of its depth with less than 1 part per thousand salinity at any time during the year. Multiple lines of evidence may be used to make this estimation (*e.g.*, vegetation, proximity to a known estuary, or salinity measurement).

Location Criteria

The following location rules apply such that the site reflects the intended probabilistic stream characteristics.

- ➢ During the site evaluation field visit, the field crew will attempt to access the site at the given coordinates or as nearby as possible, with recognition of the challenges of sampling in urban areas, particularly in gaining access to discretely defined locations. Ideally, a suitable sampling location will be located within 250 meters of the given candidate site coordinates.
- ➢ If access, flow, physical, and chemical criteria are not met within this distance, the field crew may continue to investigate locations upstream and downstream of the initial reach with the objective finding a suitable site that maintains the original candidate site characteristics.
- ➢ Suitable sampling sites upstream and downstream of the candidate site coordinates must fall within these constraints:
  - the final site is the same size class of the original candidate site; and
  - there are no continuous surface-water inflows in excess of approximately 25 percent of the flow already in the reach[1]; and
  - either :
    - o there is no substantial, abrupt change in adjacent land use such as from residential to industrial, or from native vegetation to developed conditions; or
    - o the final site is less than 500m from the original candidate site coordinates.

The RSMP will determine how to interpret (*i.e.*, statistically weight) the data from all of the sites sampled by permittees who have chosen to conduct their own monitoring.

[1] During the site confirmation process, questions about a how specific reach is defined were directed to RSMP Coordinator Brandi Lubliner at 360-407-7140.

Site Lists

Pooled fund sites suitable small stream sites are listed in Table 3 by physical location, strata, monitoring agenda, and RSMP Contractor. Sites are shown in Figure 1 and are also available on Ecology's RSMP website at www.ecy.wa.gov/programs/wq/stormwater/municipal/status.html.

Table 3. Tally of sites by location, RSMP Contractor conducting the monitoring, strata and monitoring type (monthly water quality or watershed health).

County (RSMP Contractor if different)	UGA Strata	Sites to be monitored for WQ and WH (WQ site ≤#71 for outside UGA; WQ site ≤ #55 for within UGA)	WQ +WH Count	Maybe	Sites monitored only for WH (Summer only)	WH Count
King	Outside	8,24,38,45,47	5		69,72,74,86,94,98	6
King	Inside	1,2,34,36,40,42,55	7		61,67,70,74,80,82, 84	7
Snohomish South (King)	Outside	11,39	2		79	1
Snohomish South (King)	Inside	3,9,18,48,50	5		65,68,77,79,85	5
Skagit and USGS[1]	Outside	19,20,27,44	4		75	1
Skagit and USGS[1]	Inside	15, m45	2	m45		
Snohomish North (USGS)	Outside	50	1		71,76,78,80,89	5
Snohomish North (USGS)	Inside	38,44,47	3			
Whatcom (USGS)	Outside	32	1		96,97	2
Whatcom (USGS)	Inside	16, 21	2		64	1
Pierce (USGS)	Outside					
Pierce (USGS)	Inside	4,5,23	3		63,81	2
Kitsap (USGS)	Outside					
Kitsap (USGS)	Inside	6,19,30,33	4			
Thurston (USGS)	Outside	m22, 28,30,60	5	m22		
Thurston (USGS)	Inside	20,24	2		62	1
Mason (USGS)	Outside	1,25,46,56,59	5		83	1
Mason (USGS)	Inside	0, 25	2			
Jefferson (USGS)	Outside	54	1			
Jefferson (USGS)	Inside					
San Juan and USGS[1]	Outside	6	1			
San Juan and USGS[1]	Inside					
Clallam (USGS)	Outside	9,26,33,37,42	5		84,93	2
Clallam (USGS)	Inside	17	1		87	1

[1]=Skagit County or San Juan Islands Conservation District (SJICD) will monitor for WQ and USGS will conduct summer WH monitoring.

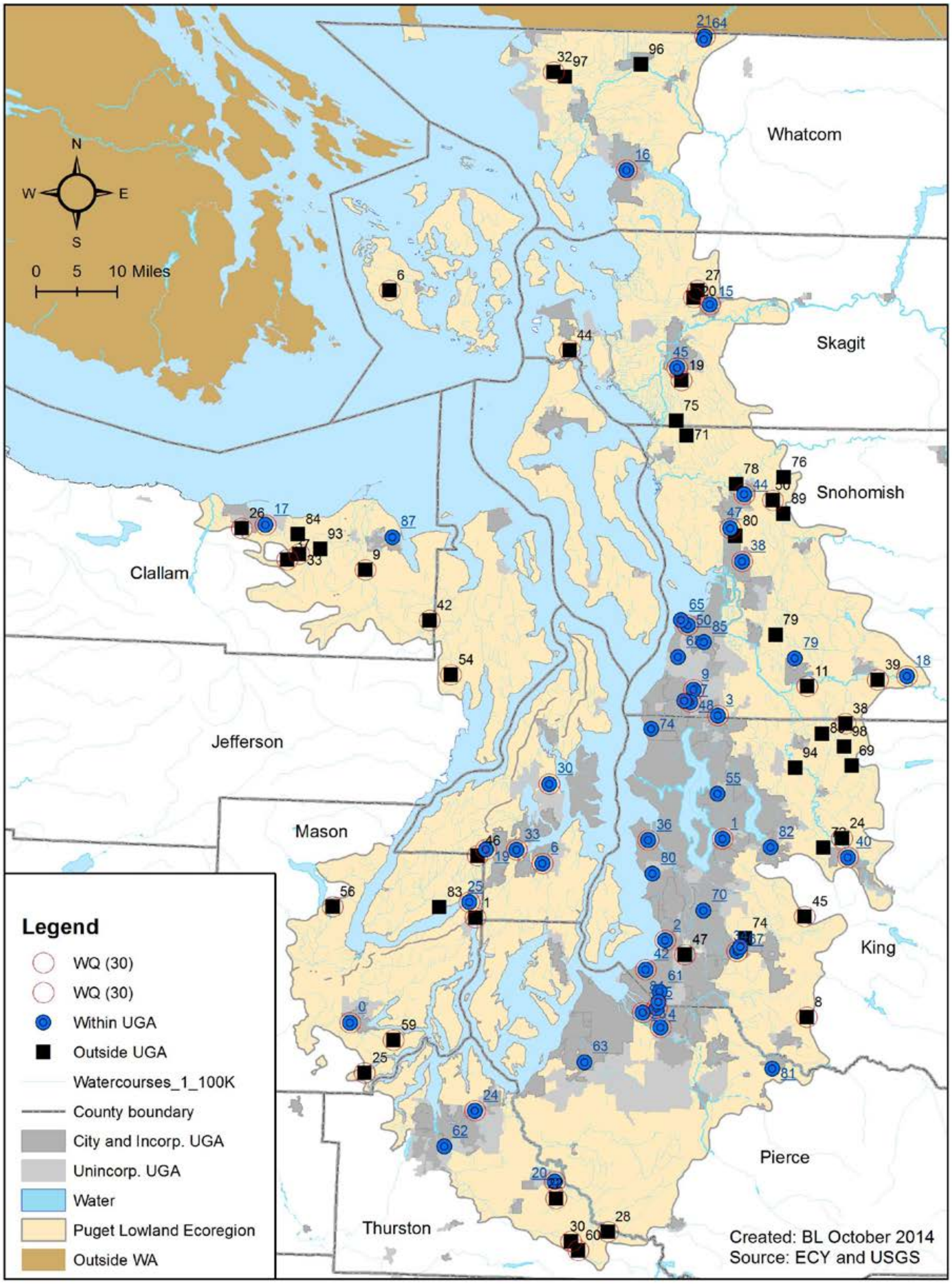

Figure 1. USGS verified suitable small stream site locations for the UGA and non-UGA assessment areas in the Puget Lowlands Ecoregion for the RSMP.

Table 4. RSMP Puget Lowland Stream Sites Within UGA found suitable for sampling

Monitoring: Both (WQ+WHM) or WHM	Monitored by Team Member	Tally count	Strata	ORDER	County	Longitude	Latitude	WC_GNIS_NM	Trip Notes
Both	USGS	1	WUGA	**0**	Mason County	-123.138842	47.212238	Goldsborough Creek	Site meets criteria and is accessed using public trails at the end of W. Hulbert Rd. Original coordinates for sampling will work.
Both	USGS	2	WUGA	**1**	King County	-122.170087	47.559867	Coal Creek	Good access at pipeline gate off of Coal Creek Parkway. Good amount of flow with cobble/gravel bed, site meets all criteria.
Both	USGS	3	WUGA	**2**	King County	-122.315089	47.375259		Sampling site is in State Park campground with easy access. Site meets criteria and can be sampled at original coordinates.
Both	King	4	WUGA	**3**	Snohomish County	-122.18943	47.780422	North Creek	Easy access below pedestrian bridge off of 240th St. SE. Site meets criteria at original coordinates.
Both	USGS	5	WUGA	**4**	Pierce County	-122.322624	47.219225	Wapato Creek	Site is accessed using farmer's dirt road alongside stream. Parking just off of Freeman Rd and meets all criteria. Access to original point is possible.
Both	USGS	6	WUGA	**5**	Pierce County	-122.333499	47.253482	West Hylebos Creek	Site is accessible from bridge near original point off of HWY 99. Stream is braided close to point, but downstream of the bridge will work.
Both	USGS	7	WUGA	**6**	Kitsap County	-122.644583	47.508186	Blackjack Creek	Can walk to through vacant lot and down a steep bank off of Sherman Avenue and access original coordinates.
Both	King	8	WUGA	**9**	Snohomish County	-122.255255	47.825567	Swamp Creek	Good access off of Magnolia road at old Snohomish County gauging site. Swamp Creek follows slightly different path than plotted reach. Can sample directly at original coordinates.
Both	Skagit	9	WUGA	**15**	Skagit County	-122.234445	48.516929	Willard Creek	Channel for Willard Creek was plotted incorrectly, but it will work where it crosses N. Reed Street which is within about 400 meters of original point.
Both	USGS	10	WUGA	**16**	Whatcom County	-122.468	48.753304	Whatcom Creek	Whatcom Creek Trail Easement. City-owned, easy access to creek.
Both	USGS	11	WUGA	**17**	Clallam County	-123.410056	48.098573	White Creek	Nice site behind Peninsula Community College, easy trail access from parking lot behind tennis courts. Site meets all criteria and can be sampled at original coordinates.
Both	King	12	WUGA	**18**	Snohomish County	-121.687737	47.857207	May Creek	Stream has multiple access points around original coordinates. Could not access stream behind residential homes. Easiest access off of Evergreen and Evergreen at suggested coordinates. In high flows will not be able to wade to get to original coordinates.
Both	USGS	13	WUGA	**19**	Kitsap County	-122.794589	47.530155		Site is accessed on Bremerton Watershed property; ~20 minute hike to the site, Locked gate is accessible by talking with City of Bremerton. A good sampling point is ~200 meters downstream of the original point. Original point is ponded water from beaver activity.
Both	USGS	14	WUGA	**20**	Thurston County	-122.590177	46.93826	Yelm Creek	Hard to define stream banks, flow is through a grass field. During periods of higher flow stream likely creates different channels. Higher up in reach the stream has better defined stream banks but is further than 500 meters. Thurston Co - has been sampling this site for years, just discontinued. There is a weir and staff gage. Big loosing reach up on the prairie, the lower Yelm creek is heavily groundwater influenced.
Both	USGS	15	WUGA	**21**	Whatcom County	-122.264225	48.996864	Johnson Creek	Easy access to original coordinates in Sumas City Park. Streambed is very soft which will lead to problems wading during high flows. Discharge measurement could be made from bridge during high flows.
Both	USGS	16	WUGA	**23**	Pierce County	-122.370452	47.245261	Wapato Creek	Easy access at 12th St E. different enough from 4 to be worth sampling Can access off of Alexander Ave behind Marine Consultants building. Site has well defined stream banks and meets sampling criteria. Exact coordinates can be reached.
Both	USGS	17	WUGA	**24**	Thurston County	-122.804292	47.061007	Woodland Creek	Site meets criteria, and is perennial downstream of fish hatchery. Safe access point is on north side of I-5, at Draham Road, although not on NHD layer. Thurston Co - is sampling this site for years. There is a staff gage at Draham Road.
Both	USGS	18	WUGA	**25**	Mason County	-122.834787	47.434662		Site meets criteria but has minimal flow, not sure if it is perennial. Original coordinates work for access.
Both	USGS	19	WUGA	**30**	Kitsap County	-122.632377	47.650827		Access is from parking on NE Gulds Pond Road., Sampling point is slightly downstream from original point to avoid culvert for benthic sampling.

Both	USGS	20	WUGA	**33**	Kitsap County	-122.714191	47.530723	Gorst Creek	Site meets criteria, park at gate off of W. Belfair Valley Rd. Same gate to use for site 57, easy hike to original coordinates. Sampling point is downstream of confluence of Gorst and Heines Creek. Parish Creek inflow marks the end of the defined reach, but appears to be less than 25% of overall flow (therefore reach should be long enough for benthic sampling).
Both	King	21	WUGA	**34**	King County	-122.125217	47.358357	Little Soos Creek	Good access, site is used for a gage (non-USGS) right next to original coordinates. Park at Covington Storage, path down to stream.
Both	King	22	WUGA	**36**	King County	122.366763	47.55413		Longfellow creek just above golf course. Easy access from SW Brandon St. and Greg Davis Park. Easy to get within 100 meters of original point.
Both	USGS	23	WUGA	**38**	Snohomish County	-122.133609	48.057884	Munson Creek	Good access off of Northpoint Park Trail, park at 67th St NE and hike to point on trail. Original coordinates should work fine.
Both	King	24	WUGA	**40**	King County	-121.837039	47.530665	Kimball Creek	Accessed through vacant lot, stream looks good. Better access where it crosses 76th, but off of original reach so original coordinates are given for preferred. Stream meets all criteria.
Both	King	25	WUGA	**42**	King County	-122.365473	47.322384		No defined channel above 509, but maybe below. In extensive outwash deposits so may not flow on surface. Park at gate near Lakota Sewage Treatment Plant, and walk to site. Long enough reach for benthic, but heavily vegetated. Site meets requirements. Point is ~400 meters from original coordinates
Both	USGS	26	WUGA	**44**	Snohomish County	-122.130527	48.177787		Accessible where stream crosses 74th Ave. Upstream side of 74th is better than downstream and closer to the actual point. Stream meets criteria.
Both	Skagit	27	WUGA	**m45**	Skagit County	-122.318468	48.401734		Low flow, but easy access off of Anderson Rd. and trail down from private yard. No one home, need to contact for permission to cross. Oct2014- Site is good, but will depend on access from railroad permission.
Both	USGS	28	WUGA	**47**	Snohomish County	-122.167267	48.116288		Good access off of 47th, lots of vegetation growth, maybe low flow during late summer. Site meets criteria.
Both	King	29	WUGA	**48**	Snohomish County	-122.263128	47.803505		Old gaging site off of Oakway, better defined channel here than downstream, sample from upstream side of Oakway at given coordinates. Site meets criteria.
Both	King	30	WUGA	**50**	Snohomish County	-122.274786	47.940925		Park at ETW (welding company near Boeing campus) parking lot adjacent to gated road. Use gravel rd. access past yellow gate. Ecology restoration site, easy access.
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WHM only	King	31	WUGA	**55**	King County	-122.185817	47.640092	Yarrow Creek	Good flow volume, will need to decide where to sample in relation to pasture and natural channel. Original coordinates are in pasture with cows and horses (will make it hard for benthic survey). Natural channel on the other side of 116th Ave NE, would suggest sampling here.
WHM only	King	32	WUGA	**61**	King County	-122.327168	47.283291	West Hylebos Creek	Site will work at point downstream of original coordinates, at USGS 12102920 site. In wetland; may not be a discernible channel. Original location is in a wetland park, but downstream on the same reach is a good sampling point where the stream is well defined. Parking is at old blueberry park off of SW 356 St, trail down to stream. October 7, 2014 King County says this site meets criteria.
WHM only	USGS	33	WUGA	**62**	Thurston County	-122.881906	46.995385	Deschutes River	River was too high to wade at the time of access, otherwise meets criteria. If wade-able in the summer than could get discharge and WQ sample from bridge. October 8, 2014 Wadeable in late summer. One mile upstream of brewery, 200 feet downstream of soccer fields on Henderson. USGS gage at brewery.
WHM only	USGS	34	WUGA	**63**	Pierce County	-122.520315	47.153806	Clover Creek	Public access point off Pacific Highway S.W. Point is at USGS gage 1000m from point. Original coordinates will work, but if we can deviate this far we'd suggest going to the USGS gage for sampling.
WHM only	USGS	35	WUGA	**64**	Whatcom County	-122.266962	48.991317	Johnson Creek	Site meets criteria, on the same reach as 21. Access through nearby truck yard.
WHM only	King	36	WUGA	**65**	Snohomish County	-122.293291	47.949872		Access off of Mukilteo Ln., in a public park. Site meets criteria, slightly different coordinates to avoid rail yard.
WHM only	King	37	WUGA	**67**	King County	-122.116314	47.367294	Little Soos Creek	Easy access on neighborhood trail, good amount of flow, gravel/cobble stream bed. Site meets criteria.
WHM only	King	38	WUGA	**68**	Snohomish County	-122.298991	47.884082		Nice trail down to stream, need to call housing development for access for private trail. Site meets criteria, access from Blue Heron Blvd.
WHM only	King	39	WUGA	**70**	King	-122.21649	47.430471		Good access off of 192nd, site meets criteria. Depending on where you sample there is dense vegetation around stream.

					County				This will make it hard to sample.
WHM only	King	40	WUGA	**74**	King County	-122.364925	47.754242	Boeing Creek	Site located within Boeing creek park in shoreline. Access is easy, 4 min to site. Site meets criteria.
WHM only	King	41	WUGA	**77**	Snohomish County	-122.278622	47.805535		Access is through Brier fire station, my need to let them know that we would like to park there, sample on upstream side of Poplar way. Stream meets criteria.
WHM only	King	42	WUGA	**79**	Snohomish County	-121.987861	47.885793		Minimal flow may dry up, Access off of 124th, Small neighborhood trails.
WHM only	King	43	WUGA	**80**	King County	-122.353478	47.494843	Salmon Creek	Good amount of flow, public trail access behind Shic Shadle Hospital. Site meets criteria, park at Shic Shadle and hike to point.
WHM only	USGS	44	WUGA	**81**	Pierce County	-122.02595	47.149476		On the same reach as site 52, identified site that will work is closer to order #52. Sample at given coordinates (~500 meters away).
WHM only	King	45	WUGA	**82**	King County	-122.042018	47.546079	North Fork Issaquah Creek	Easy access by parking on the side of the road at 4th Avenue Northwest. Will need to decide on reach extent for benthic sampling. Site meets criteria.
WHM only	King	46	WUGA	**84**	King County	-122.329929	47.264583	West Hylebos Creek	Site is accessible at the end of S 376th St. Site meets criteria. Make sure to sample after the confluence of two channels upstream.
WHM only	King	47	WUGA	**85**	Snohomish County	-122.231022	47.911151	North Creek	North Creek looks okay where it crosses E. Mcgill.
WHM only	USGS	48	WUGA	**87**	Clallam County	-123.069079	48.084458	Bell Creek	Site was accessed on gravel road behind Sequim's waste-water treatment facility. Road leads directly down to the stream. The stream meets all criteria and looks to be perennial. Preferred coordinates are downstream from the original due to ease of access.

Table 5. RSMP Puget Lowland Stream Sites Outside the UGA found suitable for sampling

Monitoring: Both (WQ+WHM) or WHM	Monitored by Team Member	*Tally count*	Strata	ORDER	County	Longitude	Latitude	GNIS_Name	Notes on Site Visit
Both	USGS	*1*	OUGA	**1**	Mason County	-122.8176	47.40716553		Original coordinates are on fish hatchery property. Artificial channel, with confined flow. On the other side of Coulter Creek Rd. stream is accessible, has uninterrupted flow, defined channel and a natural stream bed. Less than 100m from original point.
Both	SJICD	*2*	OUGA	**6**	San Juan County	-123.09895	48.52611		Point on the outfall of reservoir. Downstream of the weir about 250 meters across Wold Rd is a great site. Channel is well defined, developed stream bed, consistent flow, and within the required distance. October 7, 2014 field visit: There is very low flow. The weir is spilling water. May be or had been an ultrasonic sensor deployed there.
Both	King	*3*	OUGA	**8**	King County	-121.93774	47.242882		Was able to access near original point at a site that would work, homeowner's information on file with the USGS. Site meets criteria.
Both	USGS	*4*	OUGA	**9**	Clallam County	-123.138764	48.023786	Canyon Creek	Stream is accessible downstream from reach near fish hatchery. Upstream at point is in a steep sided canyon, unsafe to access. Was unable to access stream 500m down from point, on private property, but likely could access this point if needed and had time to contact owner. Was able to make it within 600 m of original point.
Both	King	*5*	OUGA	**11**	Snohomish County	-121.953240	47.836086	High Rock Creek	Steep gradient near point, will be tricky for discharge and benthic sampling, but could make work. Streambed is composed of exposed bedrock, cobbles, and gravel. Easily defined edge, and apparent year-round flow. Only about a foot of wetted width and less than an inch of depth (site visit on September 17, 2014)
Both	Skagit	*6*	OUGA	**19**	Skagit County	-122.30661	48.379443		Natural channel that is in a ditch for this section of rd. might be usable. Stream bottom is natural substrate, believe this is natural but modified.
Both	Skagit	*7*	OUGA	**20**	Skagit County	-122.278929	48.528191	Willard Creek	Willard creek just before it flows into Thomas Creek. Extremely slow flow, mud bottom stream. Likely slow-moving water during summer month, but may have minimal flow. Stream is modified to run along the side of the road.
Both	USGS	*8*	OUGA	**22**	Thurston County	-122.585614	46.907687	Yelm Creek	Steady flow, but very hard to define stream banks for benthic sampling and for measuring discharge due to large amount of grasses growing up through channel.
Both	King	*9*	OUGA	**24**	King County	-121.85345	47.564723	Mud Creek	Site is easy to access. Year-round flow could be questionable depending on the year. If a key could be obtained for the Snoqualmie Valley Trail it would be faster to drive down to the site. Suggest sampling on the upstream side of the trail (~50m from original point) due to safer access down the embankment.
Both	USGS	*10*	OUGA	**25**	Mason County	-123.09686	47.123144		Site is easy to access down railroad tracks off of SE Old Olympic Highway. Year-round flow could be questionable in a dry year. Stream has a well developed streambed, suggesting year-round flow. Gravel and sand streambed, with dense vegetation around stream. Make sure not to confuse this tributary with the larger river that it flows into. Sample point is on the tributary.
Both	USGS	*11*	OUGA	**26**	Clallam County	-123.47265	48.090743	Tumwater Creek	Hard site to access due to steep hillside, but "do-able." Park at power line service gate off of Benson Rd and hike down old roadbed to the stream (lots of overgrowth). Stream is wade-able year-round, and should have year-round flow. Bed is composed of gravels and cobbles.
Both	Skagit	*12*	OUGA	**27**	Skagit County	-122.26793	48.541156	Thomas Creek	Need to drive up Union Rd. to the very end next to railroad tracks (private rd. let owner know you are there, seems very amenable to us using it.) Once you park, hike .2 mi next to railroad track to access point. Nice sampling site with year-round flow, Sand/gravel stream bed and easily definable banks.
Both	USGS	*13*	OUGA	**28**	Thurston County	-122.44784	46.850753	Powell Creek	Site is next to Nisqually Land Trust (likely on the same parcel of land). Wading/hiking to the point is necessary to get to the correct reach. Stream is a ponded, sinuous wetland area, until you get down to the reach where it becomes well defined. Perennial stream, with a sand/gravel streambed, and easily definable stream banks. Beaver activity in the area, the characteristics of the site could quickly change.
Both	USGS	*14*	OUGA	**30**	Thurston County	-122.542990	46.831628	Deschutes River	Access is from bridge crossing the Deschutes on Cougar Mt Trail SE. River may be too high to wade during winter storms, but both discharge and sampling could be completed from the bridge. River is low enough for benthic sampling in the summer.

Both	USGS	15	OUGA	**32**	Whatcom County	-122.673307	48.925987	California Creek	Access is from old house that is overgrown with weeds and appears abandoned on Creasey Rd. Walk through field towards stream, two small ditches are crossed and should not be confused with the main stream and sampling point. Stream is slow moving and deep for its width. Stream bottom is mostly mud with some gravel. During high flow events the stream will be hard to wade.
Both	USGS	16	OUGA	**33**	Clallam County	-123.317124	48.048180	Bagley Creek	Easy access off of Ripplebrook Dr., Parked at empty lot that is for sale and hiked to stream site. Stream had moderate-minimal flow, but developed streambed would suggest that the site is perennial. Easily defined banks with a cobble and gravel streambed. Can access original point.
Both	USGS	17	OUGA	**37**	Clallam County	-123.348618	48.037726	Surveyor Creek	Access is from Clallam Co. PUD site. Easy trail to stream. Suggest sampling from end of reach. Point is accessible but hiking upstream is slick and would add a large amount of time to sampling and potentially unsafe. Tom Martin from Clallam Co. PUD took us to the site and mentioned that the stream runs through a steep canyon further up. Suggested sampling point is about 500 meters downstream from original point.
Both	King	18	OUGA	**38**	King County	-121.850274	47.770559	Cherry Creek	Dense brush makes it unreasonable to bushwhack to original point. Preferred sampling point is slightly off of Stossel Creek Rd. about 250m from the original point. Natural channel with heavy overgrowth. Definable stream banks, with a cobble/gravel streambed.
Both	King	19	OUGA	**39**	Snohomish County	-121.766255	47.849324		Easy access off of 164th St. SE. Can sample directly at original coordinates. Natural stream channel with year-round flow, definable stream banks. During extreme events it may not be possible to wade, but water quality sampling and discharge measurement could be conducted from the bridge on 164th.
Both	USGS	20	OUGA	**42**	Clallam County	-122.963867	47.937425	Snow Creek	Sample near forest service road access point, about 550 meters down from original coordinates. Stream meets all sampling criteria. Main concern would be snow on the forest service road in winter.
Both	Skagit	21	OUGA	**44**	Skagit County	-122.609383	48.428358		Best place to access is below HWY 20 bridge where stream is well defined, and fewer breaks due to culverts. This section is about 300 meters downstream of original coordinates. Stream site meets all criteria. Park just off HWY 20 and hike down steep hillside.
Both	King	22	OUGA	**45**	King County	-121.948440	47.423196	Carey Creek	On DNR land, Access from gate off 298th Ave SE. easy .5 mi walk on trail to stream. Original coordinates are accessible, but trail crosses stream at a nice point for water quality sampling and discharge. Well defined channel and streambed with sand/gravel/and cobbles. May be able to get keys to DNR gate, but road would only be drivable part-way in.
Both	USGS	23	OUGA	**46**	Mason County	-122.81661	47.518473	Bear Creek	Park at gate at the intersection of Tiger Lake Rd W and NE Tiger-Mission Rd. Site is about a 1mi hike from there. Steep hillside down to stream, "do-able" but care should be taken. Directly at point there is beaver activity creating ponds, stream is well defined about 150 meters downstream from original coordinates at the preferred coordinates. Sand/gravel bed in natural stream channel. Photos are of preferred sampling site
Both	King	24	OUGA	**47**	King County	-122.262567	47.350832		Stream is slightly off from where it was originally plotted, but meets criteria. At some points it flows in modified channel, but it is a natural stream and not just a drainage ditch. Streambed composed of cobbles/gravel. Contact info for owner on file with the USGS.
Both	USGS	25	OUGA	**50**	Snohomish County	-122.055045	48.168039	Jim Creek	No one home at private residence, can access off of Jordan Rd. need to find home owner before regularly accessing site. Larger stream, with definable banks and cobble/boulder stream bed. Could possible hike to point when flows are low enough, but this point is easier to access and within ~250 meters.
Both	USGS	26	OUGA	**54**	Jefferson County	-122.902386	47.841306		Easy access off of Wildwood Rd. Site is preferable downstream of road and point. Better channel definition at this point, which is less than 200 meters from original coordinates. Flow is likely minimal in summer, but looks like it is likely perennial.
Both	USGS	27	OUGA	**56**	Mason County	-123.195894	47.418367	Dow Creek	Accessed off of N. Lake Cushman Rd. Can sample at the point. Smaller stream with definable edges, cobble/gravel stream bed. Need to be careful to sample correct tributary to Dow Creek where original coordinates are plotted. Dow creek itself would be a better sampling site which you cross when accessing this tributary. NHD Reach was plotted on trib.
Both	USGS	28	OUGA	**59**	Mason County	-123.023480	47.183278	Mill Creek	Easy access off of SF Fireweed Rd. Park at jersey barriers near site and walk down old roadbed (~5 min to site). Stream is slow moving and large, with a cobble bed and easily definable stream banks.
Both	USGS	29	OUGA	**60**	Thurston County	-122.524167	46.816180	Deschutes River	Access is through Driftwood Valley neighborhood, gate code on file with the USGS. Hike down horse trail to reach point (~10min). Larger river site that may be un-wadeable in the winter. Cobble/boulder streambed and easily defined edges. Large reach will be needed for benthic sampling.

WHM only	King	30	OUGA	**69**	King County			Stossel Creek	Able to access upstream of point. Point is in locked timber area, need to call Hancock timber for access. King County agreement will allow WHM summer monitoring here, but not monthly WQ.
WHM only	USGS	31	OUGA	**71**	Snohomish County	-122.288934	48.280379	Church Creek	Ponded wetlands near sampling pt. but would work just slightly downstream. Access is from driveway off of 314th Pl. NW. Dense brush over stream makes for hard sampling, but will work. Site meets criteria.
WHM only	King	32	OUGA	**72**	King County	-121.902150	47.547015	Raging River	Great site that meets all of the defined criteria. Access is off of Preston Fall City Rd. near mine entrance, could be hard to sample during high flows. October 8, 2014 - USGS gage is about a river mile downstream. At site there is a ROW. Stage measurements only at site are do-able.
WHM only	King	33	OUGA	**74**	King County	-122.105031	47.382233	Little Soos Creek	Access is off of SE 245th St., able to drive to site. Owner gave verbal permission to access site, slightly upstream from original coordinates. Site meets all criteria.
WHM only	Skagit	34	OUGA	**75**	Skagit County	-122.317984	48.306885		Decent flow, may go dry during later summer. Easy access near the intersection of Miltown Rd and Pacific HWY. Stream meets criteria, and sampling is possible at original coordinates.
WHM only	USGS	35	OUGA	**76**	Snohomish County	-122.025796	48.209697	Jim Creek	Access is through private property, owner was very nice about having us use her trail to the river (address on file with the USGS). Stream meets all criteria and original sampling point can be used.
WHM only	USGS	36	OUGA	**78**	Snohomish County	-122.153566	48.195949	March Creek	Accessed from 220th Dr. NE on Baringer farm property may need to contact for access, though sampling could be done from where the stream crosses the road. Natural channel along agricultural field, meets criteria. Streambed is mud/sand. Reach works from original point to where the stream crosses the road.
WHM only	King	37	OUGA	**79**	Snohomish County	-122.039778	47.927346		Good Access. Were given permission from property owners to come in from above, need to send them a letter for access. Contact info on file with the USGS. Stream meets sampling criteria, point is downstream from original coordinates. Stream is perennial according to owners. Late summer visit flow is minimal but should be enough for WHM work
WHM only	USGS	38	OUGA	**80**	Snohomish County	-122.152823	48.103099		Naturally flowing channel, modified due to agricultural farm. Easy access through neighborhood green way. Stream has minimal flow, with a mud/sand streambed. Point for sampling is preferred over original coordinates due to a more natural channel.
WHM only	USGS	39	OUGA	**83**	Mason County	-122.913997	47.423735	Stimson Creek	Easy access along roadside. Nice channel, need to make sure and sample at point upstream of tributary which are the original coordinates. Stream meets all sampling criteria.
WHM only	USGS	40	OUGA	**84**	Clallam County	-123.322158	48.084056	Bagley Creek	Easy access off of Phillips Pkwy. Park at power line service road and hike down trail. Very nice site that meets all sampling criteria. Sample at original coordinates.
WHM only	King	41	OUGA	**86**	King County	-121.911286	47.751425	North Fork Cherry Creek	Access site from 178th Pl., steep gradient to get down to stream use caution. Stream meets criteria, might be difficult to wade when flows are extremely high. Site will work, but permission will be needed for WHM work.
WHM only	USGS	42	OUGA	**89**	Snohomish County	-122.025416	48.144542	Jordan Creek	Owner gave permission to access site using an old farm road off of Jordan Rd. Contact info is on file with the USGS. Chosen sampling point is to stay out of steep sided canyon that is hard to access. Stream meets all criteria, if needed one could get closer to original point by hiking upstream, though this would add considerable sampling time.
WHM only	USGS	43	OUGA	**93**	Clallam County	-123.26155	48.058276	Pederson Creek	Easy access down logging road, if possible find key for gate, if not public entry is permitted. Less than 15 min. walk. Stream meets sampling criteria. Accessed point is ~300 meters downstream of original coordinates.
WHM only	King	44	OUGA	**94**	King County	-121.981167	47.689442		Was able to access original coordinates through the property at 26805 100th st, was given verbal permission from owner. Contact info on file with the USGS. Stream meets all criteria good site for access.
WHM only	USGS	45	OUGA	**96**	Whatcom County	-122.435869	48.943518		Access was behind barn on Hampton Rd. Stream meets criteria. Sampling could be done where Hampton Rd. crosses stream.
WHM only	USGS	46	OUGA	**97**	Whatcom County	-122.641094	48.918308		Original coordinates are too overgrown for access and sampling, but section between 4th St. and Portal will work. Flow may be ponded during late summer, but was flowing well when we were there. Will need to talk with owners to access property for benthic sampling.
WHM only	King	47	OUGA	**98**	King County	-121.851739	47.729177	Stossel Creek	Park on Stossel Creek Rd and hike down logging rd. (~10 min). Original coordinates are not in a great location for access due to heavy brush. Coordinates suggested are about 320 meters downstream. The stream meets all criteria. Large amount of brush is going to make it difficult for benthic sampling, but "do-able".

Measurement Quality Objectives

Measurement quality objectives for small stream monitoring described here are to obtain and analyze sufficient numbers of high quality samples to meet the goals and objectives of this program. Data quality indicators include precision, bias, sensitivity, representativeness, comparability, and completeness (Appendix B). The biological and habitat indicators adopted for this program come from Ecology's watershed health monitoring program for small streams (Adams, 2010a). The adopted water chemistry indicators come from Ecology's Water Quality monitoring program (Hallock, 2012), and the adopted sediment chemistry indicators come from multiple monitoring efforts within Ecology (Dutch et al., 2010; Johnson, A., 2010; and Meredith and Furl, 2008) and USGS (1994).

Field measurements

Measurements of water quality, sediment size estimation, and stream habitat variables are taken by field staff during a sample collection event. All RSMP Contractors will follow the collection methods, reporting requirements, and quality control (QC) procedures summarized in the *Field Operations* sections of this QAPP. This approach will provide field measurement data that meet measurement quality objectives (MQOs) for status and trends monitoring for small streams under the RSMP, listed in Tables 20 and 21.

RSMP Contractors will make a good faith effort to collect monitoring data described per QAPP requirements. If a water quality sample or measurement is missed on occasion, a second effort will be made to collect the sample within the same month. If a second attempt is also unsuccessful, then the RSMP Coordinator will be notified, and a third attempt is not required.

Reasons a sample or measurement may not be made include, but are not limited to: a stream goes dry; the stream site cannot be accessed due to high flow conditions, vandalism, extreme climatic conditions, or monitoring equipment has a sudden failure. Flow measurements may need to be estimated using stage height, high water mark, staff gages, or other estimation techniques during the winter months to minimize exposure to hazardous conditions for staff. Water quality samples and measurements made during very high flows may be made from anywhere within the site reach.

Laboratory measurements

Sediment and water quality analyses will be conducted at laboratories listed in Table 6. Ecology's Laboratory Accreditation Program maintains a searchable database that may be accessed from this website: www.ecy.wa.gov/programs/eap/labs/lab-accreditation.html. (Laboratory methods and reporting limits are listed in the *Quality Control* section).

Taxonomic identification will be conducted by a lab that employs taxonomists certified by the Society for Freshwater Science at the genus level with experience with the freshwater macroinvertebrates of the Pacific Northwest.

Work performed by the RSMP Contractors is expected to meet the quality control requirements of the analytical methods stated in this QAPP. These requirements are summarized in the *Quality Control* section of this document.

Laboratory selection

Multiple laboratories will be needed to ensure sample completeness. Contracting for laboratories is a responsibility of RSMP Coordinator. RSMP Contractors may not consider laboratories other than those listed in Table 6. Laboratories for water and sediment parameters were selected based on: their current accreditation status with Ecology, their ability to achieve acceptable limits of detection, and reasonable costs and efficiencies. Where feasible, laboratories may subcontract with each other to achieve required analyses.

Table 6. Laboratories for sample analysis.

Laboratory	Analytical Purpose	Address	Phone
Rhithron Associates, Inc.	Stream benthos and periphyton	33 Fort Missoula Road Missoula, Montana 59804	406-721-1977
Manchester Environmental Laboratory (MEL) [1,2]	Water and sediment conventionals, metals and PAHs for samples from USGS, Thurston County and Skagit County. All chlorophyll a analyses. Pesticides will be sub-contracted with a qualified laboratory.	7411 Beach Drive East Port Orchard, WA 98366	360-871-8800
King County Environmental Laboratory (KCEL)[2]	Water and sediment conventionals, metals and PAHs for samples from USGS and King County	322 West Ewing Street Seattle, WA 98119-1507	206-477-7200
Edge Analytical	Fecal coliform analysis for samples collected in Whatcom, San Juan, and Skagit counties	805 West Orchard #4 Bellingham, WA - 1620 S. Walnut St. Burlington, WA	Bellingham: 360-715-1212 - Burlington: 360-757-1400
Clallam County Environmental Health Laboratory	Fecal coliform from Olympic Peninsula samples	Clallam County Environmental Health 223 E. 4th St, Suite 14 Port Angeles, WA 98362	360-417-2334
AXYS Analytical Services Ltd.	Subcontracted by MEL for PCB congeners. Given additional funding: PBDEs, Pharmaceuticals and personal care products (PPCPs) and hormones/steroids (H/S)	2045 Mills Road W. Sidney BC Canada V8L 5X2	250-655-5800

[1] Chlorophyll *a* will be done at MEL as a water quality parameter.

[2] An inter-laboratory comparison for select water and sediment chemistry samples will be performed between KCEL and MEL and is discussed in the *Laboratory Quality Control Section* of this QAPP. Samples will be sent to MEL by King County.

General Field Sampling Procedures

This section describes field sampling procedures. This QAPP's appendices C through F provide detailed procedures for watershed health, water quality monitoring and quality control. Appendix G provides field forms that may be used in the field for data collection.

Scientific collection permit

The necessary permits for sampling macroinvertebrates will be obtained from the Washington Department of Fish and Wildlife (http://wdfw.wa.gov/licensing/scp). King County will obtain a permit for the small stream sites they are monitoring and USGS will obtain a permit for the remainder of the small stream monitoring sites.

Safety

RSMP Contractors should have their own safety plans, and abide by these minimum safety elements.

Sampling

Most field activities should be conducted by two people. Activities can be parsed into tasks to be accomplished by one or more persons at a given time. A contact person will be designated at the office to which field personnel report at the end of each day at pre-designated times. Staff should carefully plan field activities and obtain permission to access private land. Staff may also notify the land owner which day they will be sampling.

Field and laboratory preservatives

Biological samples collected from streams must be preserved immediately following storage in containers. Inadequate preservation often results in (1) loss of prey organisms through consumption by predators, (2) eventual deterioration of the macroinvertebrate specimens, and/or (3) deformation of macroinvertebrate tissue and body structures, making taxonomic identification difficult or impossible.

The field preservative used for biological samples is 85% denatured ethanol. The preservative is typically prepared from a stock standard of 95% denatured ethanol. Flammability, health risks, protective equipment, and containment information are listed on warning labels supplied with the preservative container. Detailed information can be found with the Materials Safety Data Sheets (MSDS). Minimal contact with the 95% denatured ethanol solution is recommended.

For the water samples, several of the nutrient parameters require field preservation using hydrochloric acid (HCL) or sulfuric acid (H_2SO_4) (see Table 14). These jars can be ordered with preservative in them, and they must be handled carefully.

Equipment and maintenance

A list of equipment necessary to complete both watershed health and water quality monitoring field activities is presented in Appendix H of this QAPP.

Servicing of scientific instrumentation will follow manufacturers' methods and will be conducted as needed. General maintenance will consist of equipment inventories, inspections, testing, and replacement of worn, torn, or missing components.

Equipment decontamination and prevention of spread of aquatic invasive species

Field work will be conducted and equipment cleaned to prevent the spread of invasive species. Staff practices and equipment that contact multiple surface waters will, at a minimum, be cleaned according to Ecology's standard operating procedure (SOP) EAP070, *Minimizing the Spread of Aquatic Invasive Species* (Parsons et al., 2012). These procedures will be followed at the end of each work day or upon leaving a water body before entering another. Some areas are designated to be of "Extreme Concern"; these areas are shown in several maps at the following link: www.ecy.wa.gov/programs/eap/InvasiveSpecies/AIS-PublicVersion.html

All sediment material not retained for analyses or archiving will be rinsed near the sampling location with stream water. Also, the sediment scoop and bowl will be rinsed on-site. Used equipment will not be used at another site on the day of sampling, unless completely cleaned.

Any portion of the sampling equipment (nets, sample container holders, scoops, bowls), filters, or other materials coming into contact with the sample will be decontaminated prior to use or will be certified as pre-cleaned from the equipment source. Sampling equipment and containers will be prepared prior to the sampling event. Otherwise, cleaning will match the purpose of sampling. For example, the kick nets only need to be free of benthic macroinvertebrates, leaves, and sticks and air dried. Nets, buckets, funnels, and other general sampling equipment may be washed or rinsed with tap water and air dried.

Sediment sampling equipment

The stainless-steel scoops and bowls used to collect sediments for organic analysis need to be properly cleaned using the following procedure. Clean implements will be stored in aluminum foil or polyethylene bags for transport to the field station. Stainless-steel sampling implements, including the spoons, bowls, and stirrers, will be cleaned sequentially:

1. Washing in non-phosphate detergent (Liquinox) and hot tap water.
2. Rinsing with hot tap water.
3. Rinsing with 10% nitric acid (if sampling for metals).
4. Rinsing with deionized water three times.
5. Air drying in clean area free of contaminants.
6. Rinsing with pesticide-grade acetone (if sampling for organics).
7. Air drying in clean area free of contaminants.

After drying, equipment will be wrapped in aluminum foil and stored in polyethylene bags until used in the field. Sampling equipment will be dedicated to a single site. Reuse will require cleaning as outlined in the procedure above, which is based on EPA guidelines (EPA, 1990).

Labeling samples

Labeling is used to identify where and when a sample was collected and the analyte(s) in that sample to be analyzed. Laboratory-prepared bottles will be labeled to identify the cleanliness and/or preservative contents for each bottle. Bottles will be either numbered or pre-labeled to ensure proper handling. Labels will be filled out in pencil or permanent pen, placed on sample containers. Sample labels will contain the following information:

- Site name and SITE_ID
- Analysis to be performed
- Date
- Sample ID or coding information
- Sample numbers (1 of 3, 2 of 3, and so on)

This labeling information will be written in the chain-of-custody forms, which are discussed below.

Chain-of-custody procedures for samples

Chain-of-custody (COC) procedures are necessary to ensure thorough documentation of handling for each sample, from field collection to laboratory analysis. The purpose of this procedure is to minimize errors, maintain sample integrity, and protect the quality of data collected. A COC form will accompany each cooler of samples sent to a laboratory. Individuals who manipulate or handle these samples are required to log their activities on the form. When the laboratory receives a cooler of samples, it will assume responsibility for samples and maintenance of the COC forms. The laboratory will then conduct its procedures for sample receipt, storage, holding times, tracking, and submittal of final data to the responsible parties. Example COC forms for benthic and water or sediment chemistry samples are in Appendix L.

Watershed Health Monitoring

This section describes watershed health monitoring which refers to physical habitat, soil chemistry measurements, and biological community characterization. These measurements and samples will be collected once at each site during the period July 1 through October 15, 2015. The biological, physical habitat, and sediment chemistry parameters for watershed health monitoring are presented in Tables 7 and 8.

Table 7. Biological and habitat parameters for watershed health monitoring

Biological and Habitat Parameters
Aquatic macroinvertebrates (benthos)
Periphyton
Physical habitat (discharge, slope and bearing, wetted width, bankfull width, bar width, substrate size, substrate depth, shade, human influence, riparian vegetation, large woody debris).

Table 8. Sediment chemistry parameters for watershed health monitoring

Sediment Parameters
Grain size[1]
Total organic carbon (TOC)
Percent Solids (both sieved fractions)
Metals (Ag, As, Cd, Cr, Cu, Pb, and Zn)
Polynuclear aromatic hydrocarbons[2]
Pesticides[3]
Phthalates[4]
Polychlorinated biphenyls (PCBs)[5]
Polybrominated diphenyl ethers (PBDEs)[6,8]
Hormone disrupting chemicals: Pharmaceuticals and personal care products (PPCPs) and hormones and steroids (H/S)[7,8]

[1] Grain size estimation will be done in the field for habitat measurements, as well as a laboratory assessment of grain size on the <2mm sieved sediments (Appendix C-4).

[2] PAH compounds include: 1-methylnaphthalene, 2-methylnaphthalene, 2-chloronaphthalene, acenaphthylene, acenaphthene anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b,j and k)fluoranthene, benzo(ghi)perylene, , dibenzo(a,h)anthracene, dibenzofuran, carbazole, chrysene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, pyrene, retene.

[3] Pesticides include: 2,4-D, carbaryl, chlorpyrifos, diuron, dichlobenil, and triclopyr

[4] Phthalates include: bis(2-ethylhexyl) phthalate, butyl benzyl phthalate, diethyl phthalate, dimethyl phthalate, di-n-butyl phthalate, and di-n-octyl phthalate.

[5] PCBs include: all 209 congeners.

[6] PBDEs include: 47, 49, 66, 71, 99, 100, 138, 153, 154, 183, 184, 191, 209.

[7] Hormone disrupting chemicals include: pharmaceuticals and personal care products, hormones and steroids per EPA Methods 1694 and 1698, respectively.

[8] Additional parameters recommended by the SWG, to the extent that funding becomes available. A sub-set of sediment sites would be considered for these parameters; sites that number from 0-120 in the "ORDER" column. Permittees selecting Option 2 will monitor for these additional parameters for sites that number from 0-120 in the "ORDER" column.

A composite sediment sample will be processed (sieved) in the field to make two different samples. One sample will be sieved to less than 63 µm and analyzed for metals (arsenic, copper, lead, and zinc). A second sample will be sieved to less than 2.0 mm and analyzed for multiple organic compounds (PAHs, pesticides, phthalates, PBDEs, PCBs, PPCPs, and H/S) and total-organic carbon (TOC). This less than 2mm fraction will also be analyzed grain size distribution by a laboratory. The grain size estimation in the field (stated below) will also be conducted for habitat metric purposes. For the RSMP pooled fund sites, analysis for PBDEs, PPCPs and H/S is contingent on additional funds.

Field activities and protocols for watershed health monitoring

The field activities and associated data collection protocols required for watershed health monitoring are described below. For each activity, please reference specific appendices in this QAPP. The protocols in this QAPP are tailored to the RSMP and based on Ecology's ambient biological monitoring program (Adams, 2010a and 2010b) and Ecology SOPs for measuring physical habitat (Clinton, 2009; Kennedy, 2009; Werner, 2009a,b,c d).

The primary field data and samples collected during watershed health data collection event (DCE) include stream discharge, sediment chemistry, benthic macroinvertebrates, periphyton, and habitat. Water quality may also be monitored (as described in the *Water Quality Monitoring* section of this QAPP) during a watershed health DCE, or it may be completed during a separate site visit.

One site is typically sampled in one workday by a two-person field team (Table 9). The following activities must be completed in the listed order during the day in order to avoid damage to biological specimens while sampling sediment or measuring habitat:

1. Site verification and layout
2. Stream flow measurement
    - Optional: water-quality measurement and sample collection
3. Benthos and periphyton sample collection
4. Sediment chemistry sample collection
5. Habitat measurements

Table 9. Typical daily work flow for a watershed health data collection event.

Activity	# Staff	Time Since Arrival On-site (hours)				
		1	2	3	4	5
Verification & Layout	1					
Streamflow measurement	2					
Benthos/periphyton sample collection	2					
Sediment sample collection	2					
Habitat measurements	2					

Watershed health monitoring is conducted according to a reach-wide sampling scheme (Hayslip, 2007) that uses equidistant transects set along a stream reach with a length equal to 20 times the bankfull width at the sample site. Benthos and sediment sampling along the reach are conducted systematically without consideration for habitat type. For example, the sampler might start collecting on the left bank at transect one, move to midstream at transect two and the right bank at transect three, and move back again until 8 square feet have been sampled from randomly chosen transects. A list of the field activities required for monitoring watershed health and the corresponding appendices of this QAPP that describe the procedures and protocols is provided in Table 10.

Table 10. Field activities for watershed health monitoring, QAPP appendices describing the procedures, and where at a site the activities take place.

Activity	Appendix	Where[1]
Site verification and layout	C-1	Entire site
Stream flow measurement	E-5	Near index station
Benthos sample collection	D-1	Major transects
Periphyton sample collection	D-3	Major transects
Sediment chemistry sample collection	C-4	Near index station
Habitat measurements		
Bank measurements	C-5	Major transects
Substrate and depth measurements	C-6	Major transects
Shade measurements	C-7	Major transects
Estimating fish cover	C-8	Major transects
Human influence	C-9	Major transects
Riparian vegetation structure	C-10	Major transects
Measuring thalweg depth	C-11	Thalweg transect
Large woody debris tally	C-12	Major transect
Habitat unit descriptions	C-13	Thalweg transect
Side-channel descriptions	C-14	Thalweg transect
Width and substrate measurements	C-15	Minor transects
Measuring slope and bearing	C-16	All transects

[1] Transects and index stations are described in Appendix C-1.

Table 11 presents the same information according to which activities take place at the different transects and stations that are established during the site layout.

Table 11. Field procedures by station within a site (transects and index stations are described in Appendix C-1).

Major Transect	Minor Transect	Thalweg Transect	Near the Index station (Transect F) [6]
Slope[1] Bearing[2] Wetted width Bankfull width Bar width Substrate sizes Substrate depths Fish cover by class Shade Human influence Riparian vegetation Benthos[3] Periphyton[3] Large woody debris [4] GPS coordinates [5]	Slope[1] Bearing[2] Wetted width Bankfull width Bar width Substrate sizes	Slope[1] Bearing[2] Thalweg depth Habitat unit presence Side channel presence Edge pool presence Bar presence	In-situ measures Sediment sampling Discharge GPS coordinates [5]

[1] Slope can be measured among any combination of convenient contiguous stations, as long as crews determine total elevation gain or average slope across the entire site length.
[2] Bearing: normally 20 measurements per site: one measurement at each major transect and one at each minor transect. Supplemental measurements sometimes are needed from intermediate thalweg transects.
[3]The benthos and periphyton samples are composite samples from eight randomly selected major transects.
[4] Large woody debris is tallied across the full length of the site, but records are kept for counts between major transects, on the *Thalweg Data Form*.
[5] Global Positioning System (GPS) is required at site coordinates (index station) and at two major transects for small streams (top and bottom of site).
[6] Except for GPS coordinates, these measurements can be done anywhere within the site, but near the index station (mid-reach, transect F) is preferred.

Field quality control procedures

To ensure the quality and consistency of sample collections, equipment maintenance and sample collection protocols described in the appendices of this QAPP will be followed.

Sample holding times

Holding times are the maximum allowable length of time between sample collection and laboratory manipulation. Holding times are different for each analyte and are in place to maximize analytical accuracy and representativeness. Each sample collected will be packaged in a container and labeled accordingly. If necessary, the permittee will coordinate with the analytical laboratory to ensure samples can be transported, received, and processed during non-business hours. Sample containers will be transported or sent by the field team to the analytical laboratory, following established sample handling and chain-of-custody procedures. At the laboratory, samples may be further divided for analysis or storage.

Tables 12 – 13 list sample volumes, holding times, containers, and preservation requirements for sediment and biological samples collected during a watershed health DCE. Appendix D elaborates on the bottles and other equipment needed for biological samples.

Table 12. Sample containers, amounts, holding times, and preservation for sediment samples.

Analysis	Container[1]	Holding Time	Preservative[2]
Percent solids	2 or 4 oz glass or PP jar	7 days	Cool to ≤6°C
Grain Size	8 oz plastic jar	6 months	Do NOT freeze or dry; cool to ≤6°C
Total organic carbon (TOC)	2 or 4 oz glass or PP jar	14 days/6 months if frozen	Cool to ≤6°C; PSEP standard (1986): may freeze at ≤18°C at lab
Metals (Ag, As, Cd, Cr, Cu, Pb, Zn)	4 oz glass[3] or HDPE jar	6 months	Cool to ≤6°C
Pesticides (2,4-D, diuron, dichlobenil, carbaryl, chlorpyrifos, and Triclopyr)	8 oz glass jar[3,4]	14 days	Cool to ≤6°C
PAHs	8 oz glass jar[3,5]	14 days/1 year if frozen	Cool to ≤6°C; PSEP standard (1986): may freeze at ≤ - 18°C at lab
Phthalates			
PCBs (congeners)	8 oz glass jar[3]	14 days/1 year if frozen	Cool to ≤6°C; PSEP standard (1986): may freeze at ≤ -18°C at lab
PBDEs	8 oz glass jar[3]	14 days/1 year if frozen	Cool to ≤6°C; PSEP standard (1986): may freeze at ≤ -18°C at lab
PPCPs and H/S	8 oz HDPE jar[6]	2 day/7 days if frozen	Freeze as soon as possible. Store in dark < -10°C until analyzed.

[1] No additional sample volume is needed for analysis and QC samples if the jar is filled, with the exception of PPCPs and H/S.

[2] Preservation needs to be done in the field, unless otherwise noted. Ice will be used to cool samples to approximately 4-6°C.

[3] Glass containers with Teflon-lined lids, certified clean by manufacturer or laboratory in accordance with OSWER Cleaning Protocol #9240.0-05 (MEL, 2008).

[4] All six pesticides can likely be combined in the same jar; check with laboratory.

[5] PAHs and phthalates can be combined in the same jar.

[6] Certified clean jar; request from laboratory.

Table 13.Sample containers, amounts, holding times, and preservation for biological samples.

Analysis	Container[1]	Holding Time	Field Preservative
Periphyton - for species analysis	500 mL brown poly bottle	6 months	Lugol's iodine to 1%; Cool to ≤4°C
Periphyton - for chlorophyll *a*[2] analysis	500 mL poly or glass vial	25 days if filtered and in acetone	Field filtered 0.7 micron glass microfiber filter. Filter is folded in quarters, placed in acetone containing vial wrapped in foil, and then placed in a polyethylene bag. Cool to ≤4°C
Macroinvertebrate	3.8 L wide-mouth poly jars	Indefinitely	Field preserved with ethanol, store in quiescent location.

[1] Replicate samples should be collected in additional container.

[2] Chlorophyll *a* will be sent to MEL, as opposed to the benthos laboratory.

Documentation

Field data measurements will be recorded in the field; example field forms are provided in Appendices C, D, and G for biological, habitat, and sediment chemistry monitoring. These forms are used by Ecology as print documents and taken into the field for recording. Ecology has developed new electronic field forms and software to improve field documentation for their watershed health monitoring program with completeness and data entry to the EIM database. The developed forms will be freely distributed to those conducting RSMP monitoring for use during the 2015 field season for habitat, benthos and sediment sampling. This software and data management are further discussed in the *Data Management* and *Stream Monitoring Reports* section of this QAPP.

Forms and documentation will include the station visit/maintenance sheet, meter calibration, and chain-of-custody forms. All entries on field documents will be made in pencil or permanent pen and will list the field technician name(s). Any errors or typos will be crossed out and rewritten by the technician who recorded the data. All corrections will be initialed and dated when made. Paper documents will be stored in an organized central filing location.

If field sampling or procedural errors are discovered, action will be taken to manage and correct those errors. Corrections may occur with corrective editing, relabeling, or, if warranted, flagging, discarding, and re-sampling. If a consistent error persists, an amendment to the sampling procedures may be required.

Composite/grab field replicate samples

Field replicates will be collected for the composited benthic macroinvertebrate, periphyton, and sediment field replicate samples (Table 14). Field replicates will be collected by splitting composited samples. The sediment samples will undergo a rigorous field homogenization to ensure adequate sample mixing prior to s

plitting. All field replicates will be labeled similar to other samples, so that the sample has its own unique number. These replicate samples will be submitted blind to the laboratory, with all other field samples.

Field blanks

Field blanks are not required for watershed health monitoring.

Table 14. Field quality control schedule for watershed health samples collected.

Field Sample Collected	Frequency	Control Limit	Corrective Action
Composited benthic macroinvertebrate, periphyton field replicate	Once	Qualitative control – Assess representativeness, comparability, and field variability	Review procedures; alter if needed
Composited sediment field replicates	10% of total samples	Qualitative control – Assess representativeness, comparability, and field variability	Review procedures; alter if needed

Water Quality Monitoring

Water quality monitoring consists of monthly year-round (January through December) measurements and collection of water samples at the field sites. Measurements and sample collection may be done from a bridge, by wading, or using a stream-side grab method, depending on the size of the stream and access, provided stream water at the specific monitoring location is well-mixed and representative. Monthly water quality sampling will occur at the first 30 suitable sites within the two assessment regions (within UGA and outside of the UGA).

Water quality parameters that are either measured in the field or in a laboratory are listed in Table 15.

Table 15. Water quality parameters to be monitored.

Parameter	Where measured
Ammonia	Laboratory
Chloride	Laboratory
Dissolved organic carbon	Laboratory
Dissolved oxygen	Field
Hardness	Laboratory
Fecal coliform	Laboratory
Metals (total and dissolved)	Laboratory
Nitrate-Nitrite-N	Laboratory
Polycyclic aromatic hydrocarbons	Laboratory
pH	Field
Orthophosphate	Laboratory
Specific Conductance	Field
Temperature	Field
Total nitrogen	Laboratory
Total phosphorus	Laboratory
Total suspended solids	Laboratory
Turbidity	Laboratory

Field activities and protocols for water quality monitoring

The primary field activities conducted during a water quality data collection event include measuring stream discharge and in-situ (field) water quality parameters, and collecting and processing water-quality samples for laboratory analyses.

Field activities for water quality monitoring and appendices within this QAPP that describe the procedures and protocols are shown in Table 16. Protocols for the RSMP water quality monitoring are adapted from Ecology's watershed health and Water Quality Index (WQI) programs are based on multiple Ecology SOPs (Ward et al., 2001; Hallock and Ehinger, 2003; Ward, 2007a,b; Hallock, 2012).

Table 16. Field activities for water quality monitoring and the appendices describing the procedures.

Activity	Appendix
Site verification	C-1[1]
Water-quality measurements and sample collection	E
Stream flow measurement	E-5

[1] The site layout part of this appendix is not applicable to a water-quality data collection event (DCE)

Field quality control procedures for stream flow monitoring

To ensure the quality and consistency of stream flow (or discharge) measurements the protocol described in Appendix E-5 will be followed. A brief summary of the protocol is presented below. If an existing continuous stream gage is already installed near the site, then a waded discharge measurement and stage height may not be needed. The functionality of the gage and relative distance and appropriate use will be verified.

Stage height and stream discharge.

Seasonal conditions were considered during site verification. The discharge measurement will occur monthly over an entire year and may include sampling during inclement weather or high-flow conditions. Field staff must always survey the sample location on the day of sampling for hazards for staff and equipment.

Monthly a measurement of stage height will be gathered. The stage (water-surface elevation) of the stream can be measured from a staff gage or other stable measurement point of either manmade or natural origin (e.g. bridge deck or railing, rebar, T-post, large boulder or weir). Most of the RSMP sites will be wadeable and a discharge measurement gathered along with the stage height each month of the year. The stage and discharge data will be used to create a site specific stage-discharge curve.

For high and very low flows the stage may be all that can be measured. Appendix E-5 provides guidance and protocol for stage and discharge under high and low flow conditions.

Field quality control procedures for water quality monitoring

To ensure the quality and consistency of sample collections, equipment maintenance and sample collection protocols described in the appendices of this QAPP will be followed.

Sample holding times

Holding times are the maximum allowable length of time between sample collection and laboratory manipulation. Holding times are different for each analyte and are in place to maximize analytical accuracy and representativeness. Each sample collected will be packaged in a container and labeled accordingly. If necessary, staff will coordinate with the analytical laboratory to ensure samples can be transported, received, and processed during non-business hours. Sample containers will be transported or sent by the field team to the analytical laboratory, following established sample handling and chain-of-custody procedures. At the laboratory, samples may be further divided for analysis or storage. Table 17 lists sample volumes, holding times, containers, and preservation requirements for sediment and biological samples collected for water quality. Appendix D elaborates on the bottles and other equipment needed for biological samples.

Table 17. Sample containers, amounts, holding times, and preservation for water samples.

Analysis	Container[1]	Holding Time	Preservative[2]
Non-filtered grab samples			
Chloride	125 mL[3] or 500 mL poly bottle	28 days	Cool to ≤4°C
Fecal coliform	250 or 500 mL autoclaved glass/poly bottle	24 hours (Hallock, 2007)	Fill bottle to shoulder, cool to ≤ 4°C
Hardness as $CaCO_3$[4]	500 mL[3] or 125 mL poly bottle	6 months	H_2SO_4 or HNO_3[3] to pH<2; cool to ≤6°C; preserve in field or lab[5]
Ammonia-N[5]	60 mL[3] or 125 mL poly bottle	28 days	H_2SO_4 to pH<2[4] cool to ≤4°C
Nitrate-Nitrite-N[5]			
Nitrogen, total	125 mL or 250 mL[3] poly bottle	28 days	H_2SO_4 to pH<2; cool to ≤4°C
Phosphorus, total			
Metals – total (Ag, As, Cd, Cr, Cu, Pb, and Zn)	500 mL poly bottle with Teflon® lid	6 months	Preserve in field or lab[6] using HNO_3 to pH<2; cool to ≤6°C
Polycyclic aromatic hydrocarbons (PAHs)	1 liter amber glass bottle with Teflon® lid	7 days to extraction, 40 days after extraction	Cool to ≤6°C
Total suspended solids (TSS)	1000 mL poly bottle	7 days	Cool to ≤4°C
Turbidity	500 mL poly bottle	2 days	Cool to ≤4°C
Filtered grab samples			
Dissolved Organic Carbon (DOC)	(2) pre-acidified 60mL, or (1) 125 mL amber glass[3] bottles	28 days	Field filter (0.45um)[6] within 15 minutes; HCl or H_3PO_4[3] to pH<2; Cool to ≤6°C
Metals – dissolved (As, Ag, Cd, Cr, Cu, Pb, and Zn)	500 mL poly bottle with Teflon® or polypropylene lid	6 months	Field filter (0.45um)[7] within 15 minutes of collection; preserve in field or lab[6] using HNO_3 to pH<2; cool to ≤6°C
Orthophosphate	60 mL clear poly[3] or 125 mL brown poly	2 days	Field filter (0.45um)[6] within 15min, and cool to <4°C

[1] Replicate samples should be collected in additional containers.
[2] Preservation should be done in the field, unless otherwise noted. Ice will be used to cool samples.
[3] Bottle size provided by KCEL; bottles or preservatives may vary between KCEL or MEL.
[4] KCEL will use the 500 ml total Metals bottle for Hardness as CaCO3.

[5] Samples for Ammonia and Nitrate-Nitrite, may avoid acid preservation by KCEL if they meet the unfrozen holding time prior to analysis, otherwise samples will be preserved with acid. Samples may be filtered in the laboratory if using best professional judgment when colorant or turbidity indicates potential for sample bias.
[6] Per EPA Method 200.8, samples for total and dissolved metals may be preserved with acid in the laboratory as long as the preservation is done at least 24 hours prior to digestion. Once preserved with acid, samples may be held at room temperature until analysis.
[7] MEL will send Whatman GD/X 25mm, or equivalent, with a cellulose acetate filters membrane and syringe; a glass microfiber pre-filter may be used for "hard to filter" OP samples. KCEL will send Nalgene surfactant-free cellulose acetate (SFCA) 0.45 µm syringe filters (Fisher # 09-740-35E) along with plastic syringe, 60 mL and 30 mL (B-D Brand, Fisher # 1482011).

Field instrument quality control

In order to maintain the highest degree of data quality, field equipment will undergo routine cleaning, calibrations, and maintenance at the recommended frequency specified by each manufacturer and described in SOPs. Appendices B and F discuss field meters.

Documentation

Field data measurements will be recorded in the field. The software being developed for Watershed health monitoring will also be able to record any in-situ water quality measurements. As previously mentioned in the Documentation section for watershed health monitoring, staff will need to prepare paper field forms in case the software is not ready in time for the January 2015 start date. Appendix M contains an example field form to record in-situ water quality measurements made at each site. Forms and documentation will include the station visit/maintenance sheet, meter calibration, and chain-of-custody forms.

All entries on field documents will be made in pencil or permanent pen and will list the field technician name(s). Any errors or typos will be crossed out and rewritten by the technician who recorded the data. All corrections will be initialed and dated when made. If field sampling or procedural errors are discovered, action will be taken to manage and correct those errors. Corrections may occur with corrective editing, relabeling, or, if warranted, flagging, discarding, and re-sampling. If a consistent error persists, an amendment to the sampling procedures may be required.

Composite/grab field replicate samples

A field quality control schedule is shown in Table 18. Field replicate samples will be collected at a rate of 10% of the total samples collected for monitoring under the permit. Field replicates will be collected by collecting additional grab samples. Parameters measured in the field (e.g. pH, temperature) also will be measured in the replicate sample for that particular site. Stage height and discharge are excluded.

All field replicates will be labeled similar to other samples, so that the sample has its own unique number. These replicate samples will be submitted blind to the laboratory, with all other field samples.

Field blanks

The term *field blanks* includes equipment rinsate blanks, trip blanks, transfer blanks, or specific equipment blanks. Blanks serve as field audits to ensure procedures to reduce contamination. A field blank sample will not be processed for sediment parameters. An equipment blank (field filter) and a single transfer blank for water-based parameters will be collected early in the monitoring program. These samples will be labeled with unique numbers, and will accompany samples to the laboratory.

- The field filter blank will be collected from the filtration apparatus using DI or RO water.
- The transfer blank will be collected by pouring lab-provided deionized (or RO) water into a clean sample bottle to determine whether field contamination (including DI water contamination) is present, unrelated to the equipment.

Other field blank samples may be collected as needed for determining a contamination source. If field blank contamination is discovered, additional field blank samples may be used to determine the source of the contamination. Field blank samples collected to determine the contamination source may include:

- A field trip blank collected by transporting unopened bottles containing organic and metal-free, certified clean water from the laboratory into the field, and then returned it to the laboratory (bottles are not opened in the field). Trip blanks are used to determine whether any contamination occurs while traveling from field to laboratory.
- A field filter blank should be prepared twice a year per RSMP contractor

Table 18. Field quality control schedule for water quality samples collected.

Field Sample Collected	Frequency	Control Limit	Corrective Action
Grab water field replicate	10% of total samples[1]	Qualitative control – Assess representativeness, comparability, and field variability, see Table 20.	Review procedures; alter if needed
Field filter blank	At least twice a year	Analyte concentration should be below the reporting limit	Compare filter blanks for analyte to determine whether the sampling process is the source of contamination; re-evaluate decontamination procedures; evaluate results greater than 5x blank concentrations
Transfer blank	At least one sample a year	Blank analyte concentration should be below the reporting limit	Compare blanks for analyte to determine whether the sampling process is the source of contamination; re-evaluate decontamination procedures; evaluate results greater than 5x blank concentrations
Other blank samples for determining a contamination source	As needed	Blank analyte concentration should be below the reporting limit	Compare results from separated blanks to isolate the source of contamination; evaluate results greater than 5x blank concentrations

[1] Total samples refers to the total number of samples of the pooled fund sites or number of sites monitored by Option 2 permittees.

Laboratory Quality Control Procedures

This section discusses the laboratory QC procedures that will be implemented to provide high quality data. Field QC procedures were previously described as part of the *Field Operations* sections of this QAPP. QC will be monitored throughout the duration of the study. The quality of raw, unprocessed, and processed data is subject to review according to established protocols in the *Measurement Quality Objectives* section of this QAPP.

Biotic samples

QC procedures for biotic samples are currently limited to field replicates precision and laboratory duplicates for accuracy for benthic macroinvertebrates and periphyton. Contract laboratories will make every effort to ensure accurate identification of specimens. More information on laboratory QC procedures is provided in Appendix F-2 and F-3.

Water and sediment samples

This section discusses QC procedures that will be implemented by the contracted analytical laboratory to provide high quality chemical and physical analyses that meet these QAPP requirements. Contract laboratories will make every effort to meet sample holding times and target reporting limits for all parameters. Laboratory QC procedures and results will be closely monitored throughout the duration of the permit-mandated sampling. The quality of laboratory data is subject to review via the established protocols in the *Measurement Quality Objectives* section. A typical schedule for laboratory QC samples is shown in Table 21 and, at a minimum, includes:

- Laboratory duplicates
- Matrix spikes
- Matrix spike duplicates
- Method/instrument blanks
- References (lab standards/surrogate standards/internal standards)

Table 19. Laboratory quality control schedule for monitoring.

Quality Control Sample[1]	Analysis Type	Frequency[2]	Corrective Action
Laboratory Duplicates	Metals	5% of total samples or 1 per batch (method-specific)	Evaluate procedure; reanalyze or qualify affected data
	Conventional		
	Microbiology		
Matrix Spikes (full constituent list)	Metals	5% of total samples or 1 per batch	Evaluate procedure and assess potential matrix effects; reanalyze or qualify data
	Conventional	5% of total samples or 1 per batch	
	Organics	5% of total samples or 1 per batch	Evaluate duplicates and surrogate recoveries and assess matrix effects; evaluate or qualify affected data
Matrix Spike Duplicates[3]	Metals and Organics	At least 1 samples per year; Metals can be run either by MSD or lab duplicates at otherwise; 5% of total samples or 1 per batch	Evaluate procedure and assess potential matrix effects; reanalyze or qualify data
Method Blanks	Metals	5% of total samples or 1 per batch (method-specific)	Blank concentration may be used to define a new reporting limit. Evaluate procedure; ID contaminant source; reanalyze samples if blanks are within 10x concentration. No action necessary if samples are >10x blank concentrations
	Conventional		
	Organics		
	Microbiology		
Spiked (or Fortified) Blanks	Metals, Organics and Conventionals	5% of total samples or 1 per batch (primarily water)	Evaluate matrix spike recoveries; assess efficiency of extraction method; flag affected data
References (lab control standard, lab control sample, or standard reference materials)	Metals	5% of total samples or 1 per batch (spiked blank). If available, solid batches only: LCSs at 10% of total samples or 2 per batch (SRM/SRMD).	Evaluate lab duplicates/matrix spike recoveries; assess efficiency of extraction method; evaluate or qualify affected data
	Conventional	5% of total samples or 1 per batch	
	Organics	5% of total samples or 1 per batch (spiked blank). If available, solid batches only: SRMs at 10% of total samples or 2 per batch (SRM/SRMD).	
Surrogates	Organics	Surrogates frequency is 100%	Evaluate results; qualify or reanalyze or re-prep/reanalyze samples.
Internal Standards	Metals and Organics	Internal Standard frequency is 100% for GC/MS and ICPMS methods	Evaluate results; dilute samples, reassign internal standards or flag data.

[1] Quality control samples may be from different projects for frequencies on a per-batch basis.
[2] Frequencies may be determined from the study number of samples collected by the permittee.
[3] The lab may use either a matrix spike duplicate or laboratory duplicate to evaluate precision based on the method.

Instrument calibration

The instrumentation used by the chosen laboratories will meet or exceed manufacturers' specifications for use and maintenance. Maintenance of this equipment will be conducted in a manner specified by the manufacturer or by the QA guidelines established by the chosen laboratory.

Duplicate/splits

Laboratory duplicate samples will be analyzed regularly to verify that the laboratory's analytical methods are maintaining their precision. The laboratory should perform "random" duplicate selection on submitted samples that meet volume requirements. After a sample is randomly selected, the laboratory should homogenize the sample and divide it into two identical "split" samples. To verify method precision, identical analyses of these lab splits should be performed and reported. Some parameters may require a double volume for the parameter to be analyzed as the laboratory duplicate. Matrix spike duplicates may be used to satisfy frequencies for laboratory duplicates.

Matrix spikes and matrix spike duplicates

Matrix spike samples are triple-volume field samples (per parameter tested) to which method-specific target analytes are added or spiked into two of the field samples, and then analyzed under the same conditions as the field sample. A matrix spike provides a measure of the recovery efficiency and accuracy for the analytical methods being used. Matrix spikes can be analyzed in duplicate (matrix spike/matrix spike duplicate [ms/msd]) to determine method accuracy and precision. Matrix spikes will be prepared and analyzed at a rate of 1/20 (five percent) samples collected or one for each analytical batch, whichever is most frequent. Use of ms/msd at the frequency of 5% of the total number of samples is common practice. For the purposes of permit monitoring, these frequencies meet the expectations.

Blanks and standards

Laboratory blanks are useful for instrument calibrations and method verifications, as well as for determining whether any contamination is present in laboratory handling and processing of samples.

Laboratory standards

Laboratory standards (reference standards) are objects or substances that can be used as a measurement base for similar objects or substances. In many instances, laboratories using digital or optical equipment will purchase from an outside accredited source a solid, powdered, or liquid standard to determine high-level or low-level quantities of a specific analyte. These standards are accompanied by acceptance criteria and are used to test the accuracy of the laboratory's methods. Laboratory standards are typically used after calibration of an instrument and prior to sample analysis.

Surrogate and internal standards

Surrogate standards are used to process and analyze extractable organic compounds (PAHs, phthalates, and pesticides). A surrogate standard is added before extraction, and it monitors the efficiency of the extraction methods. Internal standards are added to organic compounds and metal digests to verify instrument operation when using inductively coupled plasma mass spectrometry (ICP-MS) analysis and gas chromatography-mass spectrometry (GC-MS) analyses.

Method blanks

Method blanks are designed to determine whether contamination sources may be associated with laboratory processing and analysis. Method blanks are prepared in the laboratory using the same reagents, solvents, glassware, and equipment as the field samples. These method blanks will accompany the field samples through analysis.

Instrument blank

An instrument blank is used to “zero” analytical equipment used in the laboratory’s procedures. Instrument blanks usually consist of laboratory-pure water and any other method-appropriate reagents, and they are used to zero instrumentation.

Inter-laboratory comparison

There is a recognized need to conduct an inter-laboratory comparison study because multiple laboratories will analyze samples for the RSMP. The two main laboratories KCEL and MEL will participate in the inter lab comparison. Parameters were chosen either because the analytical methods vary slightly or because the parameter itself tends to be have more natural variability in the field samples.

The following parameters are planned for the inter-laboratory comparison study.

> Water samples: ammonia, nitrate+nitrite, turbidity, dissolved metals, and to a lesser extent PAHs.
>
> Sediment samples: percent solids, metals, and to a lesser extent PAHs.

The RSMP will target 10% of the total samples for inter-lab comparison sediment samples; 10 sediment samples total. A lesser effort is planned for the waters (a rate of 2% of the water samples) are initially planned for comparison to limit expense and effort if there are minor differences. A recent local laboratory comparison study showed few and minor differences between MEL and KCEL for several of the parameters that will be analyzed in this study (King County, 2009). PAHs will be compared to a lesser extent as well due to costs.

Measurement quality objectives (MQOs) for laboratory samples

This section refers to the MQOs, the acceptance thresholds for water data collected under the Water Quality Index monitoring, and sediment data collected under watershed health monitoring. MQOs specifically are used to address instrument and analytical performance.

MQOs established for stormwater permit monitoring are based on guidance from multiple sources, including EPA, Ecology, and laboratory experience. Tables 20 and 21 represent how data will be verified prior to reporting results. Failure to meet the MQOs may result in data being qualified or rejected.

Table 20. Measurement quality objectives (MQOs) for water chemistry and chlorophyll *a* for periphyton.

Water Parameters	Methods in Water MQO[3]	Reporting Limit Target	Field Replicate (RPD) [1]	Matrix Spike[2] (% Recovery)	Lab Duplicate (RPD) [1]	Control Standard/ Surrogate (% Recovery)
		Sensitivity	Precision	Bias and Accuracy	Precision	Bias and Accuracy
Conventionals						
Chloride	EPA 300.0 or SM4110B	0.1 mg/L	≤20%	75-125	≤20%	85-115
Dissolved Organic Carbon (DOC)	SM 5310B	1 mg/L	≤20%	75-125%	≤20%	85-115
Dissolved Oxygen*	Electrode meter	±0.2 mg/L	n/a	n/a	n/a	n/a
Fecal coliform	SM 9222D	1 cfu/100 mL	≤50%	n/a	method-defined	n/a
Hardness as CaCO3	SM 2340B and EPA 200.7 or 200.8	0.3 mg/L	≤20%	75-125	≤20%	85-115
pH*	Electrode Meter	± 0.2 std. units	≤10%	n/a	n/a	n/a
Specific conductance* (conductivity)	Electrode meter ±5 us/cm at 100 us/cm	15 umhos/cm	≤10%	n/a	n/a	90-110
Total suspended solids (TSS)	SM 2540D	1 mg/L	≤25%	n/a	≤25%	80-120
Turbidity	SM 2130[5]	0.5 NTU	≤25%	n/a	≤25%	90-110
Temperature*	Electrode meter	± 0.2°C	≤10%	n/a	n/a	n/a
Chlorophyll *a* – in periphyton[4]	SM 10200H(3)	0.1 ug/L	≤50%	n/a	≤20%	n/a
Nutrients						
Ammonia-N	SM 4500-NH_3H[5-MEL] SM 4500-NH_3G[5-KCEL] Kerouel & Aminot 1997[5-KCEL]	0.01 mg/L	≤20%	75-125	≤20%	80-120
Nitrate+Nitrite-N	SM 4500-NO_3^-I[MEL] or SM 4500-NO_3^-F [5-KCEL]	0.01 mg/L[MEL] 0.04 mg/L[KCEL]	≤20%	75-125	≤20%	80-120
Total nitrogen (TN)	SM 4500-N-B[MEL] or SM 4500-N-C[KCEL]	0.025 – 0.1 mg/L	≤20%	75-125	≤20%	80-120
Orthophosphate	SM 4500 P-G, E, or F	0.003 mg/L	≤20%	75-125	≤20%	80-120
Total phosphorus (TP)	SM 4500 P-H, E, or F	0.005 – 0.01 mg/L	≤20%	75-125	≤20%	80-120

Water Parameters	Methods in Water MQO[3]	Reporting Limit Target	Field Replicate (RPD) [1]	Matrix Spike[2] (% Recovery)	Lab Duplicate (RPD) [1]	Control Standard/ Surrogate (% Recovery)
		Sensitivity	**Precision**	**Bias and Accuracy**	**Precision**	**Bias and Accuracy**
Metals and Organics						
Dissolved and Total Metals (Ag, As, Cd, Cr, Cu, Pb, Zn)	EPA 200.2/EPA 200.2 mod digestion[KCEL], EPA 200.8 mod ICPMS[5]	0.2 ug/L for Ag, As, Cd, Pb 0.5 ug/L for Cu, Cr 5 ug/L for Zn	≤20%	75-125	≤20%	85-115
Polycyclic Aromatic Hydrocarbons (PAHs)	EPA 8270D (GC/MS)[5]	0.1 ug/L	≤40%	Compound specific 40-140	≤40%	Compound specific 40-150

*Field-measured parameters follow manufacturer's website guidelines for meter calibrations.
EPA: Environmental Protection Agency method (http://water.epa.gov/scitech/methods/cwa/methods_index.cfm).
KCEL = King County Environmental Laboratory
MEL = Manchester Environmental Laboratory
SM: *Standard Methods for the Examination of Water and Wastewater* (www.standardmethods.org).
[1] The relative percent difference (RPD) must be less than or equal to the indicated percentage for values that are greater than 5 times the reporting limit. RPD must be ±2 times the reporting limit for values that are less than or equal to 5 times the reporting limit.
[2] For inorganics, the *Laboratory Program Functional Guidelines* state that the spike recovery limits do not apply when the sample concentration exceeds the spike concentration by a factor of 4 or more (EPA, 2010).
[3] MQOs are based on Hallock (2012) and SOP EAP033 (Swanson, 2007).
[4] MQOs are based on Adams (2010a) and MEL (2008) for chlorophyll *a* content, once field-filtered from a periphyton slurry sample.
[5] This method is part of the inter-laboratory comparison study between KCEL and MEL.

Table 21. Measurement quality objectives (MQOs) for chemical analysis of sediments.

Sediment Parameters for Bioassessment	Analysis Methods in Sediment MQO	Reporting Limit Target	Lab Replicate (RPD)[1]	Matrix Spike[2] (% Recovery)	Matrix Spike Duplicate (RPD)[1]	Control Standard/ Surrogate (% Recovery)
		Sensitivity	Bias and Precision	Bias and Accuracy	Bias and Precision	Bias and Accuracy
Grain Size on <2mm sieved sediment	PSEP, 1986 sieve and pipette or ASTM D422	Sensitivity = 1.0%	≤20%	n/a	n/a	n/a
Percent Solids[7]	SM 2540 G	Sensitivity = 0.01%	≤20%	n/a	n/a	n/a
Total Organic Carbon	PSEP (1986, with 1997a,b updates), combustion/CO^2 [5-MEL 2008] Or PSEP, 1986 combined with EPA 9060A [5-KCEL]	Sensitivity = 0.1%	≤20%	n/a	n/a	80-120
Metals[7]: (Ag, As, Cd, Cr, Cu, Pb, Zn)	EPA Method 6020A or 200.8 (ICP-MS)	(0.1, 0.2, 0.1, 2.0, 0.5, 0.5, 5.0) mg/Kg dw	≤20%	75-125	≤20%	85-115 (spiked blank) ERA Soil[10] 80-120 (As, Cd, Cu, Pb, Zn) 74-126 (Ag) 79-120 (Cr)
2,4-D, triclopyr	EPA 8151A (GC-MS/MS)	6.7 ug/Kg dw	n/a	40-130	≤40%	40-130
Chlorpyrifos and Dichlobenil	EPA 8270D (GC-MS/MS)	6.7 ug/Kg dw	n/a	40-130	≤40%	40-130
Diuron and Carbaryl	EPA 8321B (LC-MS/MS)	6.7 ug/Kg dw	n/a	30-130	≤40%	40-130
Phthalates	EPA 8270D (GC-MS)	70 ug/Kg dw Except di-n-octlylphthalate (250 ug/Kg dw)	Compound specific ≤40%	Compound Specific 40-150	≤40%	40-150[3]
Polycyclic aromatic hydrocarbon (PAH) compounds[7]	EPA 8270D (GC-MS)	70 ug/Kg dw	Compound specific ≤40%	Compound Specific 50-150	≤40%	Spiked Blank Compound Specific 50-150[3] SRM 1944 Compound Specific 40-200[11]
Polychlorinated biphenyls (PCBs)	EPA Method 1668A	20 ng/Kg dw[4]	≤20%	50-150	≤40%	Compound Specific 25-150[3]

Sediment Parameters for Bioassessment	Analysis Methods in Sediment MQO	Reporting Limit Target	Lab Replicate (RPD)[1]	Matrix Spike[2] (% Recovery)	Matrix Spike Duplicate (RPD)[1]	Control Standard/ Surrogate (% Recovery)
		Sensitivity	Bias and Precision	Bias and Accuracy	Bias and Precision	Bias and Accuracy
Polybrominated diphenyl ethers (PBDEs)	EPA 1614	2 ng/Kg dw[4]	≤20%	50-150	25-150%[5]	50-150
Pharmaceuticals and personal care products (PPCPs)	EPA 1694 (HPLC-MS/MS)	1- 1000 ug/Kg dw[8]	Compound specific ≤40%	n/a	n/a	Compound specific 5-200[9]
Hormones/Steroids (H/S)	EPA 1698 (HR-GC/MS)	0.1- 100 ug/Kg dw	Compound specific ≤40%	n/a	n/a	Compound specific 5-200[9]

EPA: Environmental Protection Agency Method (http://water.epa.gov/scitech/methods/cwa/methods_index.cfm).
SM: *Standard Methods for the Examination of Water and Wastewater* (www.standardmethods.org).
PAH compounds include: 1-methylnaphthalene, 2-methylnaphthalene, 2-chloronaphthalene, acenaphthylene, acenaphthene anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b, j and k)fluoranthene, benzo(ghi)perylene, dibenzo(a,h)anthracene, dibenzofuran, carbazole, chrysene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, pyrene, and retene.

Pesticides include: 2,4-D, triclopyr, carbaryl, and chlorpyrifos.
Phthalates include: bis(2-ethylhexyl) phthalate, butyl benzyl phthalate, diethyl phthalate, dimethyl phthalate, di-n-butyl phthalate, and di-n-octyl phthalate.
PBDE congeners include: 47, 49, 66, 71, 99, 100, 138, 153, 154, 183, 184, 191, 209.
PCB congeners include: all 209 congeners.
PSEP: Puget Sound Estuary Program (PSEP) Protocols, www.psparchives.com/our_work/science/protocols.htm.

RPD: Relative percent difference.
[1] The relative percent difference (RPD) is calculated when at least one of the result values is above the practical quantitation limit; if both values are below then the RPD is not calculated.
[2] For inorganics, the *Laboratory Program Functional Guidelines* state that the spike recovery limits do not apply when the sample concentration exceeds the spike concentration by a factor of 4 or more (EPA, 2010).
[3] Semivolatile surrogate recoveries are compound specific. MQOs are based on Johnson (2005) and Dutch et al. (2010).
[4] Varies with congener. PBDE and PCB MQOs are based on Johnson (2010) and Dutch et al. (2010).
[5] Except 20-200% for 13C12DeBDE; see EPA Method 1614.
[6] Applies to most congeners; see EPA Method 1668A.
[7] This parameter is part of the inter-laboratory comparison study between KCEL and MEL
[8] PPCP and H/S MQOs are based on Dutch et al. (2010) and Lubliner et al. (2008).
[9] Labeled compounds are used, not surrogates; see EPA Method 1694 for PPCPs and 1698 for H/S.
[10] ERA solid LCS, “Metals in Soil”. The catalogue number is 540; the lot number for the current KCEL aliquot in-house is e D081-540.
[11] SRM 1944, “New York/New Jersey Waterway Sediment”.

Data Management

RSMP Contractors will be collecting and managing data from field observations and field measurements. The RSMP Coordinator will manage data from the laboratories used for the RSMP. All finalized data will be stored in EIM.

Field data

RSMP Contractors will record field water quality and watershed health data using field forms. If necessary, paper field forms should be printed on waterproof paper and kept in a three-ring binder during sampling. All field data sheets will be kept in an organized manner, copied, and originals sent to the RSMP coordinator. The copies should be stored by the RSMP Contractors. Post-processed data will be finalized and incorporated into electronic EIM spreadsheet templates and sent electronically to the RSMP coordinator.

Ecology intends to provide to RSMP Contractors electronic field data collection software that will assist RSMP Contractors to assure completeness in the field for benthos and habitat monitoring, and with loading this data to Ecology's Watershed Health database in EIM. Because timing (anticipated completion date of spring 2015) of the software development may not suit monitoring needs under this QAPP, recording on field forms is required.

Laboratory data

Chemical and bacteria laboratory data will be sent to the RSMP Coordinator from each laboratory following analysis. Reporting times may vary depending on holding time of the parameter. Water quality data turn around should not exceed 3 months of the documented sampling date. Sediment data turnaround time should also be 3 months for most parameters, except the organic compounds, commonly take 6 months for laboratories to return data. Laboratory reports will be reviewed by the RSMP Coordinator for errors or missing data; sub-contracted lab reports will be reviewed by the contracted laboratories. The RSMP Coordinator may implement corrective actions or contact the RSMP Contractors for support in doing so. Finalized electronic laboratory data will be loaded to Ecology's EIM database by RSMP Coordinator.

Data storage

All field forms, photographs, electronic data, and laboratory data generated for this project will be stored by the RSMP Contractors in an organized filing system for electronic or paper files. Field forms, EIM data forms, and laboratory data deliverables will be sent to the RSMP Coordinator for storage in paper and electronic files. Location, measurement, and sample result data will be evaluated through the data verification process, outlined earlier in this QAPP. Acceptable results will be entered into Ecology's EIM database and used by scientists to prepare a summary report.

Benthos data will be loaded into King County's Puget Sound Stream Benthos database (www.pugetsoundstreambenthos.org/), as well as the Watershed Health section of Ecology's EIM database. Periphyton data, habitat data, and any field-measured data will be entered into the Watershed Health section of EIM.

Data Verification and Usability

Data verification

Data verification involves examining the data for errors, omissions, and compliance with quality control (QC) acceptance criteria.

RSMP Contractors and field staff will verify field results after measuring and before leaving the site. They will keep field notes to meet the requirements for documentation of field measurements. The field lead will ensure that field data entries are complete and error-free. The field lead also will check for consistency within an expected range of values, verify measurements, ensure measurements are made within the acceptable instrumentation error limits, and record anomalous observations.

The field lead will verify field data to ensure that:

- Data are consistent, correct, and complete, with no errors or omissions.
- Results of QC samples accompany the sample results.
- Established criteria for QC results were met.
- Data qualifiers are properly assigned where necessary.
- Data specified in the Sampling Process Design were obtained.
- Methods and protocols specified in this QAPP were followed.

If labs suspect field blank contamination, the labs will notify the field crew and RSMP coordinator. The sample results will be reviewed by the RSMP coordinator to determine if samples associated with the field blanks should be qualified based on the contamination. Sample results may be flagged with a *J* if they are less than, or equal to, 5 times the field blank concentration.

The project manager at the taxonomic laboratory will verify all taxonomic results, and the laboratory will verify all analytical results prior to reporting.

Corrective actions for inadequate data

If discrepancies in the data are found, there are two options for correction, depending on when the problem is identified.

1. If the problem is identified before the end of the index period (July 1 to October 15), a review of the protocols and SOPs outlined in the appendices of this document is required. After this review, a repeat site visit may be made to re-collect the sample. This may occur if the data set is incomplete or incorrectly collected. Due to the inter-related nature of chemical and biological conditions, problems identified in the chemical or biological data should be addressed by again collecting the entire suite of chemical and biological analyses parameters. Because the habitat is mostly constant within an index period, if the data in question is related to habitat, only the missing habitat information needs to be collected. Before the second sampling, the investigator must review the SOPs and the appendices of this document to understand the protocols. Equipment should be cleaned and recalibrated and checked for proper function.
2. If the problem is identified after the index period, the data should be flagged and the problem explained in a comment in the database. This will allow the Ecology investigator, as well as external users of these data, to know how these data may be used in projects. If the data are incomplete, or if some data standard was not met, the data will not be used to meet the objectives of the study design.

Data usability assessment

Data usability assessment follows verification. This involves a detailed examination of the data package using professional judgment to determine whether the quality objectives have been met. The project manager examines the complete data package to determine compliance with procedures outlined in the QAPP and SOPs. The RSMP Coordinator and RSMP Contractors will ensure that the MQOs have been met and determines if the quality of the data are usable for the project objectives.

Stream Monitoring Reports

2015 RSMP Contractor Report(s)

All RSMP Contractors will submit quarterly stream monitoring reports as deliverables to the RSMP Coordinator. The stream monitoring report will include a complete discussion of the monitoring effort. The report will include:

- A summary of the RSMP Contractor's monitoring activities for water quality, watershed health, and sediment chemistry
- The field monitoring data gathered using field meters and observations, including the field data sheets
- A detailed account of any problems or concerns that arose during sampling
- If new sites were selected, documentation of reasons for and timing of when initial sites were found unsuitable, and of the site evaluation and confirmation for the new sites

Table 22 outlines the required monitoring report elements. These monitoring reports shall be submitted electronically, as MS Word documents.

Annual Reports

The RSMP Coordinator will prepare a brief annual monitoring report in June of 2015 and 2016 for the SWG. The annual stream monitoring report will include a complete discussion of the monitoring effort. The report will include a summary of the RSMP Contractor's monitoring activities for water quality, watershed health, and sediment chemistry and the elements in Table 22 as information is made available.

Data Analysis and RSMP Small Streams Final Report

An addendum to this QAPP will be written in 2015 to update this section and describe the analysis goals of the RSMP small streams data. Direction and support for this addendum will come from both the PSEMP SWG and the PSEMP Freshwater Work Group (FWG). The final report will at a minimum include a complete status assessment for the monitoring program. Table 22 provides a list of elements that will be included in the final report.

Table 22. Report elements.

Category	Reporting Requirement
Site Confirmation	Documentation of the site confirmation process, including desktop evaluation and field visits for each of the required number of assigned sites.
	List of sites disqualified and specific reasons for disqualification.
	List of final sites monitored. In a table, provide final GPS coordinates for each site and the distances from the initial GPS locations provided in the Master Sample; and indicate the Strahler stream order.
Ancillary Site Information	Description of land use adjacent to the reach sampled.
	Description of the upstream land use of the basin contributed to the site sampled.
	Area (in square miles) of the basin draining to the site.
	Approximate (to the nearest 5%) percentages of industrial, commercial (including multi-family residential), residential (3 categories: 5 or more dwelling units per acre; 3-4 dwelling units per acre; 1-2 dwelling units per acre), agricultural, and forest land uses in the basin area draining to each site.
Water Quality Monitoring	Sample information (dates, times, locations).
	Tabular water quality data. Water Quality Index (WQI) monitoring results shall be provided in an Excel spreadsheet cross-tab format (see Appendix N). This format is designed to facilitate WQI calculations by the permittee or Ecology.
	Summary results for each monitored parameter at each site and for all of the sites.
	Computation of the WQI for each site.
Watershed Health Monitoring	Sample information (dates, times, locations).
	Benthos, habitat, periphyton, and sediment monitoring results for each site and for all of the sites.
	B-IBI score for each site using the 0-100 scale.
Concerns	Narrative description of any deviations from this QAPP, including any delays, problems, and resolutions in conducting required monitoring activities.
Recommendation	Description of the results of the first round of the RSMP small streams monitoring program. Recommendations on the site representation, parameters monitored, needed additional analysis for data interpretation, and any other information that would be useful for the next round of the Puget Lowland small streams monitoring.

References

Web links to resources

EPA's aquatic resource monitoring - frequently asked questions

Survey sampling:	www.epa.gov/nheerl/arm/sursampfaqs.htm
Survey design:	www.epa.gov/nheerl/arm/surdesignfaqs.htm
Data analysis:	www.epa.gov/nheerl/arm/dataanalysisfaqs.htm

EPA's data analysis resources and tools for surveys

General statistical books on survey designs:
www.epa.gov/nheerl/arm/bibliography.htm#generalsurveydesignbooks

Monitoring Data Analysis and Reporting:
www.epa.gov/nheerl/arm/analysispages/monitanalysisinfo.htm

Presentations on statistical analysis processes:
www.epa.gov/nheerl/arm/presents.htm

Statistical tools for data analysis (Software for R):
www.epa.gov/nheerl/arm/analysispages/software.htm

Example analysis software for EMAP West Wadeable Stream Data
www.epa.gov/nheerl/arm/analysispages/r10_work/r10_intro.htm

Stressor Identification Guidance:
http://water.epa.gov/scitech/swguidance/standards/criteria/aqlife/biocriteria/stressors_index.cfm

Biological Indicators of Watershed Health:
http://water.epa.gov/scitech/swguidance/standards/criteria/aqlife/biocriteria/index.cfm

Ecology's relevant resources for biological, habitat, and water quality sampling

Status and Trends Statewide Monitoring:
www.ecy.wa.gov/programs/eap/stsmf

Stream Biological Monitoring:
www.ecy.wa.gov/programs/eap/fw_benth

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

River and Stream Water Quality Index:
www.ecy.wa.gov/programs/eap/fw_riv/docs/WQIOverview.html

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Ecology, 2012b. Phase II Municipal Stormwater Permit. National Pollutant Discharge Elimination System and State Waste Discharge General Permit for Discharges from Small Municipal Separate Storm Sewer Systems. Water Quality Program, Washington State Department of Ecology. Olympia, WA. Issuance date: August 1, 2012.

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