Quality Assurance Project Plan Guidance

Special Condition S8.D

Phase I Municipal Stormwater Permit

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Quality Assurance Project Plan Guidance

Guidance for Special Condition S8.D of the Phase I Municipal Stormwater Permit

by
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Abstract/Executive Summary

The Washington State Department of Ecology (Ecology) prepared this Quality Assurance Project Plan (QAPP) Guidance to assist permittees under the Phase I Municipal Stormwater NPDES Permit (Phase I Permit), issued January 2007. The focus of this guidance document is on S8.D Stormwater Monitoring requirements found in the Phase I Permit. This guidance does not address requirements for other monitoring activities found in special condition S8 including S8.E, Targeted Stormwater Management Program Effectiveness Monitoring or S8.F, Stormwater Treatment and Hydrologic Best Management Practices Evaluation Monitoring. Using the information provided in this document collaboratively with other Phase I permittees provides a means for consistent data collection to ensure data comparability.

List of Acronyms

%R – Percent reduction
BOD5 – Biological oxygen demand (5-day test)
DQI – Data quality indicator
EMC – Event mean concentration
MBAS – Methylene blue activated substances
MQO – Measurement quality objective
MS – Matrix spike
MSD – Matrix spike duplicate
NPDES – National Pollutant Discharge Elimination System
PAH – Polycyclic aromatic hydrocarbons
PCB – Polychlorinated biphenyl
QA – Quality assurance
QAPP – Quality Assurance Project Plan
RPD – Relative percent difference
RY – Reporting year
SOP – Standard operating procedure
TSS – Total suspended solids

Introduction

Sections in this QAPP Guidance follow Ecology's *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies,* Publication No. 04-03-030 (Ecology 2004). Each section corresponds to one of the 14 required elements of a QAPP with each section organized into the following four categories:

- **General guidance –** Guidance taken from Department of Ecology, U.S. Geological Survey and/or Environmental Protection Agency publications define the content of each section. Use this language as guidance to assist with development of each section of your QAPP.
- **Optional boilerplate content –** Text or tables are provided for your use. This information may be included in your draft QAPP, although some tailoring may be necessary.
- **Additional resources or references –** Many sections include references and websites for additional information.

References

This QAPP guidance should be used in *addition* to Ecology's *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies*. Permittees are not required to use this guidance to develop permit required QAPPs. Language used in this guidance document is derived from the references listed below and does not legally override any new or existing permit requirements. The references used in the development of this guidance include:

1. Department of Ecology *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies*, Publication No. 04-03-030 (Ecology, 2004).
2. Department of Ecology *Quality Assurance Project Plan Development Tool, Module 2, Ecology Template for Preparing QA Project Plans* (Ecology Module 2, 2004).
3. Department of Ecology *Phase I Municipal Stormwater Permit* (Ecology, 2007).
4. Department of Ecology *Phase I Municipal Permit Fact Sheet* (Ecology, 2006).
5. Phase I Permit Appeals Settlement Agreement for Section S8. Stormwater Monitoring (Ecology, 2008).
6. U.S. Geological Survey, *National Field Manual for the Collection of Water Quality Data, Book 9* (USGS, 2006).
7. *U.S. EPA Guidance on Environmental Data Verification and Data Validation* (EPA QA/G-8, 2002).

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What is a Quality Assurance Project Plan (QAPP)?

A QAPP describes the goals and objectives of a monitoring project, and procedures necessary to achieve objectives. Preparation of a QAPP helps focus and guide project planning, and promote communication among those who contribute to the study. A completed QAPP provides direction to those who carry out monitoring projects while providing regulators/managers a view of successful and validated data collection systems.

Preparing a QAPP should be a team effort coordinated by a designated project manager. The team includes (where applicable) the municipal client, representatives of the analytical laboratory (or laboratories), field staff, and anyone else who will contribute to the project. The team may also include specialists to provide advice on quality assurance, information management, and statistics.

What do I do if my QAPP becomes outdated?

Ecology must review and approve QAPPs submitted under S8.D of the Phase I National Pollutant Discharge Elimination System (NPDES) Municipal Stormwater General Permit (Phase I Permit). After Ecology's approval, programs may be adjusted as you learn more about the monitoring project (sampling procedures, equipment, storm events). The QAPP should be kept up-to-date and used as a training tool for staff. The QAPP should be updated periodically and revised to include changes to your program. Only substantial changes to the Stormwater Monitoring program must be submitted to Ecology for review and approval. Some examples of substantial changes include:

- Relocating a monitoring site.
- Sampling procedure changes that may affect data quality.
- New data analysis procedures.
- New analytical methods used.

What should my QAPP look like?

The Phase I Permit requires you to use the *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies* (Ecology 2004). Each of the following 14 elements must be contained in sections in your QAPP. If a section is not pertinent to your sampling design, create the page with the section header and indicate "not applicable" and explain why. Required QAPP sections include:

Section 1a	Title Page
Section 1b	Approval Page
Section 2a	Table of Contents
Section 2b	Distribution Lists
Section 3	Background

Section 4	Project Description
Section 5	Organization and Schedule
Section 6	Quality Objectives
Section 7	Sampling Process Design (Experimental Design)
Section 8	Sampling Procedures
Section 9	Measurement Procedures
Section 10	Quality Control
Section 11	Data Management Procedures
Section 12	Audits and Reports
Section 13	Data Verification
Section 14	Data Validation (Usability) Assessment

Preparing a QAPP requires a basic understanding of concepts related to sampling, field and laboratory measurements, and assessment of data quality. Attachments can provide additional information useful to this QAPP and can include documents such as:

- Standard Operating Procedures (SOPs).
- Glossaries for defining terms used.
- Laboratory quality assurance procedures.
- References of sources cited or used.
- Standard field and laboratory forms.

All attachments, including SOPs, should be included in your Table of Contents and submitted with the QAPP. The Phase I Permit requires two hard copies and one electronic version of the QAPP submitted to the assigned Regional Permit Specialist. Be sure to include your permit number.

The Department of Ecology provides SOPs for public use. Stormwater sampling SOPs referenced in Appendix A of this document are available on the Environmental Assessment Program's Quality Assurance Website at: http://www.ecy.wa.gov/programs/eap/quality.html.

Ecology's Stormwater Monitoring Reporting Guidance provides additional guidance for data reporting under the S8.D: http://www.ecy.wa.gov/biblio/1010028.html.

Ecology's *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies* (Ecology 2004) is available at: http://www.ecy.wa.gov/biblio/0403030.html.

Section 1a Title Page

General guidance

The *Title Page* should include project title, permittee information (including permit number), date of QAPP, and author(s) of QAPP.

Optional boilerplate content

Table 1. Boilerplate Title Page

Title of Project:
Permittee Information:
Author(s):
Date of Project:

Section 1b Approval Page

General guidance

The *Approval Page* should identify key project officials by name, title, and organization name. Approvers can include, but are not limited to: project managers, quality assurance managers, data reviewers, field staff, laboratory managers, and/or prime contractors and subcontractors. Certification and signature requirements should meet requirements in General Condition G19 of the Phase I Permit.

Optional boilerplate content

Table 2. Boilerplate Approval Page

Name	Title	Organization Name	Signature

Section 2a Table of Contents

General guidance

The *Table of Contents* should identify each section of your QAPP according to the *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies* (Ecology 2004). List tables, figures, and appendices/attachments, and include references (if applicable).

If information for a required section is unavailable or not applicable to your study, keep the section heading and include text such as “no data available” or “not applicable”. If additional information is applicable to your project, include it as an attachment or as an appendix.

Optional boilerplate content

Table 3. Boilerplate Table of Contents

	Page #
Title Page	
Approval Page	
Table of Contents	
Distribution List	
Background	
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Audits and Reports	
Data Verification and Validation	
Data Quality (Usability) Assessment	
List of Tables	
List of Figures	
List of Attachments (Appendices)	

Section 2b Distribution List

General guidance

The *Distribution List* should list all individuals and/or organizations that will receive copies of the approved QAPP and any subsequent revisions. Include the names, titles or positions, and organization of key project personnel responsible for project implementation, funding, and all others who will be distributed a copy of the approved QAPP. Examples include project manager, laboratory manager, field team leader, data processor or statistician, modeler, quality assurance (QA) officer, data reviewer, and essential contractor, and/or subcontractor personnel.

Optional boilerplate content

Table 4. Boilerplate Table for Distribution List

Name	Title	Organization Name

Section 3 Background

General guidance

The *Background* section of your stormwater monitoring QAPP can include a description of the permit-driven purpose for conducting the project with project goals and objectives. Include a brief description of your stormwater monitoring sites (study area) and describe the associated drainage basin. A more detailed description of your selected sites and your site selection process should be included in Section 7, *Sampling Process Design*.

Optional boilerplate content

The Phase I Permit applies to all entities in Washington State required to have permit coverage and conduct Stormwater Monitoring in accordance with S8.D under current (Phase I) U.S. Environmental Protection Agency (EPA) stormwater regulations. This includes cities and unincorporated portions of counties whose populations exceed 100,000. Washington State Phase I permittees include:

- King County.
- Pierce County.
- Snohomish County.
- Clark County.
- City of Seattle.
- City of Tacoma.

Under the 2007 Phase I Permit, two Phase I Secondary permittees are also required to conduct Stormwater Monitoring in accordance with S8.D:

- Port of Seattle.
- Port of Tacoma.

The stormwater problem

Rain, and its resulting stormwater runoff, collect and carry pollutants from the air and impervious surfaces, such as rooftops, landscaping, and pavement in various environments. According to the Puget Sound Action Team:

- Stormwater pollution has harmed virtually all urban creeks, streams, and rivers in Washington State.
- Stormwater is the leading contributor to water quality pollution of urban waterways in the state.
- Two species of salmon and bull trout are threatened with extinction under the federal Endangered Species Act. Loss of habitat due to stormwater and development is one of the causes.

- Shellfish harvest at many beaches is restricted or prohibited due to pollution. Stormwater runoff is often one of the causes.
- English sole are more likely to develop cancerous lesions on their livers in more urban areas. Stormwater likely plays a role (Ecology, 2006).

During the wet winter months, high stormwater flows, especially long-lasting high flows, can:

- Cause flooding.
- Damage property.
- Harm, and render unusable, fish and wildlife habitat by eroding stream banks, widening stream channels, depositing excessive sediment, and altering natural streams and wetlands.

In addition, more impervious surface area from development means less water soaks into the ground. As a result, drinking water supplies are not replenished, and streams and wetlands are not recharged. This can lead to water shortages for people, and inadequate stream flows and wetland water levels for fish and other wildlife.

There are many pollution sources that may contaminate stormwater, including land use activities (ranging from private homes to commercial and industrial activities, golf courses, agriculture, and parks), operation and maintenance activities, illicit discharges and spills, atmospheric deposition, and vehicular traffic conditions. Many of these sources are not under the direct control of the municipalities that own and operate the storm sewer systems. Some contaminants come from historical use (legacy contaminants); others are naturally occurring and enter through actions such as erosion. The following table lists some common stormwater pollutants with a selection of related potential sources (Ecology, 2006).

Table 5. Pollutants and Potential Sources

Pollutant	Potential Sources
Lead	Motor Oil, Transmission Bearings, Gasoline
Zinc	Motor Oil, Galvanized Roofing, Tire Wear, Down Spouts
Cadmium	Tire Wear, Metal Plating, Batteries
Copper	Brake Linings, Thrust Bearings, Bushings, Roofing
Chromium	Metal Plating, Rocker Arms, Crank Shafts, Brake Linings, Yellow Lane Strip Paint
Arsenic	ASARCO Smelter, Fossil Fuel Combustion
Bacterial/Viral Agents	Domestic Animals, Septic Systems, Animal & Manure Transport
Oil & Grease	Motor Vehicles, Illegal Disposal of Used Oil
Organic Toxins	Pesticides, Combustion Products, Petroleum Products, Paints & Preservatives, Plasticizers, Solvents
Sediments	Construction Sites, Stream Channel Erosion, Poorly Vegetated Lands, Slope Failure, Vehicular Deposition
Nutrients	Sediments, Fertilizers, Domestic Animals, Septic Systems, Decomposing Vegetative Matter
Heat	Pavement Runoff, Loss of Shading Along Streams
Oxygen Demanding Organics	Vegetative Matter, Petroleum Products

(Ecology, 2006)

Controlling stormwater discharges

Stormwater runoff discharges are not continuous, and storm events can be unpredictable. These discharges are intermittent and weather-dependent in nature (i.e., rainfall amount, duration, and intensity). There is a wide range of pollutants and their concentrations in stormwater runoff vary from one storm event to another. Municipal stormwater discharges are not centrally located, but consist of large numbers of outfalls where stormwater is discharged throughout an entire city (hundreds, or even thousands of outfalls within a city are typical). Discharge variability is also caused by a wide range of physical factors including hydrology and geology, infiltration into the ground or the capturing of groundwater into the conveyance system, gradient, drainage area, percent impervious surface etc.

Three basic control strategies exist for stormwater. First, prevent pollutants from coming into contact with stormwater by using source control best management practices (BMPs). Second, apply treatment BMPs prior to discharge to surface or ground waters to reduce pollutants in the discharge. Third, control the flow rate of stormwater through flow control BMPs (Ecology, 2006).

Required stormwater monitoring program

The primary objective of the monitoring program described in S8.D of the Phase I Permit is to characterize pollutants from three different land uses by sampling three outfall discharges. The knowledge of pollutant loads from various land uses drained by the municipal storm sewer systems is necessary to gauge whether the comprehensive stormwater management programs are making progress towards the goal of reducing the amount of pollutants discharged and protecting water quality. This information will help to provide a feedback loop for adaptive management of stormwater management programs. The number of samples per year, coupled with qualifying event criteria, is used to establish a sufficient dataset from which annual and seasonal loading are estimated.

Sites for long-term stormwater monitoring, based on land use types, have been selected to represent the municipal area. Attempts were made to select sites where opportunities exist to measure and record water quality trends over time. Stormwater at each outfall discharge site will be monitored in the following ways, as required in S8.D of the Phase I Permit:

- Continuous flow monitoring (for the first year) and during all sampled storm events.
- Continuous rainfall data collection.
- Flow weighted-composite sampling for chemical analyses.
- Grab sampling for limited chemical analyses.
- Toxicity testing of seasonal first-flush storm.
- Sediment sampling for chemical analyses.

Section 4 Project Description

General guidance

The *Project Description* section of your stormwater monitoring QAPP can include a summary of the type of monitoring (sampling) and analysis planned in accordance with S8.D. This section in your QAPP should also include any practical constraints imposed upon the study design, and a description on how newly collected data may inform decision-making and your Stormwater Management Program (SWMP).

Optional boilerplate content

The sampling design for stormwater monitoring under S8.D includes three primary components that will be conducted at each monitoring site through the remainder of the Phase I Permit cycle:

- Composite stormwater sampling including flow rate data collection and rainfall data collection.
- Toxicity sampling.
- Sediment sampling.

Composite stormwater sampling including grab sampling

Flow-weighted composite and grab sampling techniques will be used to collect stormwater samples from qualifying storm events throughout each water year. The water year applicable to all of the Phase I permittees is from October 1st through September 30th each year. A goal of 60% to 80% of the stormwater samples will be collected during the wet season each year, and a goal of 20% to 40% will be collected during the dry season.

Grab samples will be collected at each stormwater monitoring site during qualifying storm events as early in the storm event as possible. Standard operating procedures for collecting grab samples from stormwater discharges can be found in Appendix A.

Continuous flow data will be collected for one year to establish rainfall and runoff relationships at each outfall site and during all storm events.

Event mean concentrations (EMCs), total annual pollutant loads, and seasonal pollutant loads will be calculated for each sampled parameter at each monitoring site. Standard operating procedure for calculating pollutant loads can be found in Appendix A.

General guidance: Standard operating procedure for automatic stormwater sampling can be found in Appendix A of this document.

Toxicity sampling

Toxicity sampling will be conducted using composite sampling equipment at each stormwater monitoring site. One sample will be collected during the seasonal first flush storm event at each site. Sampling will be targeted in August or September with one-week antecedent dry period (or October, irrespective of antecedent dry period, if unsuccessful in August or September). One sample is to be collected with a limit of two attempts required.

The stormwater sample for toxicity testing will also include chemical analyses on the same sample, or an equally representative stormwater sample, collected simultaneously. The purpose of the chemical analysis for toxicity testing is to verify the presence of toxic substances that could reduce viability of salmonid embryos.

General guidance: A question and answer guidance document for toxicity can be found in Appendix B. Additional guidance for toxicity monitoring can be found in other sections of this guidance document.

Sediment sampling

Sediments will be collected at each stormwater monitoring site using sediment traps or similar devices. If sufficient volume is unattainable from these devices, other methods for collection may be approved by Ecology. Collected sediments will be analyzed annually for pollutants that have shown to be associated with stormwater discharges and are found in urban embayments.

General guidance: Standard operating procedures for collecting stormwater sediments using in-line sediment traps can be found in Appendix A of this document.

Additional resource or reference to assist with this section

The National Stormwater Quality Database (NSQD, Version 1.1), February 16, 2004, Robert Pitt, Alex Maestre, and Renee Morquecho: http://unix.eng.ua.edu/~rpitt/Research/ms4/Paper/Mainms4paper.html.

Section 5 Organization and Schedule

General guidance

The *Organization and Schedule* section of your stormwater monitoring QAPP should identify your project team members and their project roles and/or responsibilities. Project team members can include Ecology regional staff, your organization's project manager and/or quality assurance manager, staff involved with QAPP review, field team lead(s), laboratory manager(s), database researchers (weather), data processors or modelers, and/or contractor or subcontractor staff.

This section of your QAPP should also provide a detailed description of the project schedule. Each monitoring site may have a slightly different schedule. Consider the following when developing a schedule: equipment purchase, delivery and installation, staff training, initiation of monitoring, sediment trap establishment, sample retrieval, permit-required deadlines, scheduled maintenance, data validation, and Stormwater Monitoring Report preparation. Remember that independently developed monitoring programs have 1.5 years from permit *effective* date to be fully implemented, and collaboratively developed monitoring programs have 2 years from permit *effective* date to be fully implemented (Phase I Permit, S8.G). Include your full monitoring implementation deadline which means equipment is installed, responsible personnel are trained, and storm event monitoring has begun at all required monitoring sites.

Wet season extends from October 1st until April 30th each year, and dry season extends from May 1st through September 30th each year.

This section of your QAPP can help identify special training needs or certifications with associated dates of completion. Training needs may include confined space entry training for entering manholes to install equipment or collect samples, sample collection procedure training (for sediment, grab, and composite sampling), and equipment training (programming, calibration, installation, and maintenance).

Optional boilerplate content

The table below contains a list of individuals involved with the major aspects of the project, and personnel responsible for updating the QAPP.

Table 6. Boilerplate List of Individuals Table

Name	Type of Project Involvement	Organization

The following tables can be used as boilerplate information to outline your monitoring implementation requirements (schedule varies between independent and collaborative programs, see S8.G of the Phase I permit).

Table 7. Boilerplate Table for Scheduling

Activity	Anticipated Date of Initiation	Anticipated Date of Completion	Deliverable	Deliverable Due Date
Continuous Flow Recording of all Storm Events			Establish a baseline rainfall/runoff relationship	Not reported to Ecology but available upon request
Dry-weather storm events			Stormwater Monitoring Report*	3/31/
Toxicity Sampling (First flush event)			Stormwater Monitoring Report* and Toxicity Follow-up Actions (if applicable)	3/31/
Wet-weather storm events			Stormwater Monitoring Report*	3/31/
Sediment Sampling			Stormwater Monitoring Report*	3/31/

*Submitted with Annual Report.

Section 6 Quality Objectives

General guidance

The *Quality Objectives* section of your stormwater monitoring QAPP should include a description of your selected decision quality indicators (DQIs) for performance and acceptance criteria. Common decision quality indicators include precision, bias, representativeness, comparability, completeness, and sensitivity. These indicators help measure the quality of the data collected for the project. Specifically, your QAPP should indicate how DQI's will be met for the project. Depending upon the selected DQIs, the QAPP should include specifics, such as the relative percent difference (RPD), acceptance criteria, and how the DQI meets the definitions in the sampling design.

This section of your QAPP should also include your project's measurement quality objectives (MQOs) that will be used as acceptance thresholds, or goals, for the project's data. Refer to the Optional Boilerplate MQO table (Table 8) to help develop your project's MQOs. Reporting limits listed in Appendix 9 of the Phase I permit (Table 20 and 21) can be used for the Lowest Concentration of Interest MQO. Be sure to select your proposed analytical method planned for analyzing each parameter into your MQO table with your targeted reporting limit. Analytical methods not listed in Appendix 9 of the Phase I permit may be used, but must have prior approval by Ecology.

Optional boilerplate content

Decision quality indicators

Precision
Precision is a measure of the variability in the results of replicate measurements due to random error—the greater the variability, the less the precision. Precision can be demonstrated through the collection of duplicate samples during a sampling event. The relative percent difference (RPD) between the duplicate sample and the sample of origin can be used to determine whether sample variation is too great.

General guidance: Typically a formula is presented in the QAPP and used to determine precision. The QAPP should provide the formula and the formula should demonstrate how it meets the definition of precision.

Bias
Bias is the difference between the population mean and the true value. The bias and precision associated with data collection can directly affect the level of uncertainty in parameter estimates. Bias and precision (collectively known as accuracy) are two principal attributes, or characteristics, of data quality in environmental studies. Bias represents systematic error (i.e., persistent distortion that causes constant errors in a particular direction), while precision represents random error (i.e., error among repeated measures of the same property under identical conditions, but not systematically in the

same direction). Estimates of measurement bias and precision, and associated minimum detection limits, or quantitation limits, are used to determine how well a measurement method performs for a specific range of concentrations.

General guidance: One method for measuring bias can be done by assessing matrix spikes.

Accuracy
Accuracy is an estimate of the closeness of a measurement result to the true value. It is estimated by re-analyzing a sample to which a material of known concentration, or amount of pollutant has been added; usually expressed as percent recovery.

General guidance: Accuracy can be measured by collecting a matrix spike and matrix spike duplicate (MS/MSD) sample for analysis. Typically a formula is presented in the QAPP and used to determine accuracy. The QAPP should provide the formula and the formula should demonstrate how it meets the definition of accuracy.

Representativeness
Representativeness is a qualitative term that expresses a degree to which data accurately represents a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition.

General guidance: Representativeness can be estimated by evaluating how physical samples are collected in the field that appropriately reflects the environmental condition being measured (stormwater).

Comparability
Comparability is a qualitative term that expresses the measure of confidence that one data set can be compared to another and can be combined for the decision(s) to be made.

General guidance: Compare sample collection and handling methods, sample preparation and analytical procedures, holding times, stability issues, and QA protocols.

Completeness
Completeness is a measure of the amount of valid data needed to be obtained from a measurement system.

General guidance: Compare the total number of valid measurements completed with a targeted goal. A target can be established for completeness of data (example: 95% completeness).

Sensitivity
Sensitivity denotes the rate at which the analytical response (absorbance, volume, meter reading) varies with the concentration of the parameter being determined. In a specialized sense, it has the same meaning as the detection limit. Determine the minimum concentration or attribute that can be measured by a method (method detection limit), an instrument (instrument detection limit), or a laboratory (quantitation limit).

General guidance: Refer to Table 20 and 21 of this document for reporting limits taken from Appendix 9 of the Phase I Permit.

Table 8 . Boilerplate Table for Measurement Quality Objectives

Parameter	Analytical Method	Check Standard (LCS)	Duplicate Samples	Matrix Spikes	Matrix Spike-Duplicates	Surrogate Standards	Lowest Concentrations of Interest (Reporting Limit)
		% Recovery Limits	Relative Percent Difference (RPD)	% Recovery Limits	Relative Percent Difference (RPD)	% Recovery Limits **	Units of Concentration

Notes:

This table is constructed with the same units used to report results for laboratory QC analyses. Information on the default QC sample types and QC limits can be obtained from the laboratory that will be performing the analyses. An exception is pH, which is usually analyzed in the field.

**Surrogate recoveries are compound specific.

(Module 2, Ecology 2004)

Section 7 Sampling Process Design

General guidance

Mapping and site selection

The *Sampling Process Design* section of your stormwater monitoring QAPP should include a map outlining the drainage area to each monitoring site. The map should indicate your rain gauge location, the percentage of each land use within each drainage basin to each site, any nearby receiving water bodies, and any other relevant information needed to illustrate the drainage basin boundary. A map should also include the location of each monitoring site.

The permit requires stormwater monitoring sites to have mapped drainage and conveyance system and be suitable for permanent installation and operation of sampling equipment. Additionally, each selected site must be associated with a permit-required discernable land use, and be representative of the jurisdiction. The site selected must be defensible in the QAPP. It will be most beneficial to your program to select larger drainage areas with various inputs for a more comprehensive approach to monitoring.

Site logistics

The QAPP should include site details, such as site modifications planned to accommodate sampling equipment, site accessibility issues, and any other potential problems that could be encountered (access, vandalism, tidal influence).

Time of concentration

The permit requires an estimated time of concentration for each drainage basin. The QAPP can include any software models, methods, or formulas used for determining time of concentration. Single-event calculations can be used to determine your time of concentration. For reference, see the *Stormwater Management Manual for Western Washington (2005) Volume 3*. Ecology recommends using models such as StormSHED.

Quality control samples

Your design should also include planned field quality control samples (duplicates, replicates, field blanks) that will be collected and analyzed to meet data quality objectives outlined in Section 6. Include the proposed frequency of collection.

Storm event criteria design

The QAPP should describe the qualifying storm event criteria, parameters for analysis, samples collected during stormwater outfall sampling, toxicity sampling, and sediment sampling). The Phase I permit allows for up to three storm events, which do not meet the minimum amount of rainfall (0.2”) to be counted toward your overall sampling goal of a maximum of 14 storms per year. The following special conditions in the Phase I permit include the required list of parameters for each monitoring element:

- Outfall monitoring parameters, S8.D.2.b.
- Grab sampling parameters, S8.D.2.f.
- Sediment sampling parameters, S8.D.2.g.i.
- Toxicity and associated parameters sampling, S8.D.2.e.iii.

Tables 11, 12, 13, and 14 below include required parameters for each monitoring element (flow weighted composite sampling, sediment sampling, grab sampling and toxicity sampling)

Volume estimates for each monitoring element can be found in Table 16 and 17 in Section 9, *Measurement Procedures*.

Optional boilerplate content

Site descriptions

General Guidance: The following table can help track your monitoring site characteristics in your QAPP.

Table 9. Boilerplate Table of Monitoring Site Characteristics

	Monitoring Site Name		
Site Characteristics	**Site #**	**Site #**	**Site #**
Location			
Drainage Area (acres)			
% Commercial			
% Low Density Residential			
% High Density Residential			
% Industrial			
% Impervious Area			
Time of Concentration			
Rain Gauge Location (latitude/longitude)			

Qualifying storm event criteria for stormwater sampling

Samples will be collected and reported based on water year. The water year is defined as October 1st through September 30th each year. The following storm event criteria will be used to determine qualifying storm events:

Table 10. Permit Required Qualifying Storm Event Criteria

	Wet Season	Dry Season
Seasonal Period	October 1 through April 30	May 1 through September 30
Minimum Amount of Rainfall	0.20” min. no fixed max.	0.20” min. no fixed max.
Rainfall Duration	No fixed min. or max.	No fixed min. or max.
Antecedent Dry Period	< or equal to 0.02” rain in previous 24-hours	<or equal to 0.02” rain in previous 72-hours
Inter-event Dry Period	6 hours	6 hours

*Up to 3 storm events can be collected that do not meet the 0.2” minimum amount of rainfall.

List of analytical parameters for outfall sampling

Flow weighted composite sampling

The following table lists the flow-weighted composite samples that will be collected and analyzed at each outfall monitoring site.

Table 11. Table of Flow Weighted Composite Sampling Parameters

Parameter	
Total suspended solids	
Turbidity	
Conductivity	
Chloride	
Biological oxygen demand (5-day test)	
Particle size distribution	
Hardness as CaCO3	
Methylene blue activated substances (MBAS)	
Fecal coliform	
Total phosphorus	
Orthophosphate	
Total Kjeldahl nitrogen	
Nitrate/nitrite	
Total recoverable zinc	
Total recoverable lead	
Total recoverable copper	
Total recoverable cadmium	
Total mercury - required for industrial and commercial basins only	
Dissolved copper	
Dissolved lead	
Dissolved zinc	
Dissolved cadmium	
Dissolved mercury - required for industrial and commercial basins only	
Polycyclic aromatic hydrocarbons (PAHs)	Acenaphthene
	Acenaphthlylene
	Anthracene
	Benzo(a)anthracene
	Benzo(b)fluoranthene
	Benzo(k)fluoranthene
	Benzo(ghi)perylene
	Benzo(a)pyrene
	Chrysene
	Dibenzo(a,h)anthracene
	Fluoranthene
	Fluorene
	Indeno(1,2,3-cd)pyrene
	Naphthalene
	Phenanthrene

Parameter	
	Pyrene
Phthalates	Bis(2-ethylhexyl)phthalate
	Butyl benzyl phthalate
	Di-n-butyl phthalate
	Diethyl phthalate
	Dimethyl phthalate
	Di-n-octyl phthalate
Herbicides	2,4-D
	MCPP
	Triclopyr
Pesticides (Nitrogen)	Dichlobenil
	Pentachlorophenol
	Prometon
Pesticides (Organophosphorus)	Diazinon, malathion, chlorpyrifos

List of analytical parameters for sediment chemistry sampling

The following table lists the sediment sampling parameters that will be collected and analyzed from each outfall monitoring site.

Table 12. Table of Required Sediment Sampling Parameters

Parameter	
Grain size	
Total solids	
Total volatile solids	
Total organic carbon	
Total recoverable zinc	
Total recoverable lead	
Total mercury - required for industrial and commercial basins only	
Total recoverable copper	
Total recoverable cadmium	
Polycyclic aromatic hydrocarbons (PAHs)	Same list as Table 11
Phthalates	Same list as Table 11
Phenolics	Phenol
	2-methylphenol
	4-methylphenol
	2,4-dimethylphenol
	pentachlorophenol
Polychlorinated biphenyl (PCBs) - required for industrial and commercial basins only	Aroclor 1016
	Aroclor 1221
	Aroclor 1232
	Aroclor 1242
	Aroclor 1248

Parameter	
	Aroclor 1254
	Aroclor 1260
Pesticides/Herbicides	Pentachlorophenol
	Diazinon
	Chloropyrifos
	Malathion

List of analytical parameters for insufficient volumes for water and sediment analysis

During sample collection, if an insufficient volume is collected, the following list of priority parameters will be applied (Figure 1 and 2).

For all sites, the following water quality parameters will be analyzed as indicated in priority order:

- Total suspended solids
- Conductivity
- MBAS
- Metals
- Hardness

For industrial or commercial sites, the following water quality parameters will be analyzed as indicated in priority order:

- PAHs
- Phthalates
- Pesticides
- Nutrients
- BOD5
- Chlorides

For low density and high density residential sites, the following water quality parameters will be analyzed as indicated in priority order:

- Nutrients
- Pesticides
- PAHs
- Phthalates
- BOD5
- Chlorides

Figure 1. List of Parameters for Insufficient Volume –Water Quality

For all sites, the following sediment quality parameters will be analyzed in the following priority order:

- Grain size
- Total organic carbon
- Metals

For industrial or commercial sites, the following parameters will be collected (as listed in priority order) where insufficient volumes exist:

- PAHs
- Phthalates
- Phenolics
- PCBs
- Pesticides

For low density and high density residential sites, the following parameters will be collected (as listed in priority order) where insufficient volumes exist:

- Pesticides
- PAHs
- Phthalates
- Phenolics

Figure 2. List of Parameters for Insufficient Volume - Sediment Quality

List of analytical parameters for grab sampling

The following table lists the grab samples that will be collected and analyzed from each outfall monitoring site.

Table 13. Table of Required Grab Sampling Parameters

Parameter	
Fecal coliform	
Total petroleum hydrocarbons	NWTPH-Dx, NWTPH-Gx

List of analytical parameters for toxicity chemistry sampling

Chemistry data will be collected and analyzed for toxicity testing in addition to the toxicity volume needed for the Environment Canada Trout Embryo Viability test. If adequate volume is not collected for either the chemistry analysis or the toxicity volume (24-44 liters), the toxicity test will not be performed. The following table lists the chemical parameters will be collected and analyzed from each outfall monitoring site.

Table 14. Table of Required Toxicity Parameters

Parameter	
Total suspended solids	
Chlorides	
Hardness as CaCO3	
Methylene blue activated substances	
Total and dissolved copper	
Total and dissolved zinc	
Total and dissolved cadmium	
Total and dissolved lead	
Total and dissolved mercury - required for industrial and commercial basins only	
Polycyclic aromatic hydrocarbons (PAHs)	Same list as Table 11
phthalates	Same list as Table 11
Pesticides/herbicides	Same list as Table 11

Section 8 Sampling Procedures

General guidance

The *Sampling Procedures* section of your stormwater monitoring QAPP should describe the data collection procedures planned for your program. The QAPP should either include a detailed description of your sampling collection procedures (for sediment sampling, flow weighted composite sampling, toxicity and grab sampling), or reference and attach SOPs. SOPs in Appendix A may be used as attachments to your QAPP to describe procedures planned for use.

This QAPP section should include procedures for decontamination, back-up plans for when things go wrong, procedures for sample transport and communication with the laboratory. The QAPP should also include your proposed forecasting method to determine incoming storms. Include the type of equipment planned for use. For flow-weighted composite samplers, indicate the proposed bottle configuration and programming scheme.

Optional boilerplate content and general guidance

Stormwater monitoring data collection procedures

Stormwater samples will be collected from the outfall locations described in this QAPP when storm criteria are met. Qualifying storm event criteria includes:

- Rainfall volume at a minimum of 0.2” or greater (the permit allows volumes less than 0.2” to be collected for up to three storm events each year).
- Storm duration:
    - For storms lasting less than 24-hours, samples collected for at least 75% of the storm’s hydrograph.
    - For storms lasting longer than 24-hours, samples collected for at least 75% of the storm’s hydrograph during the first 24-hours of the storm.
- Antecedent dry period is less than 0.02” of rain in the previous 24-hours during the wet season, and 0.02” of rain in the previous 72 hours during the dry season.
- Inter-event dry period is 6 hours or greater.

Some samples will be collected using flow-weighted composite samplers. Samplers will be programmed according to the manufacturer instruction manual and calibrated periodically. Sampling will begin as early in the runoff event as practical and include a minimum of 10 aliquots collected throughout the storm event. Once a storm event is complete, and criteria verified, samples will be obtained from samplers and processed.

Precipitation and flow data collection
Precipitation and flow data will be collected to document all above-listed storm criteria. Flow and hydrograph data will be collected including total runoff time and volume and aliquot collection points (time) along the storm's hydrograph.

For at least one year, flow data will be collected from each site. Flow records for all storm events will be collected and retained to establish baseline rainfall/runoff relationship and provide estimated calculations for pollutants loads. More details on calculating pollutant load can be found in Standard Operating Procedure for Calculating Pollutant Loads for Stormwater Discharges in Appendix A.

Precipitation data will be collected from a rain gauge located within close proximity to the drainage area of each stormwater monitoring site. As a back-up, a local personal rain gauge will be used to determine precipitation level estimates, if needed.

Deployment and weather forecast monitoring
Sampling staff will monitor and document the weather forecast for each storm event. This documentation will show due diligence for the decisions to deploy, not to deploy, or to set sampler programs based on the predicted rainfall amount.

General guidance: Targets for storm deployment may vary. It is recommended to deploy field staff when antecedent conditions are approaching and the rainfall forecast indicates 0.15 inches or more of precipitation. This section should list the tasks associated with deployment.

Grab sampling
Grab samples will be collected during storm events for fecal coliform and total petroleum hydrocarbons. If logistical problems result in no grab samples collected during a storm event, grab samples will be taken during the next storm event within the same approximate size range. Grab sampling equipment will be used to collect samples as early in the runoff event as practical. Grab samples will be collected from a representative storm stream, placed in appropriate containers, and placed directly on ice. For quality control, field staff will use appropriate decontamination and handling procedures to avoid cross contamination and field blanks will be collected.

General guidance: Further guidance is available in the Department of Ecology's Standard Operating Procedure for Collecting Grab Samples from Stormwater Discharges (Appendix A).

Sediment sampling
Sediment traps will be installed and used to collect sediment samples from outfall locations. Mounting brackets, anchor bolts, and clamps will be used to secure the traps in place in the outfall. Sediment traps will be deployed for up to one year. When sediment traps are nearly full, staff will be deployed to remove the sediment collection container from the trap housing. Sample containers will be placed in a cooler on ice after retrieval.

General guidance: Sediment traps may have insufficient volumes depending on the outfall and upstream activities. Sediment traps may have to be relocated and *periodically checked/visually inspected for volume accumulation. Field staff can perform these checks during periodic preventative maintenance. If insufficient volumes are present after a few months of deployment, further corrective actions may be needed. Corrective actions can include installing more sediment traps in the pipe or collecting additional volume from the same catch basin area. Receiving water sediments may also be collected with prior Ecology approval.*

Further guidance is available in the Department of Ecology's Standard Operating Procedure for Collecting Stormwater Sediments Using In-line Sediment Traps (Appendix A).

Decontamination

Once samples are collected, all re-usable equipment will be decontaminated with wash and rinse water. EPA approved detergents and de-ionized water (ASTM I or II) will be used to provide efficient decontamination of equipment. Equipment blanks will be analyzed to check for possible cross contamination between sampling events. Proper personal protective equipment (powder-free gloves) should be worn during sampling activities and during decontamination processes.

General guidance: Individual methods for decontamination may vary from case to case. Equipment cleaning procedures including procedures for wastewater disposal should be included in attached SOPs or described in the QAPP. The wastewater generated from decontamination procedures should be disposed of properly and according to protocol and mentioned below or in relative SOPs.

Sample processing

Once storm event criteria have been met and the storm event is complete, field staff will arrive on site (if not on site at the end of a storm event) and obtain the samples from each sampler. Sample processing will begin as soon as practical in a clean, safe area. Field staff will follow preservation and filtering requirements in 40 CFR, Part 136. For safe handling and prevention of cross contamination, field staff will wear powder-free sterile gloves while processing samples.

Field staff will review the following information prior to processing to determine if the sample meets storm event criteria:

- Review the rainfall hyetograph.
- Storm hydrograph.
- Event runoff volume.
- Time and number of aliquots collected.
- Runoff volume sampled.

Once the storm event is confirmed sample processing will be performed at the sample location or in a clean area off-site location.

General guidance: Your QAPP should include the area where sample processing will occur. If a clean area cannot be established or safety is a concern, the samples should be *placed on ice and transported back to a clean processing area for immediate filtering and preservation prior to transport to the laboratory. All procedures for sample handling, icing, filtering, storing, and preserving for grab, sediment and composite samples should follow requirements listed in 40 CFR part 136. The sampling program described in this QAPP and required in the permit involves analyzing multiple parameters with various bottle and preservation requirements. Use of glass bottles for all parameters is considered acceptable to Ecology. Metals and ortho-phosphorus samples should be filtered as soon as practical to produce the best results. Samplers should be iced during collection or refrigerated samplers used. If safety or cross contamination issues conflict with the applicability of these requirements, an alternative scenario should be presented in your QAPP.*

Field data forms, field notebooks and chain-of-custody
During sample collection, field data forms and/or field notebooks will be used to document data collection procedures. Field data forms will include the following information:

- Field staff present (on-site).
- Weather conditions.
- Date and time of site arrival.
- Time of sample collection/sample distribution into bottles w/preservative
- Equipment calibration performed and results of calibrations.
- Bottle configuration within sampler.
- Time of download of data.
- Number of samples collected.
- Any problems that occur in the field that could affect sample quality.
- Signature of field staff project manager
- Number of days of preceding dry conditions.
- Rainfall amount in inches of the storm event from when sampling begins.

Chain-of-custody (COC) forms will accompany samples transported from the site. These forms include the following information:

- Sample time and date.
- Preservatives used.
- Name of sampling personnel.
- Analytical test method requested.
- Parameter to be analyzed.
- Field Quality Assurance/Quality Control samples collect, such as duplicates, trip blanks, temperature blanks.

Toxicity data collection procedures

Toxicity samples will be collected from each stormwater monitoring site during the first flush storm event occurring between August 1st and September 30th or in October, irrespective of antecedent dry period if sampling attempts are unsuccessful during August or September. Composite samplers will be used to collect samples. Samples will be collected for both toxicity analysis and chemical analysis.

General guidance: The toxicity sample collected for both the toxicity and chemistry analyses can be collected using two different samplers, by a single, modified sampler or by using one sampler and changing out bottles in an attempt to collect the adequate volume needed (approximately 44 liters). If using two different samplers, the suction tubing of the sampler should be placed to collect the same sample stream of water and programmed identically. Volume of water should be collected for both chemical analysis and toxicity analysis. For chemistry analysis, enough volume should be collected to run all the parameters listed in Table 14, otherwise, do not perform the toxicity test. This also applies to the toxicity volume (greater than 24 liters is required), otherwise do not perform the toxicity test or the chemical analysis for the toxicity test. To capture adequate volume for the toxicity test, field staff may have to be deployed to replace containers to collect enough volume to meet the volume requirements for the toxicity test. Glass containers are preferred for toxicity collection; however, polyethylene containers may be used.

For toxicity sampling, storm forecasting models will be used for notification of incoming storms. If a storm is forecasted, the laboratory will be notified to check for gametes/egg availability. If gametes/eggs are not available, field staff will not deploy, and toxicity sampling will not be performed. This event will be documented and reported in the Stormwater Monitoring.

The holding time for gametes/eggs at the laboratory is 2 days and the holding time for the toxicity water sample is 36 hours.

General guidance: For conditional acceptance for holding times between 36 and 72 hours, staff will contact Ecology's WET Coordinator Randall Marshall (rmar461@ecy.wa.gov or 360-407-6445). Holding times in excess of 72 hours will not be accepted.

Figure 3 demonstrates the laboratory notification process that will be used once a qualifying storm event has been forecasted.

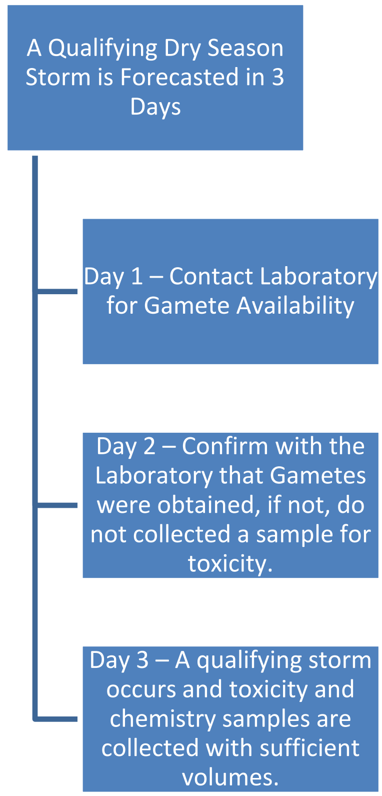

Figure 3. Laboratory Notification Process

Toxicity sampling – chemistry collection

Approximately 6.4 liters (1.7 gallons) are needed for the chemical analysis associated with the toxicity sample. The samples will be collected in the field, split if necessary from the toxicity sample, placed in the appropriate containers with preservative (if needed) and placed on ice. The chemistry samples will be processed and sent the laboratory.

General guidance: Your volume for toxicity chemistry sample collection may vary from laboratory to laboratory. Your QAPP should include the approximate volume for the analysis of all required chemistry parameters as determined by your laboratory. This will help staff train for the event.

If your chemistry collection for toxicity will also count toward meeting a qualifying storm event under S8.D.2.b, the more stringent requirements apply (i.e., flow-weighted programming is required). The chemistry analysis associated with toxicity requires fewer parameters than sampling requirements for Stormwater Monitoring. Additional parameters would have to be added to this list for analysis including BOD_5*, fecal* *coliform and TPH (as grabs), turbidity, and nutrients for the test to count toward a storm event under S8.D.2.b.*

Further guidance is available in Questions and Answers for Toxicity Sampling (Appendix B).

Additional resources or references to assist with this section

1. *Department of Ecology's Stormwater Sediment Trap Pilot Study* http://www.ecy.wa.gov/biblio/96347.html
2. 2007 CFR Title 40, part 136 http://www.access.gpo.gov/nara/cfr/waisidx_07/40cfr136_07.html
3. *U.S. Geological Survey, National Field Manual for the Collection of Water Quality Data, Book 9*, 2006.

References for weather forecasting

1. Federal Register, EPA 40 CFR Part 136 July 2007 and March 2007.
2. King 5 Doppler: http://www.king5.com/weather/radar/
3. UW Atmospheric Science: http://www.atmos.washington.edu/~ovens/loops/wxloop.cgi?mm5d1_pcp3+///3
4. NOAA QPF: http://www.wrh.noaa.gov/forecasts/graphical/sectors/sewWeek.php?page=3&element=QPF
5. COLA: http://wxmaps.org/pix/meteograms.html
6. East Pacific IR Loop: http://www.wrh.noaa.gov/sew/ir4kmP.php

Section 9 Measurement Procedures

General guidance

The *Measurement Procedures* section of your stormwater monitoring QAPP should specify the analytical method used to analyze each parameter, the reporting limit for each parameter, the frequency of analysis, number of samples to be analyzed, needed sample volume, container type, holding time and preservation. For additional information, attach laboratory SOPs for sample handling and analysis, if applicable.

The QAPP should also describe any approved alternative analytical methods and associated reporting limits where previous approval was granted by Ecology.

Recommended volume, container type, holding time and preservation requirements

The table below includes stormwater sample volume, container type, holding time and preservative needed for each required parameter.

Table 15. Sample Volume, Container Type, Holding Time and Preservation

Parameter	Recommended Quantity	Container	Holding Time	Preservation
Stormwater Monitoring Samples – All Water Matrices				
Total suspended solids (TSS)	1000 mL	1000 mL w/m poly	7 days	Cool to 4º
Turbidity	500 mL	500mL w/m poly	48 hours	Cool to 4º
Conductivity	300 mL	500 mL w/m poly	28 days	Cool to 4º
Chloride	100 mL	500 mL w/m poly	28 days	Cool to 4º
Biological Oxygen Demand (BOD5)	2000 mL	1 gallon cubitainer	48 hours	Cool to 4º, keep in the dark
Hardness (CaCO3)	100 mL	125 mL w/m poly	6 months	H2SO4 to pH<2, Cool to 4º
Methylene Blue Activating Substances (MBAS)	250 mL	1-L Amber glass	48 hours	Cool to 4º
Total phosphorus	50 mL	60mL clear n/m poly	28 days	1:1 HCL to pH<2, Cool to 4º
Orthophosphate	125 mL	125 mL amber w/m poly	48 hours	Filter in the field with 0.45um pore size, Cool to 4º

Parameter	Recommended Quantity	Container	Holding Time	Preservation
Total kjeldahl nitrogen (TKN)	125 mL	125mL clear w/m poly	28 days	H2SO4 to pH<2, Cool to 4º
Nitrate-nitrite (N/N)	125 mL	125mL clear w/m poly	28 days	H2SO4 to pH<2, Cool to 4º
Dissolved Metals (copper, zinc, cadmium, lead)	350 mL	500 mL Teflon FEP bottle, conventional or linear polyethylene, polycarbonate or polypropylene[3]	6 months	Filter; then HNO3 to pH<2, Cool to 4º
Dissolved Mercury[1]	350 mL	500 mL Teflon FEP or glass	28 days	HNO3 to pH<2, Cool to 4º
Total Metals	350 mL	500 mL HDPE bottle	6 months	HNO3 to pH<2, Cool to 4º
PAHs	1 gallon	1 gallon glass jar	7 days	Cool to 4º
Phthalate-BNA	1 gallon	1 gallon glass jar	7 days	Cool to 4º
Herbicides: 2,4-D, MCPP, triclopyr, dichlobenil, prometon, pentachlorophenol	½ gallon	½ gallon glass jar	7 days	Cool to 4º
Pesticides: Nitrogen, organophosphate, and/or chlorinated includes: dichlobenil, diazinon, malathion, chlorpyrifos	1 to 4 liters	1 liter to 1 gallon glass jar (volume effects reporting limits)	7 days	Cool to 4º
Fecal coliform	250 mL	250 mL glass/polypropylene autoclaved bottle		If chlorine is expected in the sample, then request thiosulfate preservative, Cool to 4º
Total petroleum hydrocarbons – NWTPH-Dx	1L – 1Gallon + 40 mL	1L or 1 Gallon glass jar (volume affects reporting limit) + 40 mL vial w/ septum	7 days	HCL to pH<2, Cool to 4º
Total petroleum hydrocarbons – NWTPH-Gx	120 mL	(3) 40-mL vials w/ septum	14 days	HCL, Cool to 4º

[1] Method 1669, Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels, July 1996, US EPA Office of Water Engineering and Analysis Division

Sediment Samples -All Soil Matrices				
Total solids (% solids)	25 g	2 oz. glass jar	7 days	Cool to 4º
Grain-size	100g	8 oz. plastic jar	6 months	Cool to 4º
Total organic carbon	25g	2 oz. glass jar	14 days, 6 months if frozen	Cool to 4º
Total metals: Copper, zinc, cadmium, lead	50g	4 oz. glass jar	6 months	Cool to 4º
Mercury	50g	8 oz. glass jar	28 days	Cool to 4º
PAHs	100g	8 oz. glass jar	14 days, 6 months if frozen	Cool to 4º
Phthalates-BNA	250g	8 oz. glass jar	14 days	Cool to 4º
Phenolics - BNA	250g	8 oz. glass jar	14 days	Cool to 4º
PCBs	250g	8 oz. glass jar	14 days, 6 months if frozen	Cool to 4º
Pesticides: Nitrogen, organophosphate, and/or chlorinated includes: diazinon, malathion, chlorpyrifos	250g	8 oz. glass jar	14 days	Cool to 4º
Herbicides: Pentachlorophenol	250g	8 oz. glass jar	14 days	Cool to 4º

Water quality and sediment quality sample volumes

Tables 16 and 17 include estimates for the volume needed to analyze water quality and sediment quality sampling at each outfall monitoring site. This estimate will vary from laboratory to laboratory, but should be included in the QAPP. Communicate with the laboratory to determine the volume amount needed for stormwater monitoring. For chemistry associated with toxicity sampling, see the next section.

The Ecology-designed in-line sediment traps can capture a maximum of 34 ounces of sediment. The amount of sediment typically collected in a single sediment sampler ranges from 2 ounces to as much as 10 ounces depending on sedimentation in the storm flow. To obtain the required volume, more than one sediment trap may have to be used at each location or other methods proposed (Refer to requirements in S8.D.2.f).

The following table more accurately demonstrates the volume needed for analyzing water and sediment quality samples. Many of the parameters listed in Table 15 above can be combined into a single container, lessening the volume needed for laboratory analysis.

Table 16. Estimated Sample Volumes for Water Quality Samples

Parameter/Specific Analyte		Volume in Liters**
Herbicides: 2,4-D, MCPP and Triclopyr		2
Insecticides: Diazinon, Malathion, Chlorpyrifos, Dichlobenil, and Prometon Fungicides: Pentachlorophenol		4
Phthalates and PAHs		4
Total Metals: Copper, Zinc, Cadmium, Lead, and Mercury		0.5
Dissolved Metals: Copper, Zinc, Cadmium, Lead and Mercury		0.5
TSS		1
Turbidity, Conductivity and Chloride		0.5
BOD5		4
Total Phosphorus		0.10
Hardness		0.10
Ortho-Phosphorus		0.10
N/N		0.10
MBAS***		0.50
TKN***		0.50
	Total Composite Sample Volume Needed	18 L = 4.8Gal
	Total # of Samples Derived from Composite Sample	14
Grab Samples	TPH – NWTPH-Dx	1L to 1 gallon + 40 mL
	TPH – NWTPH-Gx	120 mL
	Fecal coliform	250 mL

Notes:
The volume above does not contain estimates for quality control sample.
**Volume estimates were provided by Manchester Laboratory.
***Volume estimates provided by Columbia Analytical Laboratory.

Table 17. Estimated Sample Volumes for Sediment Quality

Parameter/Specific Analyte – Sediment Sampling	Volume in Ounces*
Grain Size	8.0
Metals and total solids	8.0
Total organic carbon	8.0
PAHs, phthalates, PCBs, Herbicides, Pesticides	32.0 oz.
Phenolics	3.5 oz.
Total in ounces	59.5 oz.

Notes:
The volume above does not contain estimates for quality control samples.
*Volume estimates were provided by Manchester Laboratory.

Toxicity sample volumes

Two separate volumes are needed for toxicity sampling, one volume is needed to analyze the toxicity test, and a separate volume is needed to analyze the chemical parameters listed in Table 18 below. The estimated volume needed for the toxicity sample alone is approximately 24 to 44 liters. Field staff will target 44 liters for the toxicity volume.

Table 18 includes estimates for the volume needed to analyze water quality chemistry associated with the toxicity sample. This estimate will vary from laboratory to laboratory, but should be included in the QAPP. Communicate with the toxicity laboratory to determine the volume amount needed.

Table 18. Chemical Parameters and Volumes for Toxicity Sampling

Parameter/Specific Analyte		Volume in Liters
Herbicides: 2,4-D, MCPP and Triclopyr		2.0
Insecticides: Diazinon, Malathion, Chloropyrifos, Dichlobenil, and Prometon Fungicides: Pentachlorophenol		4.0
Phthalates and PAHs		4.0
Total Metals: Copper, Zinc, Cadmium, Lead, and Mercury		0.5
Dissolved Metals: Copper, Zinc, Cadmium, Lead and Mercury		0.5
TSS		1.0
Chloride		0.1
Hardness		0.1
MBAS*		0.50
	Total Chemistry Sample Volume Needed	12.7 L = 3.4 Gal
	Total # of Samples Derived from Composite Sample	8

Notes:
Volume estimates were provided by Manchester Laboratory.
*Volume estimate for MBAS was provided by Columbia Analytical Laboratory.

As demonstrated above, BOD_5, fecal coliform, TPH, turbidity, nutrients and conductivity are not required for analysis for toxicity. Conductivity, pH and hardness will be measured at the toxicity laboratory upon sample receipt. The hardness sample referenced above is the optional hardness sample collected from the receiving water in order for the laboratory to adjust the sample hardness to match receiving water.

Table 19. Toxicity Testing Volume, Container Type, Holding Time and Preservation

Analysis	Recommended Quantity	Container	Holding Time	Preservation
Toxicity Samples				
Environment Canada Trout Embryo Viability	11.6 gallons – 6.4 gallons	5 gallon glass containers	36 hours	Store in dark place with minimal headspace at 4ºC

Notes:
Information in this table was provided by Nautilus Laboratory.
Container type, holding times, and recommended quantity may vary between laboratories.

Analytical methods and reporting limits

Tables 18 and 19 include a list of targeted reporting limits for each parameter required for stormwater monitoring and sediment monitoring. The QAPP should include a table of proposed analytical methods for each parameter monitored. Phase I permittees are allowed to propose alternative analytical methods and reporting limits for approval by Ecology. Ecology suggests this is done well in advance of draft QAPP submittal. To apply for alternatives to the analytical methods listed in Appendix 9, submit the proposed analytical method and/or reporting limit with a description of why the alternative is being proposed to your Regional Permit Specialist.

Table 20. Targeted Reporting Limits for Water Quality Parameters

Parameter		Required Reporting Limit
Total suspended solids		1.0 mg/L
Turbidity		+/- 0.2 NTU
Conductivity		+/- 1 umho/cm
Chloride		0.2 mg/L
BOD5		2.0 mg/L
Particle size distribution		NA
pH		0.2 s.u.
Hardness as CaCO3		1.0 mg/L
Methylene blue activated substances (MBAS)		0.025 mg/L
Fecal coliform		2 min., 2E6 max
Total phosphorus		0.01 mg /PL
Orthophosphate		0.01 mg/PL
Total Kjeldahl nitrogen		0.5 mg/L
Nitrate/nitrite		0.01 mg/L
Total recoverable zinc		5.0 µg/L
Dissolved zinc		1.0 µg/L
Total recoverable lead		0.1 µg/L
Dissolved lead		0.1 µg/L
Total recoverable copper		0.1 µg/L
Dissolved copper		0.1 µg/L
Total recoverable cadmium		2.0 µg/L
Dissolved cadmium		0.2 µg/L
Total mercury		0.1 µg/L
Dissolved mercury		0.1 µg/L
PAHs	Acenaphthene	1.0 µg/L
	Acenaphthlylene	1.0 µg/L
	Anthracene	1.0 µg/L
	Benzo(a)anthracene	1.0 µg/L
	Benzo(b)fluoranthene	1.0 µg/L
	Benzo(k)fluoranthene	1.0 µg/L
	Benzo(ghi)perylene	1.0 µg/L
	Benzo(a)pyrene	1.0 µg/L
	Chrysene	1.0 µg/L
	Dibenzo(a,h)anthracene	1.0 µg/L

Parameter		Required Reporting Limit
	Fluoranthene	1.0 µg/L
	Fluorene	1.0 µg/L
	Indeno(1,2,3-cd)pyrene	1.0 µg/L
	Naphthalene	1.0 µg/L
	Phenanthrene	1.0 µg/L
	Pyrene	1.0 µg/L
Phthalates	Bis(2-ethylhexyl)phthalate	1.0 µg/L
	Butyl benzyl phthalate	1.0 µg/L
	Di-n-butyl phthalate	1.0 µg/L
	Diethyl phthalate	1.0 µg/L
	Dimethyl phthalate	1.0 µg/L
	Di-n-octyl phthalate	1.0 µg/L
Herbicides	2,4-D	0.01 µg/L - 1.0 µg/L
	MCPP	0.01 µg/L - 1.0 µg/L
	Triclopyr	0.01 µg/L - 1.0 µg/L
	Dichlobenil	0.01 µg/L - 1.0 µg/L
	Pentachlorophenol	0.01 µg/L - 1.0 µg/L
Pesticides, Nitrogen	Prometon	0.01 µg/L - 1.0 µg/L
Pesticides, Organophosphorus	Diazinon	0.01 µg/L - 1.0 µg/L
	Malathion	0.01 µg/L - 1.0 µg/L
	Chlorpyrifos	0.01 µg/L - 1.0 µg/L
TPH	NWTPH-Dx	0.25 – 0.50 mg/L
TPH	NWTPH-Gx	0.25 mg/L

Table 21. Target Reporting Limits for Sediment Quality Parameters

Parameter		Required Reporting Limit
Grain size		NA
Total solids		NA
Total volatile solids		0.1%
Total organic carbon		0.1%
Total recoverable zinc		5.0 mg/Kg
Total recoverable lead		0.1 mg/Kg
Total mercury		0.1 mg/kg
Total recoverable copper		0.1 mg/Kg
Total recoverable cadmium		0.1 mg/Kg
PAHs	Acenaphthene	70 µg/Kg dry
	Acenaphthlylene	70 µg/Kg dry
	Anthracene	70 µg/Kg dry
	Benzo(a)anthracene	70 µg/Kg dry
	Benzo(b)fluoranthene	70 µg/Kg dry
	Benzo(k)fluoranthene	70 µg/Kg dry
	Benzo(ghi)perylene	70 µg/Kg dry
	Benzo(a)pyrene	70 µg/Kg dry

Parameter		Required Reporting Limit
	Chrysene	70 µg/Kg dry
	Dibenzo(a,h)anthracene	70 µg/Kg dry
	Fluoranthene	70 µg/Kg dry
	Fluorine	70 µg/Kg dry
	Indeno(1,2,3-cd)pyrene	70 µg/Kg dry
	Naphthalene	70 µg/Kg dry
	Phenanthrene	70 µg/Kg dry
	Pyrene	70 µg/Kg dry
Phthalates	Bis(2-ethylhexyl)phthalate	70 µg/Kg dry
	Butyl benzyl phthalate	70 µg/Kg dry
	Di-n-butyl phthalate	70 µg/Kg dry
	Diethyl phthalate	70 µg/Kg dry
	Dimethyl phthalate	70 µg/Kg dry
	Di-n-octyl phthalate	70 µg/Kg dry
Phenolics	Phenol	70 µg/Kg dry
	2-methylphenol	70 µg/Kg dry
	4-methylphenol	70 µg/Kg dry
	2,4-dimethylphenol	70 µg/Kg dry
	pentachlorophenol	70 µg/Kg dry
PCBs	Aroclor 1016	80 µg/Kg dry
	Aroclor 1221	80 µg/Kg dry
	Aroclor 1232	80 µg/Kg dry
	Aroclor 1242	80 µg/Kg dry
	Aroclor 1248	80 µg/Kg dry
	Aroclor 1254	80 µg/Kg dry
	Aroclor 1260	80 µg/Kg dry
Pesticides/Herbicides	Pentachlorophenol	1 µg/kg
	Diazinon	50 µg/kg
	Chloropyrifos	25 µg/kg
	Malathion	25 µg/kg

Measurement procedures for toxicity testing

Toxicity testing will be conducted using 44 liters of untreated stormwater collected in accordance with section S8.D.2.b. above. A complete sample test set up includes:

- 5 concentrations and control.
- 4 replicates at each concentration.
- 7 replicates of 100% sample to provide tissue for yolk/embryo analysis if needed.
- Test concentration series shall be determined using a 0.5 dilution factor.

If the total sample volume after the qualifying storm is less than 11.6 gallons (44 liters) but greater than 6.3 gallons (24 liters) then the volume collected will determine changes in the toxicity testing configuration described above in accordance with the following:

- 10 gallons (38 liters) of sample – base the concentration series on a 0.3 dilution factor.
- 8.7 gallons (33 liters) of sample – base the concentration series on a 0.3 dilution factor and reduce the number of replicates to three.
- 7.9 gallons (30 liters) – reduce the number of extra replicates of 100% sample for yolk/embryo analysis from seven to three and the number of replicates in the test itself to three.
- 6.8 gallons (26 liters) – reduce the number of extra replicates of 100% sample for yolk/embryo analysis from seven to three and base the concentration series on a 0.3 dilution factor.
- 6.3 gallons (24 liters) – reduce the number of extra replicates of 100% sample for yolk/embryo analysis from seven to three, base the concentration series on a 0.3 dilution factor, and reduce the number of replicates in the test itself to three.

If the sample volume falls between the values listed above, then the test configuration must match the next lowest volume and the excess sample used for additional replicates of 100% sample to improve the detection limit for the yolk/embryo analysis. If sample volume is less than 6.3 gallons (24 liters), toxicity sample analysis will not be conducted.

Temperature
As indicated in Ecology Publication #WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria*, samples must be immediately chilled to 0-6°C. Composite samples should be chilled as collected and grabs immediately following collection. If the sample temperature exceeds 6°C at receipt by the laboratory, then the WET Coordinator, Randall Marshall; (360) 407-6445, or randall.marshall@ecy.wa.gov; will be contacted in accordance with Department of Ecology publication # WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria* to get acceptance for the sample temperature deviation. Acceptance will not be given for samples warmer than 14°C, unless the sample is received by the laboratory within one hour after collection. Samples should meet the required temperature stated in the reference above, which is available from Ecology's website: http://www.ecy.wa.gov/biblio/9580.html.

Holding time
If the maximum holding time of the toxicity sample is exceeded (36 hours), staff will contact Ecology's WET Coordinator for conditional acceptance. Sample holding times in excess of 72 hours will not be accepted by the laboratory or Ecology. The date and time of test initiation will be recorded on field data forms or in field notebooks.

Toxicity testing (7-day test)
Procedures for the 7-day toxicity test are illustrated in the following references:

- Environment Canada. 1998. Biological Test Method: Toxicity Tests Using Early Life Stages of Salmonid Fish (Rainbow Trout). Environmental Protection Series 1/RM/28 Second Edition.
- Canaria, E.C., J.R. Elphick, and H.C. Bailey. 1999. A Simplified Procedure for Conducting Small Scale Short-Term Embryo Toxicity Tests with Salmonids. *Env. Toxicol.* 14, 301-307.

At the end of the 7-day test or exposure period, the surviving eggs will be placed into glass vials. The eggs are then visually tested for viability. Nonviable eggs are described as eggs failing to complete morphogenesis. The endpoint of this test includes:

- Eggs that did not survive during exposure to the stormwater sample.
- Eggs that inhibited development.
- Eggs that were not successfully fertilized initially.

Bench sheets will be developed during the 7-day test and included in the final data report.

An EC_{50} will be calculated for each test result using the trimmed Spearman-Karber Method. Abbot's correction may be applied to the data before deriving the point estimations. A minimum of five concentrations and a control will be used. If an EC_{50} is 100% sample or less, then the permit requires follow-up actions. Information on follow-up actions can be found in Section 8, *Sampling Procedures*.

Invalid or anomalous tests

Invalid toxicity tests may occur if the laboratory does not follow the test protocol or when the results do not meet the test acceptability criteria in the test protocol. The laboratory will usually identify invalid tests and arrange to repeat them. Ecology will also identify invalid tests when the laboratories do not. Anomalous test results happen when the laboratory appears to have conducted the toxicity test in accordance with the test protocol, but the results are considered unreliable according to the anomalous test identification criteria in Ecology Publication # WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria:* http://www.ecy.wa.gov/biblio/9580.html. Only Ecology may identify a test result as anomalous.

If a test is found invalid or anomalous, the results will be kept on file and reported in the Annual Stormwater Monitoring Report. A second attempt for toxicity testing may be necessary.

Follow-up actions when toxicity is detected

Follow-up actions when toxicity is detected ($EC_{50} \leq 100\%$ sample) are based upon an evaluation of sample chemistry compared to an existing library of fish embryo toxicity test results (Library of Toxicity Test Results).

If the EC_{50} from any valid and non-anomalous test is 100% stormwater or less, the following procedures will be followed:

- Preserve terminated organisms for up to six months.
- Compare the chemical analytical results to the Library of Toxicity Test Results to determine the presence of a detected toxicant within sixty (60) days after final validation of the data.
- Determine, through a good faith effort, if the presence of a detected parameter is within the range reported in the Library of Toxicity Test Results that may adversely affect fish embryos and if so, review the source literature found in the Library of Toxicity Test Results.

The results of the toxicity testing, and documentation of follow-up actions, will be submitted to Ecology with the appropriate Annual Stormwater Monitoring Report. Section 12, *Audits and Reports*, describes the contents of reporting on toxicity.

If a possible chemical contaminant of concern *is not* determined by library comparison and literature review:

- A Gas Chromatograph/Mass Spectrometer (GC/MS) analysis of the eggs from the highest test concentrations will be performed.
- The GC/MS does not need to be quantitative but only capable of identifying stormwater contaminants present in the eggs.

Gas Chromatograph/Mass Spectrometer yolk testing

If the concurrent chemical analyses of the sample do not detect any chemicals at concentrations known to adversely affect fish embryos, then a Gas Chromatograph/Mass Spectrometer (GC/MS) analysis of the yolks from the highest test concentration (usually 100%) is needed. The GC/MS need not be quantitative, but only capable of identifying stormwater contaminants present in the embryo or yolk.

Procedures for GC/MS extraction of yolk/embryos may vary between laboratories. Consult with your approved toxicity laboratory for methods and procedures for this analysis. Example procedures include, but are not limited to the following:

- Washington State Department of Ecology Manchester Environmental Laboratory, Standard Operating Procedures for Micro-Acetonitrile Back Extraction Clean-up of Fish Tissue, Version 1.0, 2006.
- Puget Sound Water Quality Action Team, Recommended Guidelines for Sampling Marine Sediment, Water Column and Tissue in Puget Sound, April 1997.
- Environmental Protection Agency, SW-846, Method 3500B, Organic Extraction and Sample Preparation, 1996.
- U.S. Geological Survey, EPA Extraction and Lipid Separation of Fish Samples for Contaminant Analysis and Lipid Determination, Standard Operating Procedure # HC521A, Great Lakes Science Center, Ann Arbor, Michigan, Version 1, 1995.
- Washington State Department of Health, Human Health Evaluation of Contaminants in Puget Sound Fish, 2006.

To be most useful, a yolk/embryo analysis should not be restricted to the list of chemical parameters required by the Phase I Permit. The GC/MS should capture and identify as many chemicals as it reasonably can. The Library of Toxicity Test Results has many more chemicals than the required parameters, and will be useful for comparing GC/MS results. Yolk analysis need not be quantitative because the Library of Toxicity Test Results is based upon water and not tissue concentrations. The presence of a chemical within the yolk/embryo means that the exposure can be considered significant enough to warrant checking the Library of Toxicity Test Results to see if the chemical might be toxic to the embryo life stage. If the GC/MS analysis of the yolks and embryos does not find any candidate toxicants, then the number of replicates at 100% sample will be increased to provide more tissue to the laboratory and lower the detection limits for possible toxicants. Note that GC/MS comparison to the Library of Toxicity Test

Results is not a permit requirement but can be used in the investigation to determine a possible toxicant.

Ecology will be entering the results of the chemical analyses and trout embryo toxicity testing into a database for evaluation over the long term. Examination of results at the same outfall over time and from different outfalls from around the state may reveal patterns of chemical analytical results related to toxicity test results. The overall goal of toxicity data is to update our understanding of stormwater toxicity, and provide information upon which to base adaptive stormwater management. As long as this goal is being met, confirmation of toxicant identity is not necessary.

Further information can be found in Questions and Answers for Toxicity Sampling (Appendix B).

Optional boilerplate content

Analytical methods table

The QAPP should provide a table listing the proposed analytical method used for analyzing each parameter at each stormwater monitoring site. A single analytical method should be selected for each parameter.

General guidance: Analytical methods available for use are provided in Appendix 9 of the Phase I permit.

Table 22. Boilerplate Table of Analytical Methods for Water Quality Samples

Parameter	Method	Reporting Limit
Total suspended solids		1.0 mg/L
Turbidity		+/- 0.2 NTU
Conductivity		+/- 1 umho/cm
Chloride		0.2 mg/L
BOD5		2.0 mg/L
Particle size distribution		NA
pH		0.2 s.u.
Hardness as CaCO3		1.0 mg/L
Methylene blue activated substances (MBAS)		0.025 mg/L
Fecal coliform		2 min., 2E6 max
Total phosphorus		0.01 mg P/L
Orthophosphate		0.01 mg P/L
Total kjeldahl nitrogen		0.5 mg/L
Nitrate-nitrite		0.01 mg/L
Total recoverable zinc		5.0 µg/L
Dissolved zinc		1.0 µg/L
Total recoverable lead		0.1 µg/L
Dissolved lead		0.1 µg/L
Total recoverable copper		0.1 µg/L

Parameter	Method	Reporting Limit
Dissolved copper		0.1 µg/L
Total recoverable cadmium		2.0 µg/L
Dissolved cadmium		0.1 µg/L
Total mercury		0.1 µg/L
Dissolved mercury		0.1 µg/L
PAHs		0.1 µg/L
Phthalates		1.0 µg/L
Herbicides		0.01 – 1.0 µg/L
Pesticides, Nitrogen		0.01 – 1.0 µg/L
Pesticides, Organophosphorus		0.01 – 1.0 µg/L
TPH (NWTPH-Dx)		0.25 – 0.50 mg/L
TPH (NWTPH-Gx)		0.25 mg/L

Notes:
NTU = Nephelometric Turbidity Units
Umho/cm = micromho per centimeter
Su = Standard Units

The QAPP should also provide a table listing the proposed analytical method used for analyzing sediments at each stormwater monitoring site. A single analytical method should be selected for each parameter. Analytical methods available for use are provided in Appendix 9 of the Phase I permit.

Table 23. Boilerplate Table of Analytical Methods for Sediment Parameters

Parameter	Method	Reporting Limit
Grain size		NA
Total solids (% solids)		NA
Total organic carbon		0.1%
Total recoverable zinc		5.0 mg/Kg
Total recoverable lead		0.1 mg/Kg
Total mercury		0.1 mg/kg
Total recoverable copper		0.1 mg/Kg
Total recoverable cadmium		0.1 mg/Kg
PAHs		70 µg/Kg dry
Phthalates		70 µg/Kg dry
Phenolics		70 µg/Kg dry
PCBs		80 µg/Kg dry
Herbicides/Fungicides: pentachlorphenol		0.01-1.0 µg/Kg
Pesticides, organophosphates (diazinon, chloropyrifos, malathion)		0.01-1.0 µg/Kg

Additional resources or references to assist with this section

- Department of Ecology Phase I Municipal Stormwater Permit Fact Sheet.
- Ecology's Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria, June 2005, (Canary Book Reference) http://www.ecy.wa.gov/biblio/9580.html.
- Environment Canada, Environmental Toxicology Section, Standard Operating Procedures for the Toxicity Test Using Early Life Stages of Rainbow Trout, SOP ID RBTELS11. SOP, February 1999.
- Environmental Protection Agency's Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Water to Marine and Estuarine Organisms, Appendix I, Spearman-Karber Method pages 439 – 443. http://www.epa.gov/waterscience/methods/wet/disk1/.
- A Simplified Procedure for Conducting Small Scale Short-Term Embryo Toxicity Tests with Salmonids, E.C. Canaria, J.R. Elphick, H.C. Bailey, March 1998.

Section 10 Quality Control

General guidance

The *Quality Control* section of your stormwater monitoring QAPP should include any planned quality control samples collected in the field or in the laboratory (duplicates, replicates, trip blanks, field blanks, laboratory blanks, matrix spikes, equipment blanks). This section of the QAPP should also demonstrate how the data results generated from sampling will be used to measure data quality. Typically, equations and formulas described as decision quality indicators in Section 6, *Quality Objectives,* are used to make determinations for data quality. Your QAPP should include quality control activities planned (such as field checks or field staff procedure reviews) and their frequency of occurrence. Include personnel responsible for field checks. This section should also include a description of planned corrective actions to resolve problems associated with the results from your field and laboratory quality control samples. Describe specifically the goals associated with proposed quality control samples. For example, data results from equipment rinse blanks should not exceed two times the reporting limit.

For planning purposes, it is recommended that 10% of the sample set is used for collecting quality control samples in the field. Additional blanks may be needed to meet data quality objectives and quality control goals established within your QAPP. For preparation of equipment blanks, trip blanks and field blanks, ASTM Type I or II, de-ionized water is recommended.

The QAPP should also describe how your project's sampling procedures will be consistent between sampling events. If SOPs are followed, reference and attach to your QAPP.

Laboratory quality assurance/quality control samples

Laboratory analytical quality control (QC) procedures involve the use of four basic types of QC samples. QC samples are analyzed within a batch of samples to provide an indication of the performance of the entire analytical system. Therefore, QC samples go through all sample preparation, clean up, measurement, and data reduction steps in the procedure. In some cases, the laboratory may perform additional tests that check only one part of the analytical system.

Check standards
Check standards are QC samples of known concentration prepared independently of the calibration standards. They are sometimes called laboratory control samples (LCS) or spiked blanks. Results are used to verify that analytical precision in the control and whether or not the level of bias due to calibration is acceptable. If the results for the check standards do not fall within established control limits, the measurement system should be re-calibrated. In some analytical methods, sample results may be qualified when associated check standard results are not within acceptable limits. Their concentration should be in the range of interest for the samples, and at least one check standard should be analyzed with each batch of 20 samples or fewer. Reference materials that more closely match the matrix of environmental samples may be used as check standards for the project. Some proficiency testing (PT) samples from commercial vendors can be stored and used as check standards once the true values are known. The acceptance limits for the results of analyses of these commercial samples should not be those set

by the vendor but should be established in the laboratory by replicate analyses of the PT sample. An exception may occur when reference materials are sent to the laboratory for analysis as blinds. Ecology's Laboratory Accreditation Section can help identify suppliers of PT samples and certified reference materials.

Laboratory analytical duplicates

The laboratory can analyze duplicate samples of one or more samples within each sample batch. Results are used to estimate analytical precision for that matrix at that concentration. The project manager may specify which samples are to be analyzed in duplicate. If the samples selected for duplicate analyses do not contain measurable amounts of the analyte of interest, the results provide no information on precision. In addition, if the laboratory selects samples from another study with significantly different levels of the analyte or different matrices, the estimate of precision may not be applicable to your samples. One of the field duplicates is a good choice for an analytical duplicate since you may then estimate total and analytical variability from results for the same sample.

Matrix spikes

A matrix spike is an aliquot of a sample to which a known amount of analyte is added at the start of the procedure. Matrix spike recoveries may provide an indication of bias due to interference from components of the sample matrix. Since the percent recovery is calculated from the difference between the analytical results for the spiked and un-spiked samples, its precision may be relatively poor if the spiked amount is much less than the sample concentration. If the spike is too high relative to the sample concentration, any interference effect at the sample concentration level could be masked. The laboratory may spike at a known historical concentration approximately equal to the concentration in the sample before spiking. The project manager may indicate to the laboratory, which samples might be most appropriate for use as matrix spikes and, if necessary, larger sample volumes will be provided to the laboratory for this purpose. In some cases, many replicate spikes would need to be analyzed in order to distinguish bias from the effects of random error on the recoveries. Matrix spike results will only be used in conjunction with other QC data to qualify them. The primary use of matrix spikes is to indicate the presence of bias, duplicate spike results can be used to estimate analytical precision at the concentration of the spiked samples. The project manager may instruct the laboratory to spike certain samples since matrix spikes are not automatically included in all analytical methods.

Laboratory blanks

Blanks are prepared and analyzed in the laboratory to document the response of the measurement system to a sample containing effectively none of the analyte of interest. Depending on the analytical method, the analyst will analyze one or more blanks with each batch of samples and compare the results to established acceptance limits. A positive blank response can be due to a variety of factors related to the procedure, equipment, or reagents. Unusually high blank responses indicate laboratory contamination. The blank response becomes very important when the analyte concentration is near the detection limit. Blank responses are sometimes used to correct the sample responses and to determine the limit of detection.

Types of field quality control samples

Replicates

Replicates are two independent samples collected at the same time and place. Replicate results provide a way to estimate the total random variability (precision) of individual results. If conditions in the medium being measured are changing faster than the procedure can be repeated, then the precision calculated from replicate results will include that variability as well. Field replicates in conjunction with laboratory replicates give an assessment of total precision (it is useful to have the laboratory run laboratory splits on the field replicates).Section 6, Quality Objectives includes a formula for relative percent difference (RPD) to check precision of duplicate field samples.

Field blanks

Field blanks are samples of "clean" material, which are exposed to sample collection procedures in the field. They should be analyzed like any other sample. The results for field blanks may indicate the presence of contamination due to sample collection and handling procedures (in the field or during transport to the laboratory) or to conditions in the field, such as boat or vehicle exhaust. Clearly identify field blanks so that they are not selected for analytical duplicates or matrix spikes. Field blanks are used when there is reason to expect problems with contamination or to meet programmatic or contractual requirements to demonstrate absence of contamination. Field blanks can be used to determine whether or not consistent and adequate field procedures are conducted during sampling. The use of good operational procedures in the field and thorough training of field staff reduces the risk of contamination. Several types of field blanks are described below. The pure water or other "clean" material used to prepare them must be obtained from the laboratory or other reliable supplier.

Field blanks can include:

- Transport blanks (trip blanks): A container of pure water, which is prepared at the laboratory and carried unopened to the field and back with the other sample containers to check for possible contamination in the containers or for cross-contamination during transportation and storage of the samples.
- Field blanks: Prepare by transferring pure water to a laboratory-supplied bottle, with or without preservative, depending on analyte for which the blank is being prepared. This may detect contamination introduced by handling, designated sampling area or contamination in a laboratory supplied bottle.
- Equipment blanks: Prepare by exposing clean material to the sampling equipment after the equipment has been used in the field and cleaned. The results provide a check on the effectiveness of the cleaning procedures. The rinsate blank may also detect contamination from the surroundings, from containers, or from cross-contamination during transportation and storage of the samples and is therefore the most comprehensive type of field blank.
- Filter blanks: Prepare by filtering pure water through the filtration apparatus after routine cleaning. The filter blank may detect contamination from the filter or other part of the filtration apparatus.

- Temperature blanks: Prepared in the field using distilled or de-ionized water and placed in the sampler cooler and transported to the laboratory. The laboratory can use this blank to check the temperature of the samples upon receipt.

Ideally, the results for your field blanks will be “not detected”. If the results are positives, you will need to consider them when reporting sample results and determining whether your MQOs have been met.

Optional boilerplate content

Use the table below to help identify which quality control samples are planned indicating the frequency for collection and matrix type.

Table 24. Boilerplate Table for Identifying Frequency of Quality Control Sample Collection

Blank Type	Frequency of Collection	Collection Procedures
Transport Blanks		
Equipment Blanks		
Trip Blank		
Temperature Blank		
Field Blank		
Filter Blank		

Section 11 Data Management Procedures

General guidance

The *Data Management Procedures* section of your stormwater monitoring QAPP should include a description of the planned data management procedures and identify the hardware/software used for data handling and storage. This section should describe the mechanism for recording and/or uploading data and detecting and correcting errors. Include any plans for data sharing, uploading to companion data bases and reference any planned data transfers. If data is going into Ecology's EIM database, the QAPP should specify this. The QAPP should also identify responsible personnel for data management.

This section provides project specific needs to provide consistencies for collecting assessing, and documenting data to meet requirements in S8.D of the NPDES Phase I Permit. Data collected in the field should be transferred to network computers, backed-up regularly with documents archived. Documents will be retained for five years.

Optional boilerplate content

The following records will be used, maintained and retained for this project:

- Field data sheets including field notebook entries.
- Laboratory documentation package.
- Correspondence with Ecology.
- Chain of Custody records.
- QAPP revision documentation.
- Internal audit notes or notes derived from field QA/QC checks.
- Storm event reports.
- Any additional information collected by field staff.

Section 12 Audits and Reports

General guidance

The *Audits and Reports* section of your stormwater monitoring QAPP should describe any self-audits planned during the project. If self-audits are planned, indicate frequency and corrective actions for when problems are found. Include the personnel responsible for conducting audits, writing and submitting reports. Include a list of planned reporting events such as the required Stormwater Monitoring report. Briefly describe your final report with a timeline for completion.

This section should also include any planned test runs. It is recommended that prior to storm event sampling, sampling equipment is tested and programmed. This can also provide an opportunity to train staff on equipment use and calibration.

Optional boilerplate content

Stormwater monitoring reports

Stormwater monitoring reports will be submitted as an attachment to the Annual Report and cover the previous water year (October 1 through September 30). Reports will be developed using Ecology's Stormwater Monitoring Reporting guidance document. Data results and data summaries as required in S8.H of the Phase I permit will be submitted for each monitoring element (toxicity, outfall monitoring) in each Stormwater Monitoring Report.

Calculating pollutant loads

Pollutant loads will be reported to Ecology at each stormwater monitoring site for each parameter sampled. Data results will be provided as Event Mean Concentrations (EMCs), total annual pollutant load, and the seasonal pollutant load for the wet and dry seasons. Loadings should be expressed as total pounds, and as pounds per acre, and must take into account potential pollutant load from base flow.

Guidance for calculating pollutant loads can be found in Ecology's Standard Operating Procedure for Calculating Pollutant Loads from Stormwater Discharges (Appendix A).

Toxicity reporting

Reports for toxicity testing will be submitted to Ecology in accordance with the most recent version of Department of Ecology Publication # WQ-R-95-80, Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria. Reports are submitted in the Annual Stormwater Monitoring Report.

General guidance: Further guidance for toxicity reporting can be found in Ecology's Stormwater Monitoring Report Guidance.

Self audits

Self audits will be performed during storm sampling events to ensure field staff properly collect samples and record data correctly. During self audits, project managers and/or field staff will perform the following tasks:

- Check to ensure samples are cooled as collected.
- Check sampler programming and function of equipment.
- Review data recording information from flow meters, rain gauges, and samplers.
- Check sample collection procedure compatibility to QAPPs or SOPs.

Additional resources or references to assist with this section

- Department of Ecology's Standard Operating Procedure for Calculating Pollutant Loads for Stormwater Discharges (ECY 004), September 16, 2009: http://www.ecy.wa.gov/programs/eap/quality.html.
- Department of Ecology's Stormwater Monitoring Reporting Guidance, June 2010: http://www.ecy.wa.gov/biblio/1010028.html.

Section 13 Data Verification

General guidance

The *Data Verification* section of your stormwater monitoring QAPP should indicate the planned procedures for verification and personnel responsible. The QAPP should describe how data is verified, recorded, and list correctives actions. Identify project needs for record keeping, documentation, and technical specifications for data generation and indicate the location of these records. Describe the records produced in the field and laboratory. Examples include field data sheets, laboratory sample receipt documents, sample preparation documents, and data verification records review. Describe the procedures for verifying data results for measurements done in the field and indicate responsible personnel. Include the frequency of self-audits and inspections. Attach copies of field data forms, Chain-of-Custody forms and any other records pertinent to this section.

Data verification is the in-house examination to ensure that the data is recorded, transmitted, and processed correctly. This process includes checking for data entry errors, field-sampling errors and checking calculations. It also includes checking sample information including number of duplicates collected, meeting holding times, and checking field data sheets. Data verification is also the process for evaluating the completeness, correctness, and conformance/compliance of a specific data set against the method specifications. Data verification is typically done first with data validation completed second (see next Section).

When deficiencies in data are identified, they should be documented and, if possible, resolved by implementing a corrective action. Data verification applies to activities in the field as well as in the laboratory. Personnel involved in data verification can include:

- Field personnel.
- Chemists.
- Report preparers.
- Data reviewers.
- Project leaders.
- Quality Assurance officers.
- Laboratory directors.

Optional boilerplate content

Data verification inputs

The following table lists records that will be used as inputs for the data verification process:

Table 25. Example Data Records Used in Data Verification

Operation	Common Records	Sources for Record Specifications
Sample Collection	Daily field logs, sample collection logs, Chain of Custody forms (COC)	QAPP, Standard Operating Procedures for sample collection, pre-printed COC form instructions.
Sample Receipt	COC forms from field personnel, receiver's copy of shipping bill, internal laboratory receipt forms, internal laboratory COC forms, laboratory documented temperature logs	QAPP, laboratory SOP for sample receipt, pre-printed COC instructions
Sample Preparation	Analytical services requests, internal laboratory receipt forms, internal laboratory COC forms, laboratory refrigerator or freezer logs, preparation logs or bench notes, manufacturer's certificates for standards or solutions	QAPP, reference method, laboratory SOP for analysis method, pre-printed instructions on internal forms and worksheets
Sample Analysis	Analytical services requests, internal laboratory receipt forms, internal laboratory COC forms, laboratory refrigerator or freezer logs, manufacturer's certifications for standards or solutions, instrument logs or bench notes, instrument readouts (raw data), calculation worksheets, quality control (QC) results	QAPP, reference method, laboratory SOP for analysis method, pre-printed instructions on internal forms and worksheets
Records review	Internal laboratory checklists	QAPP, laboratory SOP for analysis method or laboratory QA Plan

(EPA QA/G-8, 2002).

Data verification implementation

A two-step process will be used for data verification:

1. Identify project needs for records, documentation, and technical specifications for data generation and determine the location and source of these records.
2. Verify records that are produced or reported against the method, procedural, or contractual requirements, as per the field and analytical operations listed in the table

above, as applicable (specifically, sample collection, sample receipt, sample preparation, sample analysis, and data verification records review).

Data verification outputs

There are two general outputs of data verification:

- The verified data, and
- Data verification records.

Verified data includes data that have been checked for a variety of factors during the data verification process (checks can include transcription errors, correct application of dilution factors, appropriate reporting of dry weight versus wet weight, correct application of conversion factors, etc) and/or laboratory qualifiers, if assigned.

General guidance: Any changes to the results as originally reported by the laboratory should either be accompanied by a note of explanation from the data verifier or the laboratory, or reflected in a revised laboratory data report.

Data verification records include certification statements that certify the data have been verified and signed by appropriate personnel. Data verification records can also include a narrative that identifies technical non-compliance issues or shortcomings of the data produced during the field or laboratory activities.

Additional resources or references to assist with this section

EPA Guidance on Environmental Data Verification and Data Validation (EPA QA/G-8, 2002).

Section 14 Data Validation (Usability) Assessment

General guidance

The *Data Validation (Usability) Assessment* section of the QAPP should include a description of how the data will be assessed to determine if the data are supported by the quality objectives. After the data have been verified, a Data Validation Assessment or Usability Assessment is done. Data validation is an analyte-specific process that extends the evaluation of data beyond data verification to determine the quality of a specific data set. Results of data validation will help to evaluate whether or not the sample design is adequate and meets the needs of the study.

The QAPP should include a summary of the planned methods for data analysis. Describe how the data will be validated and how it will be used/presented. Use diagrams to illustrate trends, relationships and anomalies. The QAPP should also indicate personnel responsible for analyzing the data and how the results of the data analysis will be documented.

Comparison to data quality objectives (DQOs)

Data validation criteria are based upon the measurement quality objectives (MQOs) developed in Data Quality Objectives Section of the QAPP. The goals of data validation include:

- Evaluation of whether the data quality goals established during the planning phase have been achieved.
- Confirmation that all project requirements are met, to determine the impact on data quality of those that were not met, and to document the results of the data validation and, if performed, the focused data validation.

During data validation, assess whether or not the MQO's outlined in Section 6, *Quality Objectives* were met (representativeness, comparability, etc.). For example, if you set an MQO for completeness, compare the number of valid measurements completed with those established by the MQO. If MQOs have not been met for data, determine whether or not the data are still useable.

Data qualifiers

Data qualifiers can be used to assist with data validation. Qualifiers include the process for flagging data. It is recommended to use the most updated version of EPA's National Function Guidelines for establishing data qualifiers for flagging data.

Handling non-detect data

Non-detect data have concentrations measured below the laboratory reporting limit. This data is referred to and reported as non-detect data. These data are typically reported from the laboratory as <DL. This does not mean that there is no concentration of a parameter or analyte but rather that a concentration may be present but it cannot be accurately measured by the analytical instrument used or cannot be determined by the laboratory with 95% confidence that the

concentration is greater than zero. The statistical procedure for handling non-detects in a data set depends can vary and depend on the distribution of the concentrations in the sample. The QAPP should indicate how you plan to handle non-detect data. Many methods exist and are often dependent upon the anticipated data set. Some of these methods include:

- Substitution methods.
- Maximum likelihood estimation methods.
- Kaplan-Meier methods for interpreting non-detect data.
- Dr. Dennis Helsel's Practical Statistics for non-detect and data analysis.

Optional boilerplate content

Data validation procedures

Data collected during stormwater monitoring will be organized into the following categories:

- Data meeting all data quality objectives.
- Data failing to meet precision and/or recovery criteria and data failing to meet accuracy criteria.
- Data that meets all DQO criteria will be accepted and data failing to meet accuracy will be evaluated to conclude whether the implementation of the sampling design gave the information expected for meeting project objectives.

Validation will involve the following steps:

1. Review the project objectives and sampling design.
2. Conduct a preliminary data review.
3. Select the statistical method.
4. Verify the assumptions of the statistical method.
5. Draw conclusions from the data.

Data validation will apply to sample collection activities in the field and in the laboratory. A review and inspection of the data collected in the field and a review of the verified data will be used to determine the analytical quality of the dataset. A determination will be made detailing reasons for any failure to meet method, procedural, or contractual requirements, and an evaluation of the impact of such failures on the overall data set will be produced in the form of a data validation report and include qualified data. This report will also be reported as part of the Stormwater Monitoring Report. The focus of data validation for this project is to determine data quality in terms of accomplishment of measurement quality objectives.

Data validation inputs

General guidance: Your QAPP should include your anticipated data validation inputs. The following documents may be generated and reviewed during planning and implementation stages:

- *QAPPs or Sampling and Analysis Plans (SAPs) or other project related planning documents.*

- *Program-wide planning documents (Water Quality Management Plan or Basin Plans).*
- *SOPs including field and laboratory methods for any aspect of the data generation process.*
- *Published, approved sampling or analytical methods (Standard Methods, SW846 methods or EPA methods).*
- *Instrument calibration records.*
- *Field notebooks or daily activity logs.*
- *Sample collection logs.*
- *Chain of Custody records.*

Data validation implementation
The followings steps for data validation will be taken:

- Identify the project needs for records.
- Obtain the records that were produced during data verification.
- Validate the appropriate records to determine the quality of data and whether or not project needs were met by performing data validation and focused data validation, as requested.

Data validation outputs
The following two outputs that may result from data validation will include:

- Validated data.
- A data validation report.

Additional resources or references to assist with this section

- EPA document QA/G-9, *Guidance for Data Quality Assessment*, provides background information and statistical tools for performing each of the steps in the DQA Process.
- EPA Contract Laboratory Program National Function Guidelines for Inorganic and Organic Data Review.

Appendix A Standard operating procedures for stormwater monitoring

The SOPs found in this appendix were approved by Ecology's Environmental Assessment Program and can also be found online at http://www.ecy.wa.gov/programs/eap/quality.html

Appendix B Questions and answers for toxicity sampling

Storm event criteria and sampling protocols

Q: What are the required storm event criteria for first flush toxicity sampling?

A: The only storm event criteria applicable to toxicity testing are *August or September, with at least a one-week antecedent dry period (or October, irrespective of antecedent dry period, if unsuccessful in August or September).* S8.D.2.d.iii.

Q: Can I count my toxicity chemistry sample toward meeting a required dry season storm in S8.D.2.a.ii?

A: Yes, if your sampled event meets both sets of storm event criteria and if you are able to collect sufficient sample to address both sets of parameters. If you want to meet both requirements you must meet the 0.2" minimum rainfall depth requirement with a 1-week antecedent dry period and a 6-hour inter-event period. Additionally, there are more stormwater characterization parameters than what is listed in the toxicity chemistry requirement (e.g., turbidity, BOD5, total and ortho phosphorus, TKN and nitrate-nitrite).

Q: Why is it important to collect enough sample to send a portion of the sample to a laboratory for chemical analysis? Why not just collect enough sample for a toxicity test?

A: It is not enough to determine if the sample was toxic or not. Having chemistry results from the same sample used in the toxicity test will give you a good chance of explaining to a reasonable degree any toxicity detected. Good water chemistry results might prevent the need to conduct GC/MS on embryos from the toxicity test or to collect additional stormwater samples which might have different chemical constituents than the original sample used in the toxicity test.

Q: Is it true that adjusting the hardness of the stormwater samples is only necessary if the hardness of the stormwater and the receiving water differ by more than 20%?

A: Yes, we encourage hardness adjustment if the sample and receiving water hardness vary by more than 20%, but you may instruct your laboratory to adjust sample hardness for smaller differences if you wish.

Q: What are the procedures for collecting receiving water data for hardness?

A: Grab sampling is fine.

Q: How do I select an appropriate site for sampling the receiving water and how far away can it be from my S8.D monitoring site?

A: For sampling the receiving water, don't take the instruction too literally. If the stream can be accessed more easily and safely a bit further away, sample there. For this sample, we need typical stream hardness for that period of time determined with a reasonable level of effort.

Q: What if my receiving water is marine waters and/or has salinity influences?

A: If the receiving water is salinity-influenced, then the stormwater sample's hardness needs to be adjusted to 100 mg/L (the upper end of EPA's moderately hard range).

Q: What if my receiving water sample from freshwater receiving water exceeds 180 mg/L for hardness?

A: Contact Randall Marshall at 360-407-6445, or randall.marshall@ecy.wa.gov , or have your laboratory contact him.

Q: What bottle types do we use to collect the toxicity and related chemistry samples?

A: For toxicity sample, use glass or cubitainer. For chemistry sample, use the same bottle type as for your other S8.D chemistry samples.

Q: What should the laboratory use to preserve the trout embryos for analysis in the event that we are required to run GC/MS test?

A: Freeze and hold the embryos at very low temperature (-20° C).

Q: How do we store the trout embryos for analysis in the event that we are required to run GC/MS test?

A: Freeze and hold the embryos at very low temperature (-20° C).

Q: Will the laboratory set aside a separate sample volume and hold the volume until after the determination has been made to run the GC/MS?

A: The laboratory will use a portion of the original sample to expose extra trout eggs, and the extra trout embryos from the test will be held at 20° C in case GC/MS of their tissue and yolk is needed. When toxicity sample volumes are below 44 liters, the laboratory may not have enough volume to perform a full toxicity test plus expose extra eggs for potential GC/MS testing. Ecology encourages permittees to target 44 liters for toxicity in order to run a quality test.

Interpreting the good faith requirement in S8.D.2.a

Scenario	Meets Good Faith Attempt?
Storm that meets event criteria is targeted* but fails to produce flow at the sampling point	Yes
Storm is sampled but didn't meet event criteria	Yes, provided the event criterion is not off by more than 12 hours.
Storm criteria met but total volume is below the minimum required (e.g., 24L+ approx. 10L)	Yes
Storm criteria met but volume is on the low end of the permit-required range	Yes
Deviations from holding times for stormwater	Yes
Deviations from holding times for gametes	Yes

*Targeted means that sampling equipment was deployed, gametes were ordered and permittee was prepared to handle the sample post-collection.

Communication strategy between Ecology staff, permittees and laboratories

Contact your permit specialist if:

- You have collected volume for toxicity but your storm does not meet the 1-week antecedent dry period.
- You have targeted a storm event that met event criteria but failed to produce flow at the sampling point.

Contact Randall Marshall at 360-407-6445, or randall.marshall@ecy.wa.gov, if:

- You have collected enough sample volume for the toxicity test, but the volume is low (<30 liters). Randall will discuss with the laboratory which modifications of the E-Test to set up. The laboratory or Randall will communicate decision to permittee.
- Your toxicity sample deviates from your holding time or has a high temperature at receipt by the laboratory. The laboratory should call Randall to discuss whether or not the test should be run. The laboratory or Randall will communicate decision to permittee.

Note: For deviations from holding times for stormwater chemistry samples, use the same approach you are using (e.g., flagging) for your typical S8.D monitoring program.

Work with your laboratory if:

- Your holding time requirement for gametes has been exceeded. The laboratory will decide whether to proceed based upon its own experience and judgment. The laboratory may call Randall to discuss if test should be run. The laboratory will communicate decision to permittee.

Additional post-toxicity testing logistics

Invalid and/or anomalous test results

- The laboratory will use “Canary” book to determine if a test is valid. The laboratory will provide Randall with laboratory results and validity determination for his review. Randall will send the results and the valid/invalid determination to the assigned Ecology permit specialist for communication to the permittee.
- For anomalous test results, the laboratory will provide Randall with results for his review. Randall will make determination of anomalous/non-anomalous and send the results and his determination to the assigned Ecology permit specialist for communication to the permittee.

Analysis of results using library of comparison

- It is highly recommended that a toxicologist or equivalent conducts the library comparison since this review is highly technical. Randall will be providing technical support to each permittee/laboratory/consultant for this evaluation. Permittee must follow reporting requirements in S8.D.2.d.vii, which indicates reports are to be submitted to Ecology 120 days after data is validated.
- Submit these reports to your assigned Ecology permit specialist. Randall will review these reports and determine if a GC/MS is necessary. Your permit specialist will communicate Ecology’s determination, as well as any specific instructions, to you.

All decisions made by Randall and/or the laboratory must be documented by the permittee. The permittee is responsible for ensuring that documentation of toxicity sampling, whether successful or unsuccessful, is provided to your assigned Ecology Municipal Permit Specialist.