


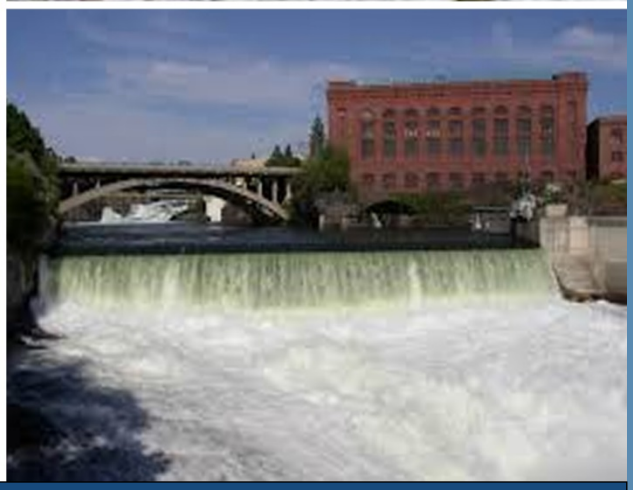

Quality Assurance Project Plan

Spokane River Toxics Reduction Strategy Study

Prepared for:
Spokane River Regional Toxics Task Force

Final Draft

March 5, 2014

LimnoTech
Water Environment | Scientists Engineers

APPROVALS (A.1)

Quality Assurance Project Plan

March 21, 2014

_____

_____

_____

_____

_____

_____

_____

Blank Page

TABLE OF CONTENTS (A.2)

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

DISTRIBUTION LIST (A.3)

QUALITY ASSURANCE PROJECT PLAN

DRAFT

MARCH 21, 2014

The approved Quality Assurance Project Plan, and any subsequent updates, will be distributed to the following list of project personnel:

ADD LIST

1. PROJECT MANAGEMENT (GROUP A)

The purpose of the Quality Assurance Project Plan (QAPP) is to document the necessary procedures required to assure that the project is executed in a manner consistent with applicable United States Environmental Protection Agency (U.S. EPA) guidance documents and with generally accepted and approved quality assurance objectives. This QAPP is organized in accordance with the basic groups and subgroup elements discussed in the U.S. EPA guidance for QAPPs. The four basic groups include project management (Group A); data generation and acquisition (Group B); assessment and oversight (Group C); and data validation and usability activities (Group D). The groups are subdivided into elements covering specific topics related to each group. The Section and Subsection headings of this QAPP include references to the U.S. EPA QAPP Guidance group letters and element numbers to facilitate cross-reference with the Guidance.

The QAPP integrates quality control policies and project-specific work tasks to successfully conduct water quality monitoring to support the toxics reduction strategy. The Spokane River Regional Toxics Task Force (SRRTTF) will actively participate and provide funds to the project. The SRRTTF will serve as the contracting authority for the project and provide overall program management. The SRRTTF has hired LimnoTech to serve as technical advisors, to provide engineering services associated with the preparation of the Sampling and Analysis Plan (SAP) for the project. CONTRACTOR will conduct the field sampling. LAB will perform laboratory analysis for polychlorinated biphenyls (PCB) and LAB will perform the laboratory analysis of all other parameters.

The QAPP has been prepared in compliance with U.S. EPA and Ecology requirements. It is the overall intent of the QAPP to provide professional guidelines for activities by all personnel on the project and to ensure that quality assurance/quality control (QA/QC) procedures are followed.

1.1 Project Organization (A.4)

Each of the organizations included in the project team has established an organizational structure for providing technical direction and administrative control to accomplish quality-related activities for the development of the project.

Key project personnel and their corresponding responsibilities are listed in Table 1 below and shown in Figure 1.

Table 1. Project Team Responsibilities

Name/Affiliation	Project Title/Responsibility
	Project Manager-General oversight, review/approval of all work products
	Senior Technical Advisor
	Department of Ecology Advisor??
CONTRACTOR	Field Manager – Synoptic Survey and Quarterly sampling events, direct all field activities, data evaluation, and reporting activities
	Quality Assurance Officer - Quality assurance, data evaluation
Lab1 and Lab2	Technical Director - Sample analysis
Lab1 and Lab2	QA/QC Manager - Lab QA

Staff members within each organization will report to their project manager for technical and administrative direction. Each staff member has responsibility for performance of assigned quality control duties in the course of accomplishing identified sub-tasks. The quality control duties include:

- Completing the assigned task on or before schedule and in a quality manner in accordance with established procedures; and
- Ascertaining that the work performed is technically correct and meets all aspects of the QAPP.

INSERT ORG CHART

Figure 1. Project Team Organization

Project Team Responsibilities

As Project Manager, _____ is responsible for general oversight of the project, including review and approval of all work products.

Consultants to the project include LimnoTech of Ann Arbor, Michigan and CONTRACTOR. The SRRTTF is responsible for management and oversight of all consultants, as well as development of this QAPP. LimnoTech is primarily responsible for preparation of the SAP and QAPP, technical support, and guidance. LAB1 is responsible for laboratory analysis of PCBs and LAB2 is responsible for testing associated with all other lab parameters.

1.2 Project Background (A.5)

The Spokane River begins in northern Idaho at the outlet of Lake Coeur d'Alene and flows west 112 miles to the Columbia River (Lake Roosevelt). The project study area includes the Spokane River from the outlet of Lake Coeur d'Alene to the upstream end of Lake Spokane (Figure 2). The Spokane River watershed encompasses over 6,000 square miles in Washington and Idaho. The river flows through the smaller cities of Post Falls and Coeur d'Alene in Idaho and large urban areas of the Spokane Valley and Spokane in Washington. Other cities in the watershed include Liberty Lake and Deer Park. The Spokane Tribe of Indians reservation lies along the north bank of the lower river (Spokane Arm of Lake Roosevelt).

The Spokane River and Lake Spokane exceed the water quality standard (170 pg/L) for polychlorinated biphenyls (PCBs) in several segments. These segments are on the state Water Quality Assessment (303[d]) list of impaired water bodies. The Washington State Department of Ecology (Ecology) first documented PCB contamination in fish tissue two decades ago, and numerous investigations by Ecology and others have been conducted to evaluate the extent of the contamination. In 2009, the Washington State Departments of Health and Ecology issued a revised Health Advisory for Spokane River Fish Consumption. The Spokane Tribe of Indians have water quality standards for PCBs in the Spokane River below Lake Spokane (also known as the Spokane Arm of Lake Roosevelt) that are more than 95% lower than State standards (3.37 pg/L), based on a higher fish consumption rate than the general population (Serdar et al, 2013)

In the past, PCBs were used as coolants and lubricants in electrical equipment, such as transformers and capacitors. In 1977 the United States banned the commercial manufacture of PCBs because they build up in the environment and can be harmful to humans and wildlife. Certain PCBs continue to be inadvertently produced as by-products in some manufacturing processes, such as the production of pigments. These PCBs can be present in consumer products and can be subsequently introduced into the environment through everyday use.

Ecology's first step to immediate direct action related to PCBs was establishing the Urban Waters Program to track sources beginning in 2007. The research led to the conclusion that PCB sources are diffuse and low

level, creating a need for a unique and collaborative approach to source tracking and elimination. In May 2011 Ecology completed a PCB Source Assessment Study (Serdar et al, 2013).The PCB Source Assessment Study provides the technical underpinnings for a PCB reduction strategy. Ecology is pursuing direct actions to lower PCB loading into the Spokane River and feels that taking steps to reduce toxics immediately will be effective. This direct-to-implementation strategy, a component in the overall Toxics Reduction Strategy for the Spokane River, will in part require emphasis on identifying and reducing PCBs at their source(s) in the watershed.

In January 2012 the collaborative Spokane River Regional Toxics Task Force (SRRTTF) was formed for the purpose of developing a Comprehensive Plan for achieving the water quality standards in the Spokane River for PCB. Task Force participants include NPDES permit holders, conservation groups, state and federal agencies, tribes and other interested parties. The Task Force's unique approach towards reducing toxic compounds is intended to result in more effective and immediate improvements to water quality. The SRRTTF activities include:

- Developing technical studies needed to understand and identify the sources of toxics.
- A public education and engagement component to advance the region-wide understanding of toxics issues.
- A best management practices implementation plan.
- A long-term monitoring plan.
- Recommendations for the development of a Spokane River toxics point and non-point source reduction plan.

Funding is provided from a combination of private and public sources.

This QAPP was developed to address the first year of data collection and is designed to ensure that all monitoring activities undertaken result in representative water quality and quantity information necessary to support a low-flow mass balance assessment and assess the seasonal variability of upstream loads. Monitoring and sampling stations have been selected to provide appropriate coverage to meet the assessment needs of the task force.

Table 2. Spokane River 2008 303(d) listing for total PCB in fish tissue

Waterbody	Reach	WB Number	Watercourse Number	Listing ID
Spokane River	Idaho Border to Latah Creek	WA-57-1010	QZ45UE	Spokane River
	Latah Creek (Hangman Creek)to Ninemile Dam	WA-54-1010		
Little Spokane River	Near Mouth	WA-55-1010	JZ70CP	Little Spokane River
Lake Spokane (Long Lake)	Ninemile Dam to Lake Spokane Dam	WA-54-9040	QZ45UE	Lake Spokane (Long Lake)
Spokane River	Lake Spokane Dam to Mouth	WA-54-1020	QZ45UE	Spokane River

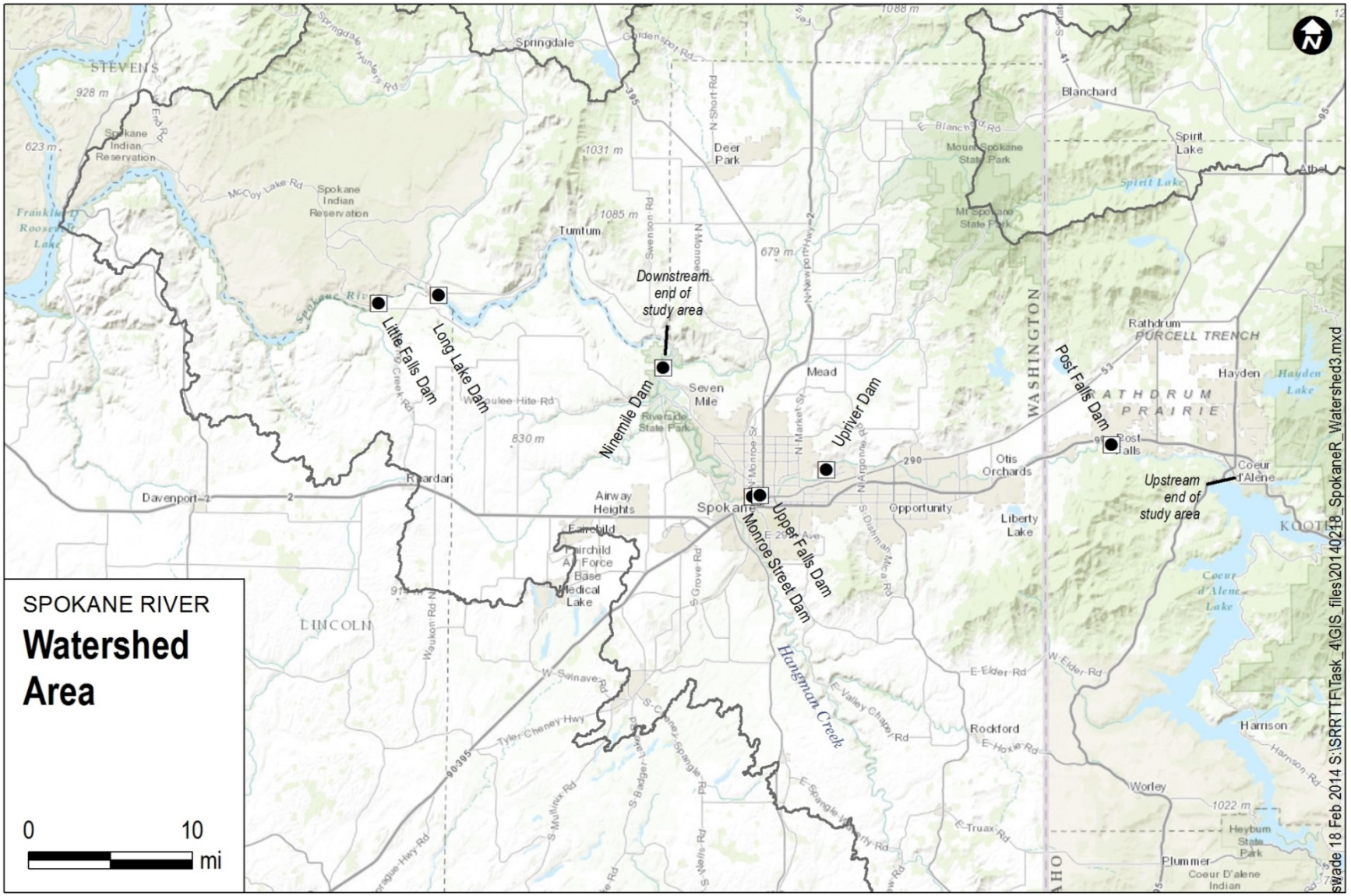

Figure 2. Spokane River Study Area

1.3 Project/Task Description (A.6) and Schedule

The Spokane watershed has existing PCB monitoring data, which provide a good estimate of the amount of PCBs entering the Spokane River from contributing source area categories (e.g. stormwater, WWTPs). Based on the Spokane River PCB Source Assessment 2004-2007 (Serdar et al, 2011), only 43% of the PCB source loading to the river between Stateline (RM 96.1) and Long Lake Dam (RM 33.9) could be identified. The existing data indicate that sources of PCBs are very diffuse throughout the watershed, such that more data will be needed to support development of a management plan with targeted control actions. Primary data gaps include:

- **The magnitude of true sources contributing to stormwater loads:** A robust dataset exists characterizing PCB concentration at numerous locations throughout the stormwater system, unfortunately these data indicate that PCB sources are very diffuse and difficult to trace back to their origin.
- **PCB sources upstream of the Idaho/Washington border:** PCBs entering from Idaho were estimated to represent 30% of the overall loading to the Spokane River in Washington.
- **The significance of loading from atmospheric and groundwater sources:** Insufficient data presently exist to define the magnitude of these source categories.

The objective of this project is to collect the necessary data to eliminate the data gaps in order to conduct a PCB mass balance assessment of the Spokane River. The first year of monitoring under this study includes the following tasks:

1. **Synoptic Study:** Conducted along the length of the river during the summer low flow period.
2. **Seasonal Integrated Sampling:** Conducted at the Lake Coeur d'Alene outlet, during three different flow regimes.

The Synoptic Survey will consist of dry weather sampling at multiple locations in the Spokane River upstream of Lake Spokane, consisting of:

- River locations with flow gaging stations
- NPDES permitted sources
- Latah (Hangman) Creek Mouth

The synoptic survey sample locations are shown in Figure 3 and summarized in Table 3.

Sampling will be conducted during the summer low flow period to minimize potential confounding effects of wet weather sources. Multiple river sampling events will be conducted (with some compositing to reduce analytical costs) over a two week sampling period to reduce the uncertainty in loading estimates caused by day to day variability in concentrations.

The Seasonally Integrated Sampling will consist of sampling at the outlet of Lake Coeur d'Alene. The intent of this monitoring is to provide information on the seasonal variability of upstream PCB loading to the Spokane River from Lake Coeur d'Alene, which will provide insight on the atmospheric contribution to the snow pack in the upstream watershed.

The sampling will be conducted on a seasonally integrated basis, with multiple samples taken and composited over each of three different flow regimes:

- Spring high flow
- Summer low flow (conducted as part of the Synoptic Survey)
- Winter moderate flow

The Seasonally Integrated Sampling locations are shown in Figure 3 and summarized in Table 3.

The parameters to be analyzed for both the Synoptic Survey and the Seasonally Integrated Sampling are listed in Table 4.

Sample collection details are provided in the Sampling and Analysis Plan (SAP).

Schedule

Key milestones associated with the project are described below along with their targeted completion dates:

Laboratory Request of Qualifications and Quote sent out	March 10, 2014
QAPP and SAP approved by Task Force	March 26, 2014
Select laboratory	March 26, 2014
Sampling Contractor Request for Proposals sent out	March 31, 2014
Select Sampling Contractor	April 23, 2014
Contractor Training	May 1, 2014
Start First Year Sampling	May 15, 2014
First Year Sampling Completed	March 31, 2015

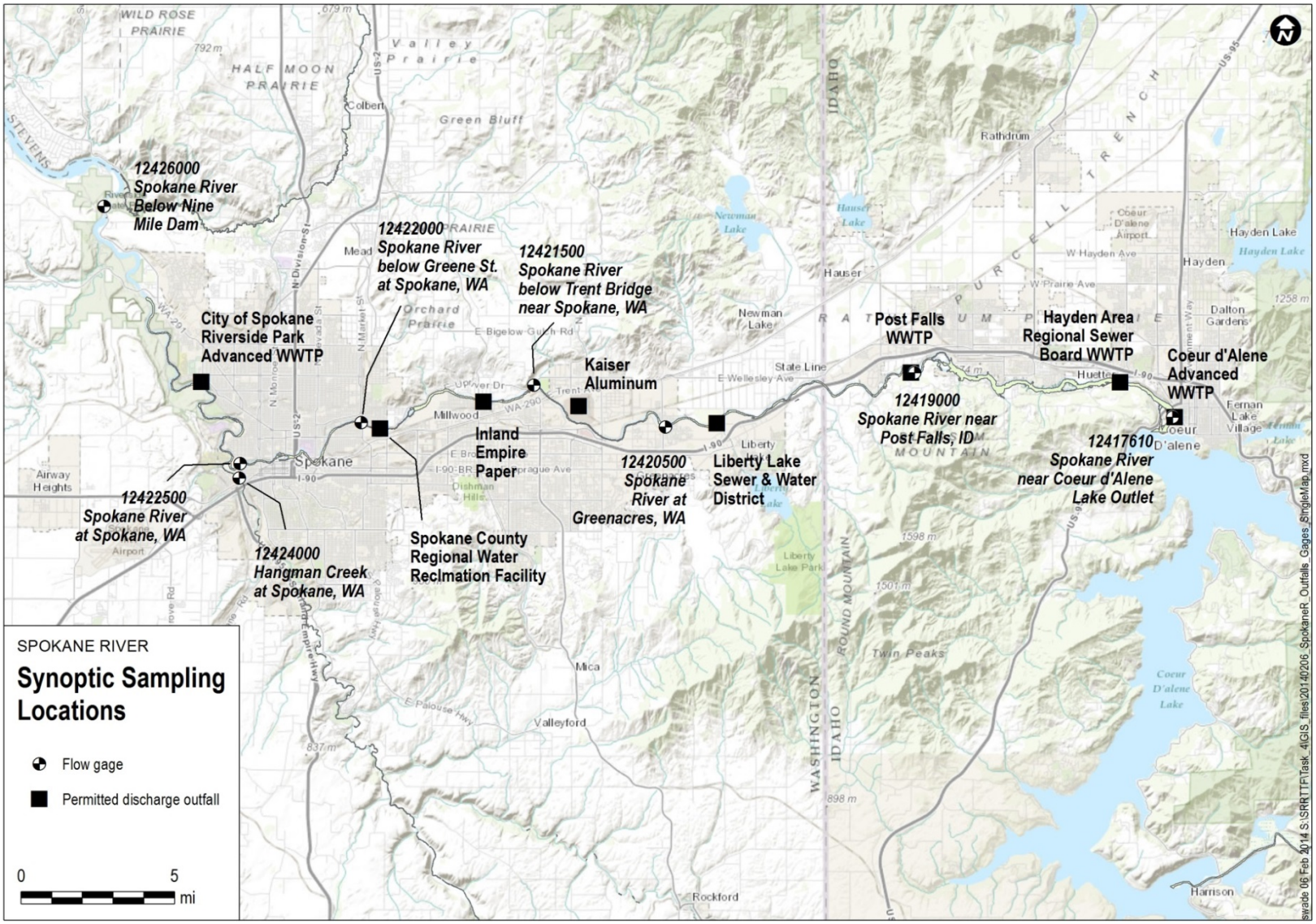

Figure 3. Spokane River Monitoring Locations Map

Table 3. Spokane River Monitoring Locations

Site	Location	Low Flow Synoptic Survey	Seasonally Integrated Sampling
SR-1	Spokane River Below 9 Mile Dam	X	
SR-2	City of Spokane Riverside Park Advanced WWTP	X	
SR-3	Spokane River at Spokane	X	
HC-1	Hangman Creek	X	
SR-4	Spokane River at Greene Street Bridge	X	
SR-5	Spokane County Regional Water Reclamation Facility	X	
SR-6	Inland Empire Paper	X	
SR-7	Spokane River at Below Trent Bridge	X	
SR-8	Kaiser Aluminum	X	
SR-9	Spokane River at Barker Road Bridge	X	
SR-10	Liberty Lake Sewer & Water District Water Reclamation Facility	X	
SR-11	Post Falls WWTP	X	
SR-12	Spokane River at Post Falls	X	
SR-13	Hayden Area Regional Sewer Board WWTP	X	
SR-14	Coeur d'Alene Advanced WWTP	X	
SR-15	Lake Coeur d'Alene Outlet	X	X

Table 4. Spokane River Monitoring Parameters

Parameter
Polychlorinated Biphenyl (PCB)– 209 Congeners
Dissolved Organic Carbon (DOC)
Total Organic Carbon (TOC)
Total Suspended Solids (TSS)
Total Dissolved Solids (TDS)
Temperature
Conductivity
pH
Dissolved Oxygen (DO)
Turbidity

1.4 Quality Objectives and Criteria (A.7)

The data quality objectives for this study have been developed in order to provide quality data that supports the objectives of the project. The analytical methods discussed in this QAPP provide a level of quality that allows the data to be used in the decision making process.

The monitoring information that will be collected to support the Spokane River toxics reduction strategy will meet the quality assurance objectives outlined in this section. Data quality will be measured in terms of the

Data Quality Indicators (DQIs); accuracy and precision, completeness, representativeness, comparability, and the required detection limits for the analytical methods. These objectives serve as a basis for developing the project SAP.

LAB1 will do the PCB analyses using EPA Method 1668C to perform low-level analysis for 209 PCB congeners using HRGS/HRMS instrumentation (Appendix C). LAB2 will conduct the laboratory analyses for all other parameters. The laboratories will analyze field and laboratory QA/QC samples using the procedures in the SOPs and the analytical method to assess data quality.

The frequency of the quality control (QC) samples and the measurement performance criteria for each QC sample for each type of analysis are provided in Table 5.

1.4.1 Accuracy

Accuracy is the degree of agreement between a measured value and the "true" or expected value. It represents an estimate of total error from a single measurement, including both systematic or matrix error (bias), and random error that may reflect variability due to imprecision. Accuracy is evaluated in terms of percent recoveries determined from results of laboratory control sample analyses. Surrogate recoveries (also known as labeled congeners), injection standards, and cleanup standards are also used to assess accuracy.

Accuracy in the field is assessed through the use of field blanks and through the adherence to all sample handling, preservation and holding times. The field accuracy objective is to have no quantifiable concentrations of PCB in the field blank.

Laboratory Accuracy Objectives

Laboratory accuracy will be assessed through the analysis of matrix spikes, duplicate analyses and laboratory control samples to determine if the percent recovery (%R) meets the objective value. Tables 5 and 6 provide a summary of the laboratory accuracy objectives. The percent recovery is calculated as follows:

$$\%R = [(C_s - C_u)/C_A] * 100$$

Where:

C_S = measured concentration of spiked sample, mg/L
C_U = measured concentration of unspiked sample, mg/L
C_A = actual concentration of spike added, mg/L

And:

$$C_A = \{[(V_u * C_u) + (V_{std} * C_{std})]/(V_u + V_{std})\} - C_U$$

Where:

V_u = Volume of unspiked sample, ml
V_{std} = Volume of known standard added as spike, ml
C_{std} = Concentration of known standard added as spike, mg/L

The percent recovery utilizing laboratory control samples is calculated as follows:

$$\%R = (C_M/C_A) * 100$$

Where:

C_M = measured concentration of control sample

C_A = actual concentration of control sample

(Laboratory control samples are standards obtained from a source outside the laboratory whose known concentration is certified by the manufacturer.)

Method blank samples will be generated by the contract laboratory and used to assess contamination resulting from laboratory procedures. Duplicate analyses and the analysis of matrix spike duplicates will be performed to verify analytical reproducibility. Matrix spikes will provide information concerning the effect of the sample matrix on the measurement methodology.

Field Accuracy Objectives

Field accuracy will be assessed through the use of field blanks. In order for the accuracy assessment to be relevant, all appropriate protocols concerning sample collection, handling, preservation, and hold times must be maintained. Field blanks will be collected at a frequency of 10% of total samples or one field blank per sampling round, whichever is less. A detailed discussion of these protocols is provided in the SAP.

Field blanks will consist of reagent grade deionized water poured into sample bottles in the field, and submitted to the analytical laboratory to assess the quality of the data resulting from the field monitoring program. Field blanks will be used to assess contamination of samples from the field conditions during sampling and travel to the laboratory.

1.4.2 Precision

Precision is a measure of reproducibility of analytical results. It can be defined as the degree of mutual agreement among individual measurements obtained under similar conditions. Total precision is a function of the variability associated with both sampling and analysis. Precision is assessed through the collection and measurement of field replicates. Relative Percent Difference (RPD) shall be calculated for each of the replicates collected for all the parameters analyzed.

Laboratory Precision Objectives

The precision of the laboratory analysis is assessed by the comparison of matrix spikes (MS) and matrix spike duplicates (MSD). The RPD between the analyte levels measured in the MS sample and the MSD sample will be calculated as follows:

$$RPD = \frac{|C_{MS} - C_{MSD}|}{0.5(C_{MS} + C_{MSD})} \times 100$$

Where:

C_{MS} = measured concentration of the matrix spike
C_{MSD} = measured concentration of the matrix spike duplicate

In situations where spiked samples are not practicable (such as TSS) to assess laboratory precision, a comparison of laboratory replicate analyses will be performed in order to calculate the RPD.

Field Precision Objectives

Field precision tests are conducted for grab samples and physical parameter readings. The precision of grab samples is assessed by the comparison of field replicates. The relative percent difference (RPD) between the analyte levels measured in the field replicates will be calculated as follows:

$$RPD = \frac{|C_A - C_B|}{0.5(C_A + C_B)} \times 100$$

Where:

C_A = measured concentration of the sample
C_B = measured concentration of the field replicate

1.4.3 Representativeness

Representativeness is the degree to which sample data accurately reflect the characteristics of a population of samples. It is achieved through a well-designed sampling program and by using standardized sampling strategies and techniques and analytical procedures. Representativeness will be achieved by ensuring that the SAP is followed and proper sampling techniques are used. This will be done by training field staff in proper sample collection techniques and reviewing field records for consistency. Representativeness in the laboratory is ensured by using the proper analytical procedure, meeting sample holding times and analyzing and assessing field replicate samples.

1.4.4 Completeness

Completeness is a measure of the amount of valid data obtained from the monitoring program compared to the amount of data that were expected. Events that may contribute to reduction in measurement completeness include sample container breakage, inaccessibility to proposed sampling locations, field equipment failure, and laboratory equipment failures.

The percent completeness (%C) is determined as follows:

$$\%C = \frac{(M_V)}{(M_P)} \times 100$$

Where:

M_V = number of valid measurements
M_P = number of planned measurements

If the completeness objectives are not achieved for any particular category of data, the Project Manager will provide documentation as to why the objective was not met and how the lower percentage impacted the overall study objectives. If the objectives of the study are compromised, re-sampling or re-measurement may be necessary.

Laboratory Completeness Objective

Laboratory completeness is a measure of the amount of valid measurements obtained from all samples submitted for each sampling activity. The laboratory Technical Director validates the numbers of valid measurements. The completeness criterion for all measurements is 95 percent. If the completeness goal is not met, re-sampling and/or re-analyzing may be necessary.

Field Completeness Objective

Field completeness is determined by the number of measurements collected versus the number of measurements planned for collection. Due to a variety of circumstances, sometimes not all samples scheduled to be collected can be collected (e.g. a creek is dry, equipment malfunctions). The total number of samples to be collected is summarized in Table 7. The number of measurements collected is validated by the Field Managers. The completeness criterion for all measurements and sample collection is 95 percent, but will be influenced by environmental situations that may alter monitoring schedules. In order to meet this goal, duplicate samples will be collected at each sample location. The duplicate samples will be stored for use in the case of sample container breakage or other problems encountered that require additional sample volume. If the completeness goal is not met, re-sampling will be may be necessary.

1.4.5 Comparability

Comparability is the confidence with which one dataset can be compared to another. It is achieved by maintaining standard techniques and procedures for collecting and analyzing samples and reporting the analytical results in standard units. Results of performance evaluation samples and systems audits will provide additional information for assessing comparability of data among participating subcontractor laboratories, if applicable.

The objective for data comparability is to generate data for each parameter that are comparable between sampling locations and comparable over time. Data comparability will be promoted by:

1. Using standard U.S. EPA approved methods, where possible.
2. Consistently following the sampling methods detailed in the SAP.
3. Consistently following the analytical methods detailed in the QAPP.
4. Achieving the required Method Detection Limits detailed in the QAPP.

All sample collection and analytical methods will be specified, and any deviations from the methods will be documented. All results will be reported in the standard units shown in Table 5 and 6. All field and laboratory calibrations will be performed using standards traceable to National Institute of Science and Technology (NIST) or other U.S. EPA approved sources.

Refer to Table 8 for the specification limits of the field measurement instruments.

Table 5. PCB data quality objectives

	Daily Calibration Verification	Sample and MB Standard Recovery	LCS Recovery	Lab Blanks (Method Blank, Instrument Blank, Calibration Blank	Detection Limit (Level at which non-detects are reported)
	% recovery limits	% recovery limits	% recovery limits	Concentration (pg/L)	Concentration (pg/L)
PCB Congeners	50-145%	25-150%	40-145%	Maximum = 50 pg/L Laboratory will JB-qualify congeners results < 3x the concentration in an associated blank	10

Table 6. Data quality objectives – DOC, TOC, TSS, TDS

Parameter	Lab Control Sample	Replicate Samples	Matrix Spikes	Matrix Spike Duplicates	Reference Method	Detection Limit
	% recovery limits	RPD	% recovery limits	RPD		
DOC	80-120%	30%	80-120%	20%	EPA 415.3	1 mg/L
TOC	80-120%	30%	80-120%	20%	EPA 415.1	1 mg/L
TSS	80-120%	30%	--	--	EPA 160.2	1 mg/L
TDS	80-120%	30%	--	--	EPA 160.1	1 mg/L

Table 7. Monitoring Program sample numbers

Parameter	Synoptic Survey Number of Samples Collected &Analyzed	Synoptic Survey Number of QC Samples Collected	Synoptic Survey Number of QC Samples Analyzed	Synoptic Survey Number of Composite Samples	Seasonally Integrated Sampling Number of Samples Collected & Analyzed	Seasonally Integrated Sampling Number of QC Samples Collected	Seasonally Integrated Sampling Number of QC Samples Analyzed	Seasonally Integrated Sampling Number of Composite Samples
PCB	70	70	21	16	10	10	4	2
Dissolved Organic Carbon	70	70	21	16	10	10	4	2
Total Organic Carbon	70	70	21	16	10	10	4	2
Total Suspended Solids	70	70	21	16	10	10	4	2
Total Dissolved Solids	70	70	21	16	10	10	4	2
Temperature	70	0	0	0	10	0	0	0
Conductivity	70	0	0	0	10	0	0	0
pH	70	0	0	0	10	0	0	0
Dissolved Oxygen	70	0	0	0	10	0	0	0
Turbidity	70	0	0	0	10	0	0	0

Table 8. Specification limits of field measurement instruments

Parameter	Instrument	Range	Accuracy	Resolution
Temperature	Hydrolab	-5 to 50°C	±0.10°C	0.01°C
	YSI	-5 to 45°C	±0.15°C	0.01°C
pH	Hydrolab	0 to 14 units	±0.2 units	0.01 units
	YSI	0 to 14 units	±0.2 units	0.01 units
Dissolved Oxygen	Hydrolab	0 to 20 mg/L	±0.2 mg/L	0.01 mg/L
	YSI	0 to 20 mg/L	±0.2 mg/L	0.01 mg/L
Conductivity	Hydrolab	0 to 100 mS/cm	±0.5% of range	1.0 uS/cm
	YSI	0 to 100 mS/cm	±1% of range	1.0 uS/cm
Turbidity	YSI	0-1000 NTU	±5% of range	0.1 units

1.5 Special Training/Certification (A.8)

Special training/certification needed for project, field, and laboratory staff to successfully complete project work is discussed in this section.

1.5.1 Project Staff

Professional staff (engineers, scientists and others) from LimnoTech and CONTRACTOR will be involved in this monitoring program. Project staff will be assigned duties based on their qualifications to accomplish the task.

1.5.2 Field Staff

Training sessions will be carried out for all field staff on proper sampling technique, sample handling and submission and general field procedures prior to conducting the first sampling event. Specific emphasis will be placed on QA/QC issues as well as on health and safety. Field staff will receive a safety briefing conducted by LimnoTech. Emphasis will be on field hazards and materials handling. The SAP outlines the safety issues of concern.

Field crews will also receive training involving the operation, maintenance and calibration of field equipment including multi-parameter probes and all other on-site equipment used throughout the field program.

Standard Operating Procedures (SOPs) for program elements included in the SAP will be distributed to staff and available at all times.

1.5.3 Laboratory Staff

The laboratory Technical Director will be the main point of contact for coordinating all sample receipt, etc. The laboratory Technical Director will be assisted by the laboratory QA/QC Manager in performing review and validation of all data generated to assure all data quality objectives have been met. The laboratory Technical Director or QA/QC Manager will contact the Project Manager immediately with any problems with samples noted during log in or with analysis. Prior to conducting the first sampling event, the Project Manager and Field Managers will meet with the laboratory Technical Director to review details of the planned progression of sampling events.

ADD DESCRIPTION OF THE LABS

All laboratory personnel receive training and have proven proficiency in their designated analytical procedures. Laboratory personnel will be provided copies of the appropriate SOPs, which will be available at all times.

1.6 Documents and Records (A.9)

The approved QAPP and any approved updates will be distributed to the list of project personnel identified in the Distribution List at the beginning of this document. These personnel are responsible for distributing copies of the QAPP to relevant personnel within their organization.

The Project Manager is responsible for initiating project files and for overseeing maintenance of the files during the course of the project. All project files will be properly identified by client, project name, project number, file description, and file number for all appropriate correspondence, memoranda, calculations, technical work products, and other project-related data. In addition, a quality assurance file will be maintained by LimnoTech containing all QA/QC related information. A back up of all computer files containing important project information will also be maintained.

Documents to be generated by field activities include staff notes, field logs, equipment logs, field on-site measurement data sheets, field audit reports, and chain of custody forms. Documents to be generated by laboratory activities include QA/QC reports, laboratory bench sheets, laboratory results, and laboratory audit reports. These documents will be included in project reports.

At the conclusion of the project, all relevant information from the project files and electronic files will be turned over to SRRTTF to be archived.

Blank Page

2. DATA GENERATION AND ACQUISITION (GROUP B)

This section of the QAPP addresses QA/QC elements related to the monitoring activities. The monitoring program QAPP was developed based on U.S. EPA requirements (EPA, 2001).

2.1 Sampling Process Design (B.1)

As described in the previous section, a Synoptic Survey will be conducted during the summer low flow period at numerous stations, and Seasonally Integrated Sampling will be conducted at the Lake Coeur d'Alene outlet during spring high flow, summer low flow and winter moderate flow. The sampling process design is discussed in the SAP.

2.2 Sampling Methods (B.2)

Standard operating procedures (SOPs) will be employed to provide consistency and reproducibility to the sampling methods used by field personnel. The SOPs are contained in the Sampling and Analysis Plan. The following sections present or reference the detailed methods for performing sampling activities including related support procedures for equipment cleaning, field measurements, and calibration and maintenance of field instruments. Sample custody procedures are presented in the Sample Handling and Custody Section of this QAPP. For all sampling related procedures, personnel will use personal protective equipment as required by the Health and Safety Plan (HASP), which is included in the SAP.

2.2.1 Surface Water Sample Collection

Surface water sampling will be conducted as specified in the SAP, to minimize sample contamination. All water quality samples will be collected from the middle of the river either by boat, from bridges or by wading.

Surface water grab samples will be collected from the middle of the river, 6 to 12 inches below the water's surface directly into the sample bottle, or using a sampling pole with a clean sample bottle attached. A new bottle will be used at each sampling station requiring the sampling pole.

If a QC sample is to be collected at a given location, all containers designated for a particular analysis for both the sample and QC sample will be filled sequentially before containers for another analysis are filled. For field replicate samples, the sample and replicate will be filled alternately. Once the samples have been collected they will be kept chilled and processed for transfer to the laboratory.

2.2.2 Field Water Quality Measurements and Monitoring

Instantaneous water quality measurements (temperature, conductivity, pH, dissolved oxygen and turbidity) using field instruments will be collected as specified in the SAP. Field measurements will be taken at each location prior to sample collection for laboratory analysis. All field instruments will be calibrated at the beginning of each day of sampling and checked again at the end of each day. Field instrument calibration and sample measurement data will be recorded in the field logbook.

2.2.3 Field Variances

As conditions in the field vary, it may become necessary to implement minor modifications to the sampling procedures and protocols described in the QAPP. If this becomes necessary, the sampling crews will notify the Project Manager/QA Officer of the situation to obtain verbal approval prior to implementing any changes. The approval will be recorded in the logbook.

2.3 Sample Handling and Custody (B.3)

Sample handling will be performed so as to collect, store, submit to the laboratory and analyze representative samples using methods as specified in the work plans and/or according to the procedures presented in the SAP. Sample containers, volumes, preservatives and holding times are summarized in Table 9. Proper sample handling and custody procedures will be employed as discussed in the following subsections of this QAPP.

Table 9. Guidelines for sample container preparation and preservation

Parameter	Container	Volume	Preservative	Holding Time
PCB	Amber glass	2 L	4° C	1 year
TSS	Plastic or glass	1 L	4° C	7 days
TDS	Plastic or glass	500 ml	4° C	7 days
TOC	Plastic or glass	60 ml	4° C, H_2SO_4	28 days
DOC	Plastic or glass	60 ml	4° C, H_2SO_4	28 days

2.3.1 Field Sample Custody

The objective of field sample custody is to assure that samples are traceable and are not tampered with between sample collection and receipt by the analytical laboratory. A person will have custody of a sample when:

- The person is one of the authorized personnel;
- The sample is in their physical possession;
- The sample is in their view after being in their possession;
- The sample is in their personal possession and secured to prevent tampering; and
- The sample is in a restricted area accessible only to authorized personnel.

Field custody documentation will consist of both field log books and chain of custody forms.

Chain-of-Custody Forms. Completed chain-of-custody forms will be required for all samples to be analyzed. Chain-of-custody forms will be filled-out by the field sampling crew during the sample collection events. The chain-of-custody form will contain the sample information:

- Unique identification number;
- Sample date and time;
- Sample description;
- Sample type;
- Sample preservation (if any);
- Analyses required.

The original chain-of-custody form will accompany the samples to the laboratory. Copies of the chain-of-custody form will be made prior to shipment for separate field documentation. A chain-of-custody form is included in the SAP. The chain-of-custody forms will remain with the samples at all times. The samples and signed chain-of-custody form will remain in the possession of the sampling crew until the samples are delivered to the express carrier (e.g., Federal Express or United Parcel Service) or to the laboratory.

Sample Packing and Shipping Requirements. Sample packaging and shipping procedures are designed to ensure that the samples and the chain-of-custody forms will arrive at the laboratory intact and together.

Samples will be properly packaged for shipment according to the procedures presented in the SAP and submitted to the appropriate laboratory for analysis. Shipping containers will be secured with strapping tape and custody seals, if required, for shipment to the laboratory. The preferred procedure includes use of a custody seal attached to the front right and back left of the cooler. The custody seals are covered with clear plastic tape. The cooler is strapped shut with strapping tape in at least two locations.

All shipments will be accompanied by the chain-of-custody form identifying the contents. It is preferred that a separate chain-of-custody form be completed for and placed in each shipping container. The original form will accompany the shipment and copies will be retained by the sampler for the sampling records.

If sample containers are sent by common carrier (i.e., by Federal Express or United Parcel Service), the carrier need not sign the chain-of-custody form. In such cases, the chain-of-custody form should be sealed inside the sample container. The bill of lading (i.e., Federal Express label) serves as the custody documentation for the shipment so long as the container remains unopened until arrival at the laboratory. Copies of the bill of lading should be retained as part of the permanent documentation of the project.

2.3.2 Laboratory Sample Custody

Laboratory sample custody will be performed in accordance with the laboratory's Quality Assurance Manual (Appendix A) and will be consistent with the guidelines set forth in this section of the QAPP.

The laboratory must have written standard operating procedures (SOPs) for sample custody including:

- Sample receipt and maintenance of custody;
- Sample storage; and
- Sample tracking.

In addition, the laboratory shall have written SOPs for laboratory safety, cleaning of analytical glass ware, and traceability of standards used in sample analysis QA/QC.

A SOP is defined as a written narrative step-wise description of laboratory operating procedures including examples of laboratory documentation. The SOPs must accurately describe the actual procedures used in the laboratory, and copies of the written SOPs shall be available to the appropriate laboratory personnel. These procedures are necessary to ensure that analytical data produced are acceptable for use. The laboratory SOPs shall provide mechanisms and documentation to meet the specification of the following sections.

Sample Receipt and Maintenance of Custody. The laboratory shall have a designated sample custodian responsible for receipt of samples and have written SOPs describing duties and responsibilities.

The laboratory shall have written SOPs for receiving and logging in of the samples. The procedures shall include but not be limited to documenting the following information:

- Presence or absence of chain-of-custody forms;
- Presence or absence of bills of lading;
- Presence or absence of custody seals on shipping and/or sample containers and their conditions;
- Presence or absence of sample labels;
- Sample label identification numbers if not recorded on the chain-of-custody record(s) or packing list(s);
- Condition of the shipping container;
- Condition of the sample bottles;
- Verification of agreement or non-agreement of information on receiving documents; and
- Resolution of problems or discrepancies.

Sample Storage. After samples are received, they are placed in secure storage where they are maintained at 4 degrees Celsius.

The laboratory shall have written SOPs for maintenance of the security of samples after log-in and shall demonstrate security of the sample storage and laboratory areas. The SOPs shall specifically include descriptions of all storage areas for samples in the laboratory, and steps taken to prevent sample contamination. Only authorized personnel should have access or keys to secure storage areas.

Sample Tracking. The laboratory shall have written SOPs for tracking the work performed on any particular sample. Documentation of sample receipt, sample storage, sample transfers, sample preparations, sample analyses, instrument calibration and other QA/QC activities shall be performed.

2.4 Analytical Methods (B.4)

The following section details the aspects of the analytical requirements, ensuring that appropriate analytical methods are employed. Appendix A contains the LAB1 and LAB2 Quality Assurance Programs (QAP). Table 6a and 6b summarize the analytical methods to be used by the laboratory. Appendix B contains all the relevant laboratory standard operating procedures (SOPs) for the project.

2.4.1 Parameter Specific Information

Table 9 displays the required container type, sample volume, preservation, and hold time for the study parameters according to the previously referenced methods. The contract laboratory will provide sample containers from a commercial supplier. All sample containers will be new and pre-cleaned by the supplier. In addition, the contract laboratory will provide sample labels for each bottle.

2.4.2 Laboratory Chain of Custody Procedures

Use of the chain-of-custody form will terminate when laboratory personnel receive the samples and sign the form. The laboratory custodian will open the sample coolers and carefully check the contents for evidence of leakage and to verify that samples were kept on ice. The laboratory will then verify that all information on the sample container label is correct and consistent with the chain-of-custody form. Any discrepancy between the sample bottle and the chain-of-custody form, any leaking sample containers, or any other abnormal situation will be reported to the laboratory Technical Director. The laboratory Technical Director will inform the Project Manager of any such problem, and corrective actions will be discussed and implemented.

2.4.3 Analytical Records

The analytical data results, intra-laboratory QA/QC results, along with a case narrative will be submitted by the contract laboratory to the Project Manager in both an electronic format and also in hard copy within a specified time frame from the completion of each sampling event (synoptic and seasonal events) (standard turn around time, no more then four (4) weeks). Also, at this time, the data sheets generated during the processing of these samples that include sample identification information will be submitted to the Project Manager for every sample analyzed. Copies of all bench sheets will be kept on file by the laboratory and made available for review upon request.

2.5 Quality Control (B.5)

Analytical quality control will be performed in accordance with the specified analytical methods and as discussed under the Quality Objectives and Criteria Section of this QAPP.

2.5.1 Field Sampling Quality Control

Field sampling QC consists of collecting field QC samples to help evaluate conditions resulting from field activities. Field QC is intended to support a number of data quality goals:

- Combined contamination from field sampling through sample receipt at the laboratory (to assess potential contamination from field sampling equipment, ambient conditions, sample containers, sample transport, and laboratory analysis) – assessed using field blanks.
- Combined sampling and analysis technique variability, as well as sample heterogeneity – assessed using field replicates.

Field Blanks – Field blanks will be collected to evaluate whether contaminants have been introduced into the samples during the sample collection due to exposure from ambient conditions or from the sample containers themselves. Field blank samples will be obtained by pouring deionized water into the sample container in the field, preserved and shipped to the laboratory with the field samples. Field blanks will be collected at a frequency of 10% or one field blank per sampling round, whichever is less.

Field blanks will be preserved, packaged, and sealed in the same manner described for the surface water samples. A separate sample number and station number will be assigned to each blank. If target analytes are found in the equipment blanks above the criteria, sampling and handling procedures will be reevaluated and corrective actions taken. These may consist of, but are not limited to, obtaining sampling containers from new sources, training of personnel, discussions with the laboratory, invalidation of results, greater attention to detail during the next sampling event, or other procedures considered appropriate.

Field Replicate Samples – Field replicate samples will be collected to evaluate the precision of sample collection through analysis. Field replicates will be collected at designated sample locations by alternately filling two distinct sample containers for each analysis. Field replicate samples will be preserved, packaged, and sealed in the same manner described for the surface water samples. A separate sample number and station number will be assigned to each duplicate. The samples will be submitted as "blind" samples to the laboratory for analysis.

Field replicates will be collected for each analytical parameter at a frequency of 10% or one field replicate per sampling round, whichever is less. The replicate samples will be collected at random locations for each sampling event. If the acceptance criteria are exceeded, field sampling and handling procedures will be evaluated, and problems corrected through greater attention to detail, additional training, revised sampling techniques, or whatever appears to be appropriate to correct the problem.

2.5.2 Field Measurements Quality Control

Quality control requirements for field measurements are provided in Table 8.

Field instrumentation will be calibrated according to the manufacturer's requirements and will be calibrated daily.

2.5.3 Laboratory Analysis Quality Control

Laboratory QC is the responsibility of the laboratory personnel and QA/QC departments of LAB1 and LAB2. The laboratory's QAPP details the QA/QC procedures it follows. The following elements are part of standard laboratory quality control practices:

- Analysis of method blanks
- Analysis of laboratory control samples
- Instrument calibration (including initial calibration, calibration blanks, and calibration verification)

- Analysis of matrix spikes
- Analysis of duplicates

The data quality objectives for LAB1 and LAB2 (including frequency, QC acceptance limits, and corrective actions if the acceptance limits are exceeded) are detailed in the QA Manual (Appendix A) and SOPs (Appendix B) or in this QAPP. Any excursions from these objectives must be documented by the laboratory and reported to the Project Manager/QA Officer.

Method Blanks – A method blank is an analyte-free matrix, analyzed as a normal sample by the laboratory using normal sample preparation and analytical procedures. A method blank is used for monitoring and documenting background contamination in the analytical environment. Method blanks will be analyzed at a frequency of one per sample batch (or group of up to 20 samples analyzed in sequence using the same method). Corrective actions associated with exceeding acceptable method blank concentrations include isolating the source of contamination and re-digesting and/or re-analyzing the associated samples (Table 5). Blank contamination will be noted in the laboratory reports, but sample results will not be corrected for blank contamination. Corrective actions will be documented in the laboratory report's narrative statement. The laboratory will JB-qualify sample results which are less than three times the level of the associated blank.

Laboratory Control Samples – Laboratory control samples (LCS) are laboratory-generated samples analyzed as a normal sample and by the laboratory using normal sample preparation and analytical procedures. An LCS is used to monitor the day-to-day performance (accuracy) of routine analytical methods. An LCS is an aliquot of clean water spiked with analytes of known concentrations corresponding to the analytical method. The LCS is used to verify that the laboratory can perform the analysis on a clean matrix within QC acceptance limits. Results are expressed as percent recovery of the known amount of the spiked analytical parameter.

One LCS is analyzed per sample batch. Acceptance criteria (control limits) for the LCS are defined by the laboratory and summarized in Table 5. In general, the LCS acceptance criteria recovery range is 80 to 120 percent of the known amount of the spiked analytical parameter. Corrective action, consisting of a rerunning of all samples in the affected batch, will be performed if LCS recoveries fall outside of control limits. Such problems will be documented in the laboratory report's narrative statement.

Matrix Spikes – Matrix spikes (MS) are prepared by adding a known amount of the analyte of interest to a sample. MS are used as a similar function as the LCS, except that the sample matrix is a real time sample rather than a clean matrix. Results are expressed as percent recovery of the known amount of the spiked analytical parameter. Matrix spikes are used to verify that the laboratory can determine if the matrix is causing either a positive or negative influence on sample results.

One matrix spike is analyzed per sample batch. Acceptance criteria for the MS are defined by the laboratory and summarized in Table 5. In general, the MS acceptance criteria recovery range is 80 to 120 percent of the known amount of the spiked analytical parameter. Generally, no corrective action is taken for matrix spike results exceeding the control limits, as long as the LCS recoveries are acceptable.

Laboratory Duplicates – A laboratory duplicate is a laboratory-generated split sample used to document the precision of the analytical method. Results are expressed as relative percent difference between the laboratory duplicate pair.

One laboratory duplicate will be run for each laboratory batch or every 20 samples, whichever is more frequent. Acceptance criteria for laboratory duplicates are specified in the laboratory QA Manual and SOPs and are summarized in Table 5. If laboratory duplicates exceed criteria, the corrective action will be to repeat the analyses. If results remain unacceptable, the batch will be rerun.

PCB: Labeled Compound, Cleanup, Internal and Injection Standards

Similar to surrogate spikes, these standards are 13C isotopes which are spiked into all field and laboratory samples prior to different points in the analytical process (extraction, cleanup and injection). 13C homologs are added prior to extraction. These homologs are used for the purpose of quantifying target compounds. Cleanup 13C homologs are added prior to cleanup of samples for the purpose of monitoring their recoveries through the cleanup processes. The third 13C homologs are added just prior to sample injection to monitor the recoveries of the pre-extraction homologs to insure they meet method criteria. Difficulties with the analytical method or sample matrix affect the recovery of these standards. If method criteria are not met the laboratory should take appropriate corrective action including re-extraction if necessary.

2.6 Instrument/Equipment Testing, Inspection, and Maintenance (B.6)

Field analytical equipment that may be used in this project includes instruments for measuring conductivity, pH, temperature, dissolved oxygen and turbidity. Testing, inspection and maintenance will be conducted in accordance with manufacturer instructions. Maintenance logs will be submitted to and kept by the Project QA Officer. The log will document any maintenance and service of the equipment. A log entry will include the following information:

- Name of person maintaining the instrument/equipment,
- Date and description of the maintenance procedure,
- Date and description of any instrument/equipment problems,
- Date and description of action to correct problems,
- List of follow-up activities after maintenance, and
- Date the next maintenance will be needed.

Calibration frequency and preventative maintenance procedures are provided in SAP.

Laboratory instrumentation and equipment will follow manufacturer instructions and accepted procedures associated with the selected analytical methods, the laboratory's QAP and SOPs.

2.7 Instrument/Equipment Calibration and Frequency (B.7)

Field analytical equipment that may be used in this project includes instruments for measuring conductivity, pH, temperature, dissolved oxygen and turbidity. Calibration procedures for the equipment will follow manufacturer instructions. To maintain field precision and accuracy, the water quality instruments will be calibrated to known standards. Field analysis and operation procedures, including calibration and sample analysis, are provided in the SAP.

Laboratory instrument calibration will follow manufacturer instructions and accepted procedures associated with the selected analytical methods, the laboratory's QAP and SOPs.

2.8 Inspection Acceptance of Supplies and Consumables (B.8)

All supplies and consumables for field and laboratory activities will be inspected for compliance with the acceptance criteria by the identified responsible party prior to use. Supplies or consumables not meeting the acceptance criteria upon inspection will not be used. Any equipment determined to be in an unacceptable condition will be replaced. Supplies and consumables will be stored in accordance with identified storage requirements.

2.9 Non-direct Measurements (B.9)

Non-direct measurements will not be used in implementation of the monitoring program.

2.10 Data Management (B.10)

Data generated through field and laboratory activities will be used for the mass balance assessment described in previous sections of this QAPP. The Project Manager will be responsible for organization and oversight of data generation, disbursement, processing and storage so that the data will be documented, accessible and secure for the foreseeable time period of its use. The Laboratory Technical Director has the same responsibility for laboratory data and information.

Instrumentation used to generate, process and store data will be configured, maintained and operated in accordance with manufacturer recommendations and accepted industry standards. Generated raw data will be stored in formats compatible with the method or instrument of generation. Processed data will be stored in text files, Microsoft Excel spreadsheets or Access databases compatible with version 2007. Electronic data will be stored in project directories on a LimnoTech computer network server that is compatible with this software and that is backed up regularly. Data reported in paper format will be stored in the project files.

2.10.1 Field Data and Information Management

Field data reporting shall be conducted principally through the transmission of data sheets containing tabulated results of all measurements taken in the field, and documentation of all field calibration activities. Field logs, equipment logs, and field data sheets will be turned over to the appropriate Field Manager following each monitored event. Following review by the Field Manager, the field sheets will be transmitted to the appropriate Project Manager for review. Copies of field sheets will be sent to LimnoTech as they are responsible for maintaining the database. Examples of standard field forms are provided in the standard operating procedures (SOPs) in the SAP.

Field Logs

Field log books serve as a daily record of events, observations, and measurements during field activities. All information pertinent to sampling activities will be recorded in the log books. The logbooks may be bound with the pages sequentially numbered or include separate sheets for field notes and method specific data logs. Personal computers may also be used to record field data. Field logs will be maintained by field staff at all times documenting activities and conditions. Field logs will be turned in by field staff following each monitored event. Copies of all field logs will be made following each monitored event and maintained in the QA/QC project file.

Entries in the log book will include:

- Name and title of author
- Name(s) of field crew
- Name(s) of site visitors
- Date and time of site entry
- Location of sampling activity
- Description of sample location
- Number and volume of samples taken
- Date and time of collection
- Sample identification numbers

- Sampling method
- Preservatives used
- Field measurements (pH, etc.)
- Date and time of shipment
- Shipment method
- Field observations

Equipment Logs

As installation, calibration and maintenance functions are completed on equipment, equipment logs will be maintained and included in the QA/QC project file.

Field On-Site Measurements – Data Sheets

Field measurement information recorded in the log book will be compiled and the information transferred into electronic format by office staff. The appropriate Field Manager will review the source document and the electronic version to verify the accurate transfer of information. Following this review, electronic field data will be transferred to the appropriate Project Manager. The original data sheets will be maintained in the QA/QC project file.

Labels

All samples collected will be labeled in a clear and precise way for proper identification in the field and for tracking in the laboratory. The samples will have pre-assigned, identifiable and unique numbers. At a minimum, the sample labels will contain the following information.

- Sampling location or name,
- Unique sample number,
- Sample description (e.g. grab, composite),
- Date and time of collection,
- Initials/signature of sampler,
- Analytical parameters, and
- Method of preservation.

Field Quality Control Sample Records

Field QC samples (replicates and blanks) will be labeled as such in the field logbooks. They will be given unique sample identification numbers and will be submitted "blind" to the laboratory. The frequency of the QC sample collection will also be recorded in the field logbook.

2.10.2 Laboratory Data and Information Management

The reporting of laboratory data will begin after the laboratory Technical Director or designee has concluded the verification review. The contract laboratory will prepare and submit full analytical and QC reports to the LimnoTech Project Manager that will include the following, as appropriate.

- Case narrative, including a statement of the conditions that samples were received, description of any deviation from standard procedures, explanation of any data qualifiers used, and identification of any problems encountered during analysis.
- Computer generated report form containing all sample results

    - a hard copy version of the report
    - an electronic version of the report on CD
- Hard copy QC summary report for each parameter by batch including the results of replicates, matrix spikes, matrix spike duplicates, controls, dilution blanks, method blanks, verification tests, etc.
- Copies of all chain-of-custody forms.
- Copies of all laboratory bench sheets will be kept on file and made available for review, for a minimum of seven years.

Following receipt of laboratory data by the LimnoTech Project Manager, the data will be reviewed and validated by the Quality Assurance Officer (QAO) following the procedures outlined in Section 4.

2.10.3 Electronic Data Management

All data collected during the course of the study will be entered into a database by LimnoTech for use in the mass balance assessment. LimnoTech will manage and maintain the database.

All electronic files will be backed up on a regular basis. At the conclusion of the project all relevant information, project files and electronic data will be turned over to the SRRTTF Project Manager for archiving. The files will be archived for a minimum of five years.

3. ASSESSMENT AND OVERSIGHT (GROUP C)

The Group C Assessment and Oversight elements are addressed in this section.

3.1 Assessment and Response Actions (C.1)

Internal quality control checks are performed to ensure that the field and laboratory generated measurements meet the project quality assurance objectives. In addition, the quality control checks are intended to identify any need for corrective action.

3.1.1 Field Measurements

Field quality control checks will consist of QA/QC samples that will be collected or prepared by the field crews to be submitted for laboratory analysis. These samples will consist of replicates and equipment blanks. Replicates will be collected at a 10% frequency (1 in 10 samples collected) and blanks will be collected at a frequency of 10% (1 in 10 samples collected). The acceptable control limits are discussed in Section 1.4. Upon receipt of the data from the monitored event, the Field Managers will assess the adequacy of the quality control checks and identify any problems.

Quality control checks will be conducted in advance of using multi-parameter meters. The checks will involve the review of the previous calibration sheets. Any problems with sensors will be addressed immediately. The result of each review will be recorded on the instrument's calibration sheet. At the conclusion of each monitored event, all calibration sheets will be reviewed by the Field Managers to assess the adequacy of the quality control checks and to review the instrument's performance to identify any problems.

The Field Managers will inform the appropriate Project Manager in writing of any quality control check issues and to discuss corrective actions. All quality control documents will be contained in a file for each monitored event.

3.1.2 Laboratory Measurements

The contract laboratory will perform quality control checks on all sample analyses. These will include replicates, matrix spikes, matrix spike duplicates, control samples, and method blanks as appropriate. Quality control procedures for analytical services will be conducted by the contract laboratory in accordance with their standard operation procedures and the individual method requirements referenced by U.S. EPA or Standard Methods. The acceptable control limits are discussed in Section 1.4. The laboratory Technical Director will inform the QA/QC Manager immediately of any quality control check issues and to discuss corrective actions.

At the conclusion of each monitored event, the contract laboratory will provide a summary of all QA/QC results. The QA/QC summary will be reviewed by the laboratory Technical Director and the QA/QC Manager to assess the adequacy of the quality control checks and to identify any potential problems. Table 10 summarizes the laboratory quality control check frequencies.

Table 10. Laboratory quality control check frequencies

Parameter	Batch Size	QC Check	Frequency
TSS	20 Samples	Control	1 each per analytical batch
		Replicate	
		Method Blank	
TDS	20 Samples	Control	1 each per analytical batch
		Replicate	
		Method Blank	
TOC	20 Samples	Control	1 each per analytical batch
		MS/MSD	
		Method Blank	
DOC	20 Samples	Control	1 each per analytical batch
		MS/MSD	
		Method Blank	
PCB congeners	20 Samples	Control	1 each per analytical batch
		Replicate	
		Method Blank	

3.1.3 System Audits and Technical Reviews

All project team members are committed to providing quality services. The primary responsibility for the quality of work products rests with the individuals doing the work and with their immediate supervisors.

For certain project components an independent technical reviewer will audit or review the work products. This reviewer may be the LimnoTech Project Manager or a consultant team member not directly involved with the work being audited. The independent technical reviewer will perform a critical, written evaluation of the work product, and the independent technical audit or review will be incorporated in the project record.

The Project Manager is responsible for identifying the work products to be audited/reviewed and the scope of the audit/review, for scheduling independent technical audits/reviews, for assigning competent, qualified independent technical auditors/reviewers, and for making sure that appropriate follow-up actions are taken to correct reported deficiencies.

Field System Audits

Field system audits will be completed to ensure that the actual field procedures conform to those documented in the SAP and associated SOPs. The Project Manager or their designees will perform the field system audits. The audit will include a check of all field records and a review of all activities to document if procedures were conducted in compliance with the specified documentation.

Laboratory System Audits

Independent auditors will complete a lab audit of the contract laboratory at some point during the monitoring program. These auditors will be designated by the Project Manager. The audit will be scheduled if possible during analysis of project samples. The audits will include an assessment of all quality system documents as well as the laboratory QAP (Appendix A) and SOPs (Appendix B). In addition, the audit will include a laboratory site visit and discussions with the laboratory Technical Director and QA/QC Manager. Also, spot checks will be performed to interview individual analysts with regard to methods used, knowledge of quality systems, training, and competency.

3.1.4 Corrective Action

Corrective actions will be implemented as required to rectify problems identified during the course of normal field and laboratory operations. Possible problems requiring corrective action include:

- Equipment malfunctions;
- Analytical methodology errors; or
- Non-compliance with quality control systems.

Equipment and analytical problems that require corrective action may occur during sampling and sample handling, sample preparation, and laboratory analysis.

For non-compliance problems, steps for corrective action will be developed and implemented at the time the problem is identified. The individual who identifies the problem is responsible for immediately notifying the appropriate Project Manager.

Any non-conformance with the established quality control procedures outlined in the QAPP will be identified and corrected. The appropriate Project Manager will issue a Corrective Action Memorandum for each non-conformance condition. All non-conformance memoranda will be discussed in the final report submitted to the SRRTTF.

Field Measurements and Sample Collection

Project staff will be responsible for reporting any suspected QA non-conformance or deficiencies to the Field Manager. The Field Manager will be responsible for assessing the suspected problems in consultation with the Project Managers to review the sampling protocols and provide additional training if necessary. If it is determined that the situation warrants a corrective action, then a Corrective Action Memorandum will be issued by the Field Manager.

The Field Manager will be responsible for ensuring that the corrective action for non-conformance takes place by:

- Evaluating all reported incidences of non-conformance;
- Controlling additional work on nonconforming items;
- Determining what corrective action is needed;
- Maintaining a log of non-conformance issues;
- Reviewing responses to corrective action memoranda;
- Ensuring that copies of corrective action memoranda and responses are included in the project files.

No additional work will be performed until appropriate corrective action has been implemented and documented in response to the corrective action memoranda.

Laboratory Analyses

Corrective actions are required whenever laboratory conditions, instrument malfunction or personnel situations have led or could potentially lead to errors in the analytical data. The corrective action taken will be dependent on the analysis and the event.

Laboratory personnel are alerted that corrective actions may be necessary if:

- QC data are outside the acceptable range for precision and accuracy as identified in Section 1.4;
- Blanks contain target analyses above acceptable levels;
- Undesirable trends are detected in spike recoveries or RPD between duplicates;

- Excessive interference is noted; or
- Deficiencies are detected by the QA staff during laboratory system audits as described in Section 3.1.3.

Corrective action procedures are often handled at the bench level by the analyst, who reviews the preparation or extraction procedure for possible errors, checks the instrument calibration, spike and calibration mixes, and instrument sensitivity, etc.

Corrective action taken within the laboratory is the responsibility of the laboratory Technical Director who informs the appropriate Project Manager when a problem occurs and of the steps taken to resolve the problem. Once resolved, full documentation of the corrective action procedure will be filed with the Project Manager. Laboratory corrective actions are described in the laboratory's QAP (Appendix A).

All non-conformance memoranda initiated by the contract laboratory will be discussed in the case narrative or included in the laboratory reports. The Project Managers will follow-up on all corrective actions that are taken to ensure that the memoranda are accurate.

3.2 Reports to Management (C.2)

The LimnoTech Project Manager and laboratory Technical Director will provide independent reporting to the SRRTTF on an as needed basis. This communication is facilitated through the use of electronic mail, which provides ready access. In addition, the team leaders will provide written reports to the SRRTTF on quality assurance issues as described in the QAPP.

Field and laboratory system audits will be performed as described in Section 3.1.3 and the results will be provided to the SRRTTF. The results of all audits will be summarized in written reports, with copies retained in the Project Files. The audit reports will be completed for field and laboratory system audits according to the general outline described below.

All audit reports will include the following sections:

- Introduction – provides background of the project, laboratory, or program element, description of personnel and affiliation of all staff involved, the name of the auditor, the time and date of the audit, and a description of the activities audited.
- Audit Findings – describes the results of the audit including a deficiency report identifying all instances where the procedures in the SAP, QAPP, or laboratory QAP were not followed.
- Conclusions – summarizes the results of the audit and includes recommended actions to address any noted deficiencies.

4. DATA VALIDATION AND USABILITY (GROUP D)

The Group D Data Validation and Usability elements are addressed in this section. The purpose of these elements is to determine if the data meet the project's Data Quality Objectives (validation) and to evaluate the data against the method, procedural and/or contractual requirements (verification). Data validation, verification, and usability assessment will be conducted as outlined in this QAPP.

The data generated from the sampling program will be subjected to a multi-tiered review process described below. This process includes:

- A review of the data at the bench and field levels;
- A secondary review of field records by the Field Managers and analytical results within the laboratory by the QA/QC Manager to verify the data against method and SOP requirements;
- A screening level review of the verified data by the LimnoTech for reasonableness and to identify obvious data anomalies;
- A validation by an objective third party; and finally,
- An assessment of the data by project team members for its usability in the project as described in Section 4.1 of this QAPP.

4.1 Data Review, Verification and Validation (D.1)

All environmental measurement data collected by project staff will be subjected to quality control checks before being utilized in the interpretive reporting. A data generation system that incorporates reviews at several steps in the process is designed to protect the integrity of the data and reduce the number of data that do not meet the Data Quality Objectives or the project goals. This section describes the requirements of each review step that will be used in this project.

4.1.1 Data Verification Requirements

The definition of data verification, as described in the EPA's "Guidance on Environmental Data Verification and Data Validation" (EPA QA/G-8) is:

"…the process of evaluating the completeness, correctness, and conformance/compliance of a specific dataset against the method, procedural or contractual requirements."

Data verification will occur at the field and laboratory level as described in Section 2.4.2. This section describes the requirements of the data verification.

Field Activities Data Verification

The Field Manager will be responsible for ensuring that the samples are collected and handled according to the procedures specified in the SAP. Sample collection verification will include confirming that the samples were collected with the proper equipment at the appropriate locations with the appropriate frequency. Sample handling verification will include confirming that the samples were stored in the appropriate containers (see Table 9) with the correct preservative, that the samples were stored at the proper temperature during transport from the field to the laboratory, and that all of the appropriate information is logged on the chain-of-custody records.

Lab Activities Data Verification

The laboratory QA/QC Manager will be responsible for verification of laboratory-generated data, although the laboratory SAPs for each method require some components of the verification to also be conducted at the bench level. Laboratory verification will include assessing that the procedures used to generate the data are consistent with the method requirements as specified in the laboratory's SOPs and that the QA/QC requirements for each method are met. Examples of method requirements include verifying the calibration and data reduction procedures. However, these requirements vary by analyte and are presented in more detail in the laboratory's QAP and SOPs (Appendices B and C, respectively). Once the data have been verified and approved by the laboratory, they will be released to SRRTTF.

4.1.2 Data Review Requirements

The Field Managers will perform data reviews that will consist of screening the field data sheets and laboratory data sheets according to established criteria listed in this section. If the established screening criteria are violated, an additional review of the quality control checks and any relevant laboratory bench sheets will be conducted. The investigation of the issue will be documented and the data will be discarded or flagged appropriately, identifying the limitations of the data. This is an additional step of review that is designed to provide an early assessment of the data's use in meeting the project goals by evaluating it within the context of well-understood constituent relationships.

Field Data Sheet Reviews

The following criteria will be used to screen the physical parameter measurements recorded by the field crews:

1. Temperature readings – do values seem reasonable
2. pH readings – do values seem reasonable
3. Dissolved oxygen readings – do concentrations compare to percent saturation
4. Conductivity readings – do concentrations seem reasonable
5. Turbidity – do values seem reasonable

Laboratory Data Sheet Reviews

The following criteria will be used to screen the analytical measurements performed by the contract laboratory:

1. Equipment blanks – are values less than detection limits?
2. Method blanks – are values less than detection limits?
3. Field blanks – are values less than detection limits?
4. Review of all values – do concentrations seem reasonable?

4.1.3 Data Validation Requirements

The purpose of data validation, as described in the EPA's "Guidance on Environmental Data Verification and Data Validation" (EPA QA/G-8) is:

> "…an analyte- and sample-specific process that extends the evaluation of data beyond method, procedural, or contractual compliance to determine the analytical quality of a specific data set."

According to U.S. EPA guidance, the data validation is typically performed by someone independent of the project activity and not associated with the organization responsible for producing the dataset. However, the data validator needs to be familiar with both the data validation requirements and the project objectives. The identified QAO from LimnoTech will conduct the data validation since LimnoTech project staff are not directly involved in the field or laboratory operations.

The first requirement in this project's data validation is to inspect the data verification and review records to ensure that no oversights were made during that process. The second requirement of the data validation is to evaluate the data against the project's data quality objectives, which are presented in Section 1.4. If data do not meet one or more of the DQIs, the data validation process will include an investigation into causes and an assessment of the impact of the noncompliant data on project objectives. The third requirement of the data validation is to evaluate the data in the context of the project's overall objectives, which are described in Section 1.3. The fourth requirement of the data validation is to communicate the data validation results to the rest of the project team.

4.2 Verification and Validation Methods (D.2)

All environmental measurement data and samples collected by project staff will be subjected to quality control prior to being entered into the project database. This is a multi-step process where the laboratory QA/QC Manager will have primary responsibility for verifying the data and a third party, who is not involved in the data collection or analysis, conducts the data validation. These steps are described in more detail in the following sections.

4.2.1 Data Verification

This section describes the procedures that will be utilized in this project for verifying the data against method, procedural and/or contractual requirements.

Field Activities Data Verification

Individual crew leaders will verify the completion of their field data sheets and chain-of-custody forms. In addition, crew leaders will also verify the proper calibration and operation of their multi-parameter instruments. At the completion of each monitored event, the Field Managers will review all field data sheets, calibration sheets, and chain-of-custody forms for accuracy and completeness. The Field Managers will also verify that monitoring QA objectives for all accuracy, precision, completeness, and adherence to the required collection techniques are being met.

Laboratory Analytical Results Verification

Individual analysts will verify the completion of the appropriate analytical test and required bench sheets. The laboratory Technical Director or designee will review calculations and inspect laboratory bench sheets and log books daily to verify their accuracy, completeness, and adherence to the specified analytical method protocols. Calibration and QC data will be examined daily by the individual analyst. The laboratory Technical Director or designee will verify that all instrument systems are under control and that QA objectives for accuracy, precision, completeness, and adherence to the required detection limits are being met.

A summary of all QA/QC results and any non-conformance issues will be included in the laboratory deliverable to the appropriate Project Manager.

4.2.2 Data Validation

This section describes the process that will be used to validate the data generated for this project. The first requirement in this project's data validation is to inspect the data, verification and review records to ensure that no oversights were made during that process. A complete set of field and laboratory information will be provided to the data validator for this task. The data management components described in Section 2.10 will be sufficient for this purpose.

The primary objective of the data validation in this project is to evaluate the data against the DQIs presented in Section 1.4. These DQIs include criteria for accuracy, precision, completeness, representativeness, comparability and compliance with required detection limits. The data management components described in Section 2.10 will provide the necessary information to make this evaluation. The following must be checked as part of the measurement data and analytical data validation activities.

1) field measurements data collection
2) field sample collection
3) sample custody
4) laboratory analytical results and case narrative
5) data reviews
6) quality control data

The QAO will conduct a systematic review of the data for compliance with the established quality control criteria based on duplicate, replicate, spiked, control, and blank data results provided by the laboratory. In addition, quality assurance evaluations of data accuracy, precision, and completeness will be performed on the field measurement data and the laboratory analytical results for each monitored event. The data validation qualifiers listed in Table 11 will be used when validating the data:

Table 11. Data validation qualifiers

Qualifier	Definition
U	The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.
J	The associated value is an estimated quantity.
R	The data are unusable (note: analyte may or may not be present)
UJ	The material was analyzed for, but was not detected. The associated value is an estimate and may be inaccurate or imprecise.
NJ	The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration.

If quality control checks or objectives were not met, an investigation of the non-conformance will be initiated by the QAO with the project team personnel, including the Field Managers, the laboratory QA/QC Manager, and the Project Manager. The non-conformance will be documented and the affected data set will be flagged appropriately, identifying any limitations.

Another objective of the data validation is to evaluate the data within the context of the project goals. As described in Section 1, these goals include providing datasets for mass balance assessment. Suitable datasets for this project will be based on the data quality assessment described above as well as an assessment of the spatial and temporal extent of the sample collection. Comparability with other sources of data will be

evaluated by comparing and, if necessary, plotting the data with previously collected data to identify outliers or anomalous values.

The data validation results will be communicated to the project team in the form of a summary table that lists the validation tasks performed and the associated results and conclusions. If the validated dataset includes non-compliant data, this data will be addressed in a memo that accompanies the summary table. Data qualifiers assigned to the data during validation will be maintained in the project database to ensure communication of validation results with current and future data users.

4.3 Reconciliation with User Requirements (D.3)

Once all field measurements and analytical data have been reviewed, quality control measures assessed, and any problems addressed, the measurement and analytical data will be assessed.

The assessment of the information generated from the monitoring program will be initiated by entering all analytical data and field measurement data into the project database. In addition flow data, stage data, field notes, and information on any sampling anomalies will be appended. All of these data will be evaluated and any relationships or correlations will be noted. The compilation of all information surrounding a sampling and/or monitoring event will be available to facilitate reconciliation with user requirements. Ultimately these data will be used for the mass balance assessment of the Spokane River.

Blank Page

5. REFERENCES

LimnoTech, 2013. Identification of Data Gaps-Final. Memorandum from Dave Dilks, Tim Towey and Kat Ridolfi to Spokane River Regional Toxics Task Force.

LimnoTech, 2014. Data Collection Strategy for PCB Comprehensive Plan - Draft. Memorandum from Dave Dilks to Spokane Regional Toxics Task Force.

United States Environmental Protection Agency (EPA), 1998. EPA Guidance for Quality Assurance Project Plans, EPA QA/G-5. Washington , DC.

United States Environmental Protection Agency (EPA), 2001. EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5. Washington, DC.

United States Environmental Protection Agency (EPA), 2002. Guidance on Environmental Verification and Data Validation. EPA QA/G-8. Washington, DC.

Washington Department of Ecology, 2004. Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies. Publication No. 04-03-030, Revision Publication No. 01-03-003.

Blank Page

APPENDIX A

LAB

QUALITY ASSURANCE MANUAL

APPENDIX B

LAB

STANDARD ANALYTICAL PROCEDURES

APPENDIX C

EPA METHOD 1668C

APPENDIX D

GLOSSARY

Accuracy – An estimate of closeness of a measurement result to the true value.

Bias – The difference between the population mean and the true value.

Blank – A sample prepared to contain none of the analyte of interest.

Calibration – The process of establishing the relationship between the response of a measurement system and the value of the parameter being measured.

Check standard – A QC sample prepared independently of calibration standards and analyzed along with the samples to check the precision of the measurement system. A check standard can also be used to check the bias due to the way calibration is done. It is also called a lab control sample.

Data Quality Objectives Process – EPA's recommended systematic planning process when environmental data are used to decide between two opposing conditions (e.g., compliance or non-compliance with a standard).

Data validation – An analyte-specific and sample-specific process that extends the evaluation of data beyond data verification to determine the analytical quality of a specific data set. It involves a detailed examination of the data package using professional judgment to determine whether the MQOs for precision, bias, and sensitivity have been met.

Data verification – Examination of the data for errors or omissions and the QC results for compliance with acceptance criteria.

Detection Limit (limit of detection) – The concentration or amount of an analyte which, on an "a prior" basis, can be determined to a specified level of certainty to be greater than zero.

Duplicates – Two samples collected or measurements made at the same time and location, or two aliquots of the same sample prepared and analyzed in the same batch.

Field blank – A blank used to obtain information on contamination introduced during sample collection, storage, and transport.

Laboratory Control Sample (LCS) – See "Check Standard".

Matrix spike – A QC sample prepared by adding a known amount of the target analyte to an aliquot of a sample to check for bias due to interference or matrix effects.

Measurement Quality Objectives (MQOs) – The performance or acceptance criteria for individual data quality indicators, including precision, bias and sensitivity.

Measurement result – A value obtained by carrying out the procedure described in the method.

Method – A set of written instructions completely defining the procedure to be used.

Method blank – A blank prepared to represent the sample matrix and analyzed in a batch of samples.

Parameter – A specified characteristic of a population or sample.

Population – The hypothetical set of all possible observations of the type which is being investigated.

Precision – A measure of the variability in the results of replicate measurements due to random error.

Quality Assurance (QA) – Adherence to a system for assuring the reliability of measurement data.

Quality Assurance Project Plan (QAPP) – A document that describes the objectives of a project and the procedures necessary to acquire data that will serve those objectives.

Quality Control (QC) – The routine application of statistical procedures to evaluate and control the accuracy of measurement data.

Relative percent difference (RPD) – The difference between two values divided by their mean and multiplied by 100.

Replicates – Two or more samples collected or measurements made at the same time and place.

Reporting Limit -

Sensitivity – In general, denotes the rate at which the analytical response (e.g., 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.

Standard Operating Procedure (SOP) – A document that describes in detail the approved way for performing a routine procedure.