

UPPER COLUMBIA RIVER

Quality Assurance Project Plan for the 2009/2010 Surface Water Study

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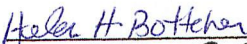
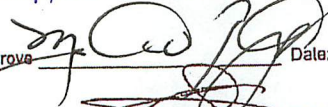
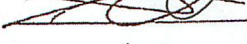
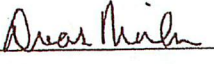
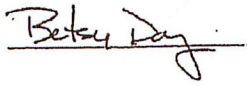


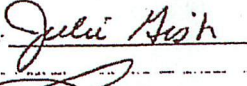
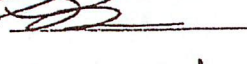
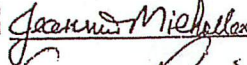
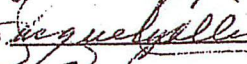
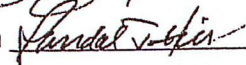
September 2009

SECTION A: PROJECT MANAGEMENT

A1 TITLE AND APPROVAL SHEET

QUALITY ASSURANCE PROJECT PLAN
FOR THE 2009/2010 SURFACE WATER STUDY

Quality Assurance Project Plan Approvals

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Teck Technical Team Coordinator:	Dreas Nielsen		Date: 8/31/09
Task Manager:	Betsy Day		Date: 8/31/09
Task QA Coordinator, Analytical Chemistry Laboratory Coordinator:	Craig Hutchings		Date: 8/31/09
Chemical Laboratory Project Manager:	Jeff Christian		Date: 8/31/09
Chemical Laboratory QA Manager:	Julie Gish		Date: 8/31/09
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Date: 9/01/09

Arsenic Laboratory QA Manager:

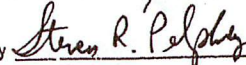
Kristina Spadafora



Date: 9/8/09

Stable Isotopes Laboratory Project Manager:

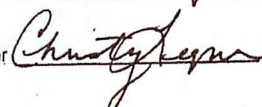
Steven Pelphrey



Date: 9/4/09

Stable Isotopes Laboratory QA Manager:

Christy Legner



Date: 9/4/09

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ACRONYMS AND ABBREVIATIONS

Agreement	June 2, 2006, Settlement Agreement
ANOVA	analysis of variance
ARAR	applicable or relevant and appropriate requirement
AWQC	ambient water quality criterion
B.C.	British Columbia
BOD	biological oxygen demand
CaCO ₃	calcium carbonate
CAS	Columbia Analytical Services
CCME	Canadian Council of Ministers of the Environment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CO ₂	carbon dioxide
COC	chain-of-custody
COI	chemical of interest
CSM	conceptual site model
CV	coefficient of variation
DMP	data management plan
DOC	dissolved organic carbon
DQO	data quality objective
Ecology	Washington State Department of Ecology
EDD	electronic data deliverable
Eh	reduction potential
EPA	U.S. Environmental Protection Agency
ESI	expanded site inspection
FGS	Frontier GeoSciences
FSP	field sampling plan
GC/ECD	gas chromatography with an electron capture detector
GC/MS	gas chromatography/mass spectrometry

GIS	geographic information system
HHRA	human health risk assessment
HRGC/HRMS	high-resolution gas chromatography/high-resolution mass spectrometry
ICP/AES	inductively coupled plasma/atomic emission spectrometry
ICP/MS	inductively coupled plasma/mass spectrometry
Isotech	Isotech Laboratories
K _{ow}	octanol–water partition coefficient
Lake Roosevelt	Franklin D. Roosevelt Lake
LCS	laboratory control sample
LRFEP	Lake Roosevelt Fisheries Evaluation Program
MDD	minimum detectable difference
MDL	method detection limit
MQO	measurement quality objective
MRL	method reporting limit
ORP	oxidation-reduction potential
Pace	Pace Analytical Services, Inc.
PAH	polycyclic aromatic hydrocarbon
PARCC	precision, accuracy or bias, representativeness, completeness, and comparability
PBDE	polybrominated diphenyl ether
PCB	polychlorinated biphenyl
PCDD	polychlorinated dibenzo- <i>p</i> -dioxin
PCDF	polychlorinated dibenzofuran
QA	quality assurance
QA/QC	quality assurance and quality control
QAPP	quality assurance project plan
QC	quality control
RI/FS	remedial investigation and feasibility study
RM	river mile

RPD	relative percent difference
SARA	Superfund Amendments and Reauthorization Act of 1986
SEV	screening ecotoxicity value
SGS	SGS Environmental Services
SHSP	site health and safety plan
SIM	selected ion monitoring
SiO ₂	silicon dioxide
Site	Upper Columbia River site
SLERA	screening level ecological risk assessment
SM	Standard Methods for Examination of Water and Wastewater
SOP	standard operating procedure
SPMD	semi-permeable membrane device
SVOC	semivolatile organic compound
TAL	target analyte list
TCM	Teck Cominco Metals Limited
Teck	Teck American Incorporated
TDS	total dissolved solids
TOC	total organic carbon
TSS	total suspended solids
UCR	Upper Columbia River
USBR	U.S. Bureau of Reclamation
USGS	U.S. Geological Survey
VOC	volatile organic compound
WAC	Washington Administrative Code
WQS	water quality standards

UNITS OF MEASURE

°C	degrees Celsius
cfs	cubic feet per second
ft	foot (feet)
in.	inch(es)
km	kilometer
m	meter(s)
pg/L	picograms per liter

A3 DISTRIBUTION LIST

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Chemical Laboratory Project Manager:	Julie Gish
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A4 INTRODUCTION AND TASK ORGANIZATION

A4.1 Introduction

This document presents the quality assurance project plan (QAPP) for the 2009/2010 surface water study in the Upper Columbia River (UCR) (Site¹), which extends from river mile (RM) 745² to RM 596³ near the Grand Coulee Dam. This study is one of the tasks that will be completed as part of the remedial investigation and feasibility study (RI/FS) that is being conducted by Teck American Incorporated (Teck) for the Site. The objective of the RI/FS is to investigate the nature and extent of contamination at the Site and assess risks to human health and the environment to an extent sufficient to develop and evaluate potential remedial alternatives for the Site that will meet applicable or relevant and appropriate requirements (ARARs), and statutory and regulatory requirements. The human health risk assessment (HHRA) will be completed by EPA, and the remaining RI/FS tasks will be completed by Teck, with EPA oversight.

This QAPP describes the organization, data quality objectives (DQOs), study design, analytical procedures, and quality assurance and quality control (QA/QC) procedures upon which the 2009/2010 surface water study will be based. The field sampling plan (FSP) describes field sampling protocols that will be followed when surface water samples are collected; the FSP is presented as an appendix to this QAPP (Appendix A). This format was adopted to provide an autonomous and concise document for use in the field during sample collection activities. EPA comments on the draft of this QAPP were provided and have been addressed; both the comments and a summary of changes made in response are provided in Appendix B. A number of EPA comments on the September 2007 draft RI/FS work plan were related to the evaluation of surface water and the development of this QAPP, and as such are provided in Appendix C.

The primary objective of the 2009/2010 surface water study is to collect information on chemicals of interest (COIs) in surface water in the UCR for use in assessing potential

¹ The Site consists of the areal extent of hazardous substances contamination within the United States in or adjacent to the Upper Columbia River, including Franklin D. Roosevelt Lake (Lake Roosevelt), from the U.S.-Canadian border downstream to the Grand Coulee Dam and all suitable areas in proximity to such contamination necessary for implementation of the response actions described in the Settlement Agreement (USEPA 2006c).

² There is a discrepancy in river mile designations by U.S. Geological Survey (USGS) and by USEPA (2006d). USGS river miles increase from RM 680 to RM 682 over a less than 1 river mile segment when transitioning between the Inchelium and Rice USGS quadrants, whereas USEPA (2006d) river miles increase from RM 680 to RM 681 over the same segment. To remain consistent with international borders, the USGS river mile designations are used herein.

³ The most downstream transect for the surface water study is located at USGS RM 605 (Plum Point).

1 risks to ecological receptors and people. EPA's DQO process (USEPA 2006a) was used
2 to guide the development of the requirements and design rationale for data collection
3 activities presented in this QAPP and associated FSP. Detailed discussions of the
4 various study components are presented in subsequent sections of this QAPP and
5 associated FSP.

6 Concerns regarding historical discharges to the Columbia River, such as liquid effluent
7 and granular slag from a facility operated by Teck Cominco Metals Limited (TCM) in
8 Trail, British Columbia (B.C.), Canada, led EPA to identify the Site for further study in
9 1999. From 2000 to 2003, EPA conducted preliminary assessments and site
10 investigations at the Site. The preliminary assessments and site investigations were
11 conducted by EPA under the authority of the Comprehensive Environmental Response,
12 Compensation, and Liability Act of 1980 (CERCLA) as amended by the Superfund
13 Amendments and Reauthorization Act of 1986 (SARA). Based on the site investigation
14 findings, EPA determined that an RI/FS at the Site was warranted (E&E 2003).

15 The facility is located on the Columbia River approximately 10 miles upstream from the
16 U.S.-Canadian border. Smelter operations have been under way in Trail, B.C., since 1896
17 (G3 Consulting 2001). The facility primarily produced lead and silver during the first
18 decade of operation, with zinc production initiated in 1916. Fertilizer plants were built
19 at the Trail smelter in the 1930s, facilitating the production of both nitrogen- and
20 phosphorus-based fertilizers. In addition to lead, zinc, cadmium, silver, gold, bismuth,
21 antimony, indium, germanium, and arsenic, this facility also produces sulfuric acid and
22 liquid sulfur dioxide. Ammonia, ammonium sulfate, and phosphate fertilizers were
23 produced at the plant until August 1994, when production of phosphate-based fertilizer
24 was terminated (MacDonald 1997). In addition to the above-mentioned elements and
25 chemicals, the Trail facility historically used and temporarily stored polychlorinated
26 biphenyls (PCBs).

27 As described in the modified RI/FS work plan, liquid effluent has been discharged to the
28 river since at least 1930, and has been a permitted discharge since October 23, 1970.
29 Granular slag was discharged into the river at Trail from the early 1930s until 1995.

30 Another smelter facility that operated along the Columbia River is the former
31 Le Roi/Northport Smelter located approximately 7 river miles downstream of the U.S.-
32 Canadian border in Northport, Washington. It began treating copper and gold ores in
33 1896, and by 1908 was processing 500 tons of ore per day. The smelter closed in 1909,
34 but reopened in 1914 after being renovated to process lead ores. In 1922, the smelter
35 again closed, and the smelting equipment was removed from the property (E&E 2000).

Analytical results from historical surface water samples in the UCR were reviewed and compiled in a database from which ranges of certain constituent concentrations could be estimated. This historical data review is presented as Appendix D and summarized in Section A5 of this QAPP. During initial work on the UCR screening level ecological risk assessment (SLERA; TCAI 2008⁴), the longitudinal and temporal coverage of the water samples in the database were found to be insufficient to fully define the concentration ranges of COIs in surface water throughout the Site. Therefore, additional surface water data in the UCR was identified as a data gap.

A4.2 Task Organization

This section presents the organizational structure for activities associated with the 2009/2010 surface water study, including task management and oversight, fieldwork, sample analysis, and data management. Teck and its technical team are conducting this work with oversight from EPA. The overall organizational structure for the project is provided in the RI/FS work plan, which also includes qualifications of Teck technical team members. For this task, the Teck technical team organizational structure and its relationship to the overall project organization is illustrated in Figure A-1. Contact information for Teck technical team task members is provided in Table A-1.

Task responsibilities include the following roles:

- EPA and Teck project coordinators
- EPA quality assurance (QA) manager
- Teck technical team task manager and field supervisor
- Teck technical team task senior technical advisor
- Teck technical team task QA coordinator
- Teck technical team laboratory coordinators
- Teck technical team database administrator
- Teck technical team task reviewers
- Project managers and QA managers for the subcontractor laboratories.

Responsibilities associated with these roles are described below.

⁴ At the time of writing, the SLERA remains a draft document and is under review by the EPA. The draft SLERA did not screen-out any COIs from surface water. As a result, COIs identified within the modified RI/FS work plan are being considered within the development of the QAPP.

A4.2.1 EPA Organization and Responsibilities

EPA will oversee Teck activities associated with the 2009/2010 surface water study and will coordinate U.S. Department of the Interior, Washington State Department of Ecology (Ecology), and tribal (i.e., the Confederated Tribes of the Colville Reservation and the Spokane Tribe of Indians) input with respect to the review of technical documents prepared and submitted by Teck. The project coordinator for EPA is Helen Bottcher. Ms. Bottcher will also be responsible for ensuring that the work performed is consistent with all applicable EPA guidance. The EPA QA manager has been assigned by EPA and is Gina Grepo-Grove.

A4.2.2 Teck Organization and Responsibilities

With the support of its technical team, Teck is responsible for conducting this 2009/2010 surface water study with oversight provided by EPA. Marko Adzic will serve as Teck's project coordinator and will have the primary responsibility for ensuring that Teck meets all the requirements and associated deliverables specified within the June 2, 2006, Settlement Agreement (Agreement) (USEPA 2006c). Mr. Adzic will also be responsible for overseeing all technical aspects of this task, coordinating with EPA, and managing the overall task schedule.

A4.2.3 Key Task Personnel

Teck technical team personnel involved in the 2009/2010 surface water study and their respective responsibilities are identified below.

Task Manager—Betsy Day is the task manager and is responsible for developing the 2009/2010 surface water study. Ms. Day will work closely with the senior technical advisor, technical reviewers, and the task QA coordinator to ensure that the objectives of the study are achieved.

Field Supervisor—The field supervisor is responsible for overseeing the planning and coordination of the surface water sampling efforts and for all aspects of sample collection activities to ensure that appropriate sampling, quality assurance, and documentation procedures are used. In the event that changes in the QAPP or FSP are needed, the field supervisor will ensure that proposed changes are coordinated with EPA's project coordinators or other designated EPA staff according to the established lines of communication between the Teck technical team, Teck, and EPA as noted in Figure A-1 and approved for the RI/FS.

Senior Technical Advisor—Dr. Scott Becker is the senior technical advisor for the 2009/2010 surface water study, and is responsible for providing technical oversight in

the design and implementation of the study, and ensuring that it meets the objectives of the RI/FS.

Task QA Coordinator—Craig Hutchings is the task QA coordinator and is responsible for providing overall QA support for the 2009/2010 surface water study; ensuring that the QAPP and FSP contain all components necessary to meet EPA guidance (USEPA 2002a); coordinating the validation of laboratory data; communicating data quality issues to the data users; and working with data users and EPA to address any data limitations. Mr. Hutchings will report directly to the task manager, and will work closely with the various laboratory coordinators and the field supervisor to ensure that the objectives of the QAPP are met.

Database Administrator—Dreas Nielsen is the database administrator and will have primary responsibility for data management and database maintenance and development. Mr. Nielsen will be responsible for overseeing and/or conducting the following activities: establishing storage formats and procedures appropriate for all data collected during the RI/FS, including surface water; working with the field crew, laboratories, and data validators to ensure all data entries are correct and complete and are delivered in the correct format; maintaining the integrity and completeness of the database; and providing data summaries to data users in the required formats for interpretation and reporting. Mr. Nielsen will report directly to the Teck technical team coordinator and will work closely with the field supervisor, task QA coordinator, and the data validation firm.

Task Safety Officer—the task safety officer for the 2009/2010 surface water study is responsible for providing health and safety oversight for the field staff that will be collecting the surface water samples.

A4.2.4 Laboratories

The following responsibilities apply to the project managers and QA manager at the analytical laboratories used for the 2009/2010 surface water study.

Laboratory Project Manager—The laboratory project manager is responsible for the successful and timely completion of sample analyses, as well as the following actions:

- Ensure that samples are received and logged in correctly, that the correct methods and modifications are used, and that data are reported within specified turnaround times
- Review analytical data to ensure that procedures were followed as required in this QAPP, the cited methods, and laboratory standard operating procedures (SOPs)

- Apprise the chemical laboratory coordinator of the schedule and status of sample analyses and data package preparation
- Notify the chemical laboratory coordinator if problems occur in sample receiving, analysis, or scheduling, or if control limits cannot be met
- Take appropriate corrective action as necessary
- Report data and supporting QA information as specified in this QAPP.

Laboratory QA Manager—The laboratory QA manager is responsible for overseeing the QA activities in the laboratory and ensuring the quality of the data for this task. Specific responsibilities include the following:

- Oversee and implement the laboratory's QA program
- Maintain QA records for each laboratory production unit
- Ensure that QA/QC procedures are implemented as required for each method and provide oversight of QA/QC practices and procedures
- Review and address or approve non-conformity and corrective action reports
- Coordinate responses to any quality control (QC) issues that affect this task with the laboratory project manager.

A5 PROBLEM DEFINITION AND BACKGROUND

COIs that are present in surface water have the potential to adversely affect ecological receptors and people if their concentrations reach levels that pose an unacceptable risk. The preliminary conceptual site model (CSM) for the UCR provides the framework for considering the relationships between surface water and people or ecological receptors. The preliminary CSM was developed in the RI/FS work plan and will undergo refinement throughout the RI/FS. COIs in water were also identified in the RI/FS work plan (USEPA 2008; Tables A-2 and A-3). Available surface water data were identified and evaluated in the RI/FS work plan and screened against conservative benchmarks within the draft SLERA⁵ (TCAI 2008). In this section, existing data are evaluated, surface water concerns are defined, and DQOs are developed.

In the next sections, the following background information is provided:

- The CSM, which frames the potential issues associated with surface water
- Overview of existing surface water data

⁵ The draft SLERA remains under review by EPA and to date has not been approved. However, given that no COIs were screened out in surface water the draft status of the SLERA does not affect the 2009/2010 surface water quality design.

- Screening against conservative screening ecotoxicity values (SEVs)
- Important observations and issues related to surface water problem definition and study design.

A5.1 Preliminary Conceptual Site Model

The preliminary CSM provides a framework within which the complex suite of chemical, physical, and biological processes and interactions that prevail at a site can be viewed in a systematic and organized manner. For the UCR RI/FS, the CSM is intended to evolve as additional information is collected. The preliminary CSM (Figure A-2) identifies surface water as a potentially important exposure medium and transport pathway for COIs. Aspects of the CSM that relate specifically to surface water (Figure A-3) provide the foundation for problem definition, discussed in detail in Steps 1 and 2 of the DQO process (see below).

A5.2 Overview of Existing Surface Water Data

This overview of historical surface water data, abstracted from Appendix D, focuses on COIs but also includes recently obtained non-COI information from Scofield and Pavlik-Kunkel (2007) to assess potential variation in water quality.

This section provides the basis for the identification of data gaps. This discussion of findings from past studies and monitoring efforts serves as a primary basis supporting the identification of major data gaps and development of data collection activities related to surface water in the UCR. Information from selected U.S. and Canadian studies and monitoring programs is presented. Data collection activities occurring north of the U.S.-Canadian border, although technically outside of the defined extent of the UCR site, are valuable for understanding temporal and spatial variability.

Surface water COI data in the UCR are largely limited to one location—Northport, Washington, near the U.S.-Canadian border—where monthly sampling and analysis of dissolved and total metals have been conducted by the U.S. Geological Survey (USGS) (1951–2000, Station 12400520) and Ecology (2001–present, Station 61A070). Data are also available for Waneta, B.C. (immediately above the U.S.-Canadian border) where the Canadian government conducts weekly water quality monitoring. Information on conventional parameters is also included. The discussion here focuses on five aspects of surface water quality:

- Longitudinal variation in non-COI measures of surface water quality as an indicator of general water conditions within the Site

- Comparison of total metals data in the Columbia and Pend Oreille rivers in Canada to total metals data in the UCR at Northport
- Comparisons of total and dissolved metals data at Northport to ecological screening criteria
- Comparison of total metals data in UCR tributaries downstream of Northport to total metals data in the UCR at Northport.
- A summary of the spatially and temporally limited information regarding organic COIs
- Evaluation of vertical profiles of field measurements (temperature, conductivity, pH, and oxygen), their seasonal changes, and their relationship to general water quality conditions within the UCR.

All of these evaluations are directly relevant to the surface water problem definition, rationale, and study design.

Non-COI Measures of Surface Water Quality in the Site—Water quality monitoring at Waneta, B.C., immediately above the U.S. border, is conducted weekly by the Canadian government. Temporal variability, measured as the coefficient of variation (CV), of a number of conventional parameters (i.e., barium, potassium, hardness, sodium, and silicon dioxide) ranged from 9 to 26 percent over the period 2000–2006 (Table A-4). This low variability indicates relatively low seasonal change in these parameters as water enters the Site.

Between January 1998 and March 2000, the Lake Roosevelt Fisheries Evaluation Program (LRFEP) conducted 38 surveys to generate conventional parameter and trace metals data between Evan’s Landing and Spring Canyon (Grand Coulee Dam). The data report (Scofield and Pavlik-Kunkel 2007) summarizes the general nature of spatial trends of the long-term average concentrations of these constituents within the study area.

The data⁶ for barium, potassium, sodium, silicon, and hardness suggest small spatial variation in the long-term averages of these constituents within the UCR (Table A-5 and Figures A-4a through A-4e). Average concentrations were also similar to those measured at Waneta, B.C. (Table A-5).

Comparison of Total Metals Data North and South of the U.S.-Canadian Border—Columbia River surface water metals data are available from Birchbank, B.C., which lies approximately 10 km (6 miles) upstream of the Trail facility, and Waneta, B.C., located

⁶ The data presented by Scofield and Pavlik-Kunkel (2007) consisted only of means and sometimes standard deviations. Thus, the data given here represent these means and sometimes grand means (e.g., overall averages). Data from outside the main stem of the UCR were not used.

downstream of the Trail facility, approximately 2.5 km (1.5 miles) upstream of the U.S.-Canadian border. Surface water data are also available from the Pend Oreille River at a site referred to as “the international boundary” (also located in B.C., just downstream of the U.S-Canadian border) and further downstream at Waneta (also located in B.C.). The Pend Oreille River enters the Columbia just downstream of the Waneta sampling station. These station locations are shown in Appendix D on Map 1.

Box plots of detected total metals concentrations in surface water from the four B.C. locations were developed for comparison with total metals data collected from Northport, Washington, from 2001 through 2005 (Appendix D, Figures 2 through 6). The box plots are based only on detected metal concentrations so that differences in detection limits do not influence comparisons of metal concentrations between stations, although detection frequencies at the four B.C. sites were very high for all metals evaluated.⁷ At Northport, however, total cadmium and total zinc were infrequently detected (detection limits at Northport were higher than those achieved at the B.C. sites).

Metals Concentrations between Evan’s Landing (RM 711) and Spring Canyon (RM 599; just upstream of Grand Coulee Dam)—Total metals concentration data were also reported by Scofield and Pavlik-Kunkel (2007). In general, analytical methods were relatively insensitive and resulted in mostly undetected values. Also, the authors suggest that samples analyzed for lead may have been exposed to lead contamination due to sampling techniques.

A synopsis of the results is provided below for key trace metals.

- **Arsenic** (n=608). Total arsenic concentrations exceeded the method reporting limit (MRL)⁸ in 15 of 608 samples. None of the samples exceeded the ambient water quality criterion (AWQC). The authors note that spatial and temporal trends were not distinguishable because of the small number of detected concentrations but that 6 of the 15 measured concentrations occurred in Porcupine Bay, which is located within the Spokane Arm of the river system.
- **Cadmium** (n=608). Total cadmium concentrations exceeded the MRL in only 1 percent (8 of 608) of the samples. These samples were located at or upriver from Seven Bays.

⁷ Mercury data are not available for the B.C. locations during the period 2001–2005.

⁸ Any deviation from the ideal laboratory sample results in a method reporting limit (MRL), which is the corrected concentration reportable for that sample under those conditions. The MRL is always equal to or greater than the method detection limit (MDL). Under ideal conditions, the analytical system provides the lowest concentration that can be reported, while minimizing uncertainty due to matrix effects. This concentration is the MDL. MRLs were not reported by Scofield and Pavlik-Kunkel (2007).

- 1 • **Copper** (n=520). Temporal and spatial patterns in total copper concentrations
2 were not evident among the 14 of 520 samples that exceeded the MRL.
3 Measureable copper concentrations occurred from Evans Landing to Spring
4 Canyon. The highest concentrations were reported at Spring Canyon and Keller
5 Ferry.
- 6 • **Lead** (n=608). Total lead was detected in 402 of 608 samples located throughout
7 the study area. Because use of a lead weight on the sampling apparatus may
8 have contaminated some of the samples, the authors believe the results are
9 questionable. Consequently, the data are not evaluated further.
- 10 • **Mercury** (n=544). Only one of 544 total mercury samples was above the MRL.
11 This sample was located at Spring Canyon.
- 12 • **Zinc** (n=608). Total zinc was measured at or above the MRL in 92 of 608 samples
13 located throughout the study area. Log-transformed zinc concentrations at
14 Porcupine Bay were significantly greater ($p=0.0079$ or less) than those in samples
15 from Evan's Landing, Kettle Falls, Gifford, Hunters, Seven Bays, Spring Canyon,
16 and the Sanpoil River.

17 **Metals Concentrations in Surface Water at Northport, Washington**—Other than the
18 LRFEP data set, COI data in the UCR are generally limited to monitoring data at
19 Northport. Seasonal patterns in total and dissolved concentrations of arsenic, cadmium,
20 copper, lead, mercury, and zinc (i.e., 2002–June 2007) were examined by plotting
21 measured concentrations, SEVs, and available flow data reported by Ecology^{9,10} against
22 time (Appendix D; Figures 7 through 12, respectively). These trends in metals
23 concentrations indicate that:

- 24 • Elevated detection limits for total cadmium and total zinc constrain data
25 interpretation for data collected after 2001
- 26 • Only one metal in dissolved form, cadmium, exceeded chronic AWQC, during
27 one sampling event
- 28 • Copper exceeded the Canadian Council of Ministers of the Environment (CCME)
29 value (as total copper) once (June 2003) (comparisons to CCME values are
30 provided in the draft SLERA and therefore are also provided here)
- 31 • Dissolved cadmium exceeded the CCME screening value (as total cadmium) five
32 times since 2003
- 33 • Total zinc exceeded the CCME screening value once (June 2003)
- 34 • Total lead exceeded the CCME screening value once (December 2005).

⁹ Elevated detection limits constrain the usability of data collected prior to 2001 and these data were not screened.

¹⁰ Flow data were based on a stage-discharge rating curve.

Comparison of UCR Total Metals Data (Northport) to Major Tributaries—

Downstream of Northport, several tributaries discharge to the UCR, including the Kettle, Colville, Spokane, and Sanpoil rivers. Concentrations of total recoverable metals for samples collected from these rivers between 1995 and 2007 were compared to the concentrations found in the UCR at Northport, with the exception of the Colville River, for which no metals data are available for this period. The following observations are based on these comparisons:

- Arsenic: Detected arsenic concentrations from the Kettle River are comparable to arsenic concentrations detected at Northport from 1995 to 2007 (Appendix D, Figure 19).
- Cadmium: The evaluation of cadmium concentrations in tributaries relative to Northport is constrained by elevated detection limits in the Northport data set (Appendix D, Figure 20).
- Copper: Copper data are available for the Kettle and Sanpoil rivers. One 1995 sample from the Sanpoil River was comparable to the highest concentrations observed at Northport prior to 2000 (Appendix D, Figure 21). Concentrations in the Kettle River in 2001 and 2002 were similar to those at Northport since 2001.
- Lead: Concentrations of total lead at Northport are similar to concentrations in the Spokane and Kettle rivers (Appendix D, Figure 22).
- Mercury: The evaluation of mercury concentrations in tributaries relative to Northport is limited by elevated detection limits in the Northport data set (Appendix D, Figure 23).
- Zinc: The evaluation of zinc concentrations in tributaries relative to Northport is also limited by the elevated detection limits in the Northport data set (Appendix D, Figure 24). However, concentrations at Northport are similar to or less than concentrations in the Spokane River. The CCME value for zinc was exceeded in one Northport sample (1 of 6 samples collected in 2003) and numerous Spokane River samples (16 of 28 samples collected in 1998–2003).

Organic COIs in the UCR—Organic chemicals previously analyzed in UCR surface water include volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides and herbicides, PCBs, polychlorinated dibenzo-*p*-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), and polybrominated diphenyl ethers (PBDEs). The distribution of these samples is spatially and temporally limited.

One surface water sample was collected from Lake Roosevelt near the city of Grand Coulee as part of the UCR expanded site inspection (ESI) in 2001. Analytes for the sample included VOCs, SVOCs, pesticides, and PCBs. The results for all organic

1 constituents were below detection limits (Appendix D, Map 2, USEPA 2003). Pesticides
2 and herbicides were analyzed in surface water samples collected by USGS at Northport,
3 Washington, from 1995 through September 2000 (Appendix D, Map 2; USGS 2006a).
4 Nearly all of the results were below detection limits (Appendix D, Table 7).

5 In 1992, Bortleson et al. (2001) measured dioxin and furan concentrations in the water
6 column (using XAD resin columns) and suspended sediment at Northport, and in
7 effluent from the Celgar Pulp Company (located upriver of the TCM facility). Dioxins
8 were detected in each type of sample while furans were detected in the suspended
9 sediment and effluent samples. The 2,3,7,8-TCDD congener was not detected in any
10 Northport sample but was detected in the effluent sample.

11 A joint study by Ecology and USGS (Serdar et al. 1994) analyzed PCDDs and PCDFs
12 from Northport surface water samples taken in 1992 and 1993 to explore the association
13 of dioxins and furans with suspended particulate matter. Some analyses were also
14 conducted on dissolved samples, and three PCDDs and seven PCDFs, including 2,3,7,8-
15 TCDF, were detected in dissolved samples in this study. The authors concluded that
16 there was a significant decrease in 2,3,7,8-TCDD and 2,3,7,8-TCDF concentrations
17 between 1990 to 1993 that coincided with modifications at the Zelstoff Celgar pulp mill.
18 No other data have been found for dioxins in UCR surface water.

19 PBDEs were the focus of a statewide study in 2005 and 2006 which included samples
20 collected with semi-permeable membrane devices (SPMDs) from near Marcus Flats
21 (Johnson et al. 2006). The SPMD sampling method allows for lower detection limits than
22 traditional water sampling techniques (further described in Section 6 of Appendix D).
23 The SPMDs were deployed in the UCR from September 8 to October 6, 2005 (Johnson et
24 al. 2006). PBDEs were detected as PBDE-47, PBDE-99, and total PBDE in the samples
25 collected by this method (Johnson et al. 2006). Concentrations of these three PBDEs in
26 the dissolved phase were estimated using known octanol–water partition coefficients
27 (K_{owS}). Estimated total PBDE concentrations were 16 pg/L in the UCR (Johnson et al.
28 2006). In comparison to PBDE concentrations in Marcus Flats, total PBDE concentrations
29 from SPMDs deployed during the same study in the Spokane River at Ninemile Dam
30 were estimated at 926 pg/L in a sample taken in fall 2005 and 146 pg/L in a sample taken
31 in spring 2006. The authors attributed this apparent seasonal variation to possible
32 dilution of local source contributions by snowmelt runoff in the upper watershed
33 (Johnson et al. 2006). In comparison to the estimated total PBDE concentration detected
34 in the fall 2005 sample from Marcus Flats, the authors state that results of the Ninemile
35 Dam samples indicate that the Spokane River may be a relatively significant source of
36 PBDEs.

Field Measurements and Stratification in the UCR—Recent data from four U.S. Bureau of Reclamation (USBR) monitoring locations in the UCR (i.e., Kettle Falls, Lincoln Boat Ramp, Keller Ferry, and at the Logboom near Grand Coulee Dam; Appendix D, Map 3) indicate that conventional parameters vary temporally and spatially, though patterns may not be consistent from year to year. Spatial and temporal trends for 2002–2006 are shown in Appendix D (Figures 25–28 and 30–41). (In these plots, depths were adjusted to approximate elevation using historical reservoir elevation data from the Columbia River DART database.)

Conductivity is a measure of major ion content of surface water. The anion and cation content of surface water reflects that of the source water, including rainfall, runoff, and groundwater infiltration. Surface water conductivity can also be influenced by pore water, tributary flow, point source runoff, and other sources or processes. Profiles of conductivity measurements collected between 2002 and 2006 at the four USBR stations (Appendix D, Figures 25–28) illustrate a seasonal change at the most upstream sampling location, Kettle Falls, in 2 of the 5 years shown. Vertical stratification in conductivity is also indicated at some downstream stations in some years.

Although Lake Roosevelt experiences substantial flows (i.e., commonly 40,000 to 200,000 cfs) and changes in water surface elevation, a weak thermal stratification of the water column can occur during the summer when solar radiation heats the surface water. Thermal stratification can limit the vertical mixing due to differences in water density. Plots of temperature measured at the four USBR monitoring stations in 2002–2006 (Appendix D, Figures 30–33) illustrate temporal variations at the four locations.

The data from 2006 provide an example of how seasonal variations in environmental conditions (flow, temperature, and drawdown) may be affecting the mixing and transport patterns within the UCR over a typical year. The four upper panels in Figure A-5 display vertical profiles of temperature and the four lower panels in Figure A-5 display vertical profiles of conductivity, a conservative tracer. In each case, the four panels, from left to right, present the data for monitoring stations near Kettle Falls (the most upstream location, at RM 703), Lincoln Boat Ramp (downstream of the Spokane River, RM 633), Keller Ferry (downstream of the Spokane River, RM 615), and Logboom (RM 597, near Grand Coulee Dam). Each panel shows the 2006 profiles that were measured at approximately monthly intervals from May through October (i.e., May 22, June 20, July 25, August 21, September 19, and October 18, 2006; profiles labeled 5–10, respectively). It is useful to consider these data in light of the typical within-year variations in reservoir water surface elevation and upstream river flow (Figure A-6).

1 With respect to temperature, the vertical profiles at Kettle Falls (upper left panel)
2 indicate that vertically mixed conditions exist throughout the year at this upstream
3 location. This is likely a result of the relatively shallow water and high degree of
4 turbulent mixing that is characteristic of the immediately upstream river reach. While
5 the river velocity is reduced in the Marcus Flats area relative to the upstream reach, the
6 river remains relatively shallow and residence time within this reach is too short for
7 thermal stratification to become established. The depth-averaged temperature is
8 approximately 11°C on May 22, reaches a maximum of 19–20°C on July 25, and then
9 decreases to 16°C by September 19 and 14°C by October 18, respectively. The vertical
10 temperature gradients become increasingly pronounced in the downstream direction,
11 from Lincoln Boat Ramp and Keller Ferry, with the surface temperature increasing
12 relative to upstream conditions. For example, by late July, the near-surface
13 temperatures approach 25°C and those in the deeper waters are about 14°C. This
14 differential reflects the inability of vertical mixing to transfer heat to the colder, deeper
15 water of the reservoir. By September 19 and October 18, however, as the inflowing water
16 is decreasing in temperature (to about 15°C and 13°C on these same dates, at Kettle
17 Falls), the temperature of the reservoir's surface water is also decreasing. This condition
18 apparently induces a density-driven overturn that begins in August (a slight gradient in
19 temperature remains); by October the water column is approaching a thermally well-
20 mixed condition.

21 These seasonal patterns in temperature are also reflected in the conductivity profiles. As
22 is the case for temperature, the conductivity profiles at Kettle Falls are consistent with
23 the existence of vertically well-mixed conditions throughout the year. The conductivity
24 is lowest in May, possibly a reflection of the lag in flushing of low-conductivity
25 snowmelt from upstream reservoirs. It appears as if this low-conductivity, warmer
26 water remains near the surface as it is transported in the downstream direction, leading
27 to the vertical gradient in conductivity apparent during May, June, and July at Lincoln
28 Boat Ramp. Conditions are more uniform in August, perhaps as a result of reservoir
29 management operations, including drawdown. While it appears that stratified
30 conditions are returning during September, this condition does not persist because of
31 the fall overturn. Similar qualitative inferences about conductivity at the more
32 downstream stations become more difficult to make, in part because of the phase shifts
33 that occur as upstream changes in conductivity propagate through the downstream
34 intermittently stratified system.

1 Measurements from the four USBR stations (Appendix D, Figures 34–37) illustrate
2 vertical variation in pH at some locations over the period 2002–2006. Variability is
3 greatest in the lacustrine portion of the Site.

4 Low dissolved oxygen is commonly a water quality concern for reservoirs that develop
5 thermal stratification during warmer months of the year. In stratified reservoirs,
6 subsurface waters below the thermocline (i.e., the hypolimnion) can develop relatively
7 low dissolved oxygen concentrations as the result of biological oxygen demand (BOD)
8 coupled with reduced exchange with the surface waters above the thermocline (i.e., the
9 epilimnion). Profiles of dissolved oxygen concentrations at the four locations collected
10 in 2002–2006 at the four USBR stations (Appendix D, Figures 38–41) do not illustrate this
11 trend, although some stratification is evident at some locations.

12 Although smaller-scale stratifications, such as gradients at the sediment–surface water
13 interface, may occur, the data reviewed for the site do not describe gradients at this
14 scale, and data describing micro-scale stratification in the UCR were not found. The
15 proposed surface water sampling program is not designed to address potential micro-
16 scale stratifications, such as those at the sediment–surface water interface, whether due
17 to thermal or conductivity gradients.

18 **A5.3 Surface Water Screening Relative to SEVs**

19 Surface water data from Northport collected between 2000 and 2006 was screened
20 against multiple SEVs (STI 2003; CCT 2004; Ecology 2006; USEPA 2006b; CCME 2007).
21 Generally, few exceedances of SEVs were found. However, because the spatial coverage
22 of the surface water sampling locations within the Site is limited to Northport, all COIs
23 will be analyzed in the proposed sampling program.

24 Results of the screening evaluation of COIs in surface water are presented in Table A-6.
25 Of the metals monitored at Northport, Washington, by Ecology (2007), only cadmium
26 exceeded the chronic AWQC (i.e., exceedance ratio of 1.4) for dissolved metals in water,
27 and only on one occasion, in November 2002. The detection limit (0.1 µg/L) was
28 relatively high, and close to the screening value of 0.19 µg/L, suggesting that there is
29 some uncertainty associated with this single exceedance. All other dissolved metals
30 concentrations in samples collected between 2000 and 2006 were less than their
31 corresponding chronic AWQC.

32 Total recoverable metal concentrations were compared to the CCME SEVs (CCME 2007),
33 which generally are lower than SEVs based on the EPA chronic AWQC (USEPA 2006b),
34 chronic Washington water quality standard (WQS) (Ecology 2006), Spokane Tribe (STI
35 2003), or Colville Confederated Tribes (CCT 2004) aquatic life chronic criteria. Detected

values of zinc, copper, and lead exceeded their respective SEVs; however, these metals exhibited only single exceedances in June 2003 (copper and zinc) and December 2005 (lead), with exceedance ratios of 1.5, 1.1, and 1.4, respectively. For total cadmium, all 26 measurements had detection limits (0.1 µg/L) that exceeded the screening value of 0.02 µg/L; however, five dissolved cadmium samples exceeded the total cadmium CCME value (0.03 µg/L) (CCME 2007).

Dissolved cadmium, selenium, and silver measurements in samples collected by USGS all had detection limits that exceeded respective SEVs.

A limited number of SEVs are available for the pesticides measured at Northport by USGS. Of those pesticides having an SEV, dieldrin could not be evaluated because its detection limit exceeded SEVs. None of the other pesticides were measured at concentrations greater than their SEVs.

In summary, few exceedances of SEVs were found for surface water at Northport, based on data collected between 2000 and 2006. Because spatial coverage of the surface water sampling locations is limited to Northport, and many of the chemicals had detection limits exceeding SEVs, all COIs will be analyzed in the proposed sampling program.¹¹

A5.4 Observations and Issues Related to Surface Water

Surface water data collected at Northport demonstrate that temporal variability is limited. However, given that available surface water data for metals are largely limited to a single station within the UCR, and given the absence of data for several COIs, uncertainties remain. Metals data for the single location monitored in the UCR—Northport—were generally comparable to metals data for tributaries. This surface water study is intended to address potential risks in the water column only. The information provided by existing data that is relevant to study design is as follows:

- Elevated detection limits make it difficult to evaluate some of the historical data. Adequate detection limits will need to be achieved in the future.
- Of the samples collected at the Northport station since 2000, only one sample exceeded chronic AWQC for a single metal, cadmium.
- Total metals concentrations at Northport are generally similar to total metals concentrations upstream of the border (i.e., Waneta, B.C.), with some influence from the Pend Oreille River.

¹¹The draft SLERA remains under review by EPA and to date has not been approved. However, given that no COIs were screened out in surface water the draft status of the SLERA does not affect the 2009/2010 surface water quality design.

- Total metals concentrations at Northport are generally similar to total metals data collected from tributaries to the UCR.
- Spatial scale is a major consideration when evaluating surface water quality. This sampling program addresses the general condition in the river, not small scale processes that are of interest to localized receptors (e.g., at the sediment–water interface).
- Conventional and field measurements indicate that some seasonal stratification may occur in the transitional and lacustrine portions¹² of the Site.

Given the reasonably low level of long-term temporal variability seen in existing data (see Appendix D), the spatial scale of the site, and the limited number of industrial or municipal point sources, sampling stations needed to provide a general picture of water quality to support the assessment of risks within the Site can be distributed on the basis of potential source areas and physiographic reaches.

A6 TASK DESCRIPTION

The 2009/2010 surface water data will be collected in a manner that will support the evaluation of the nature and extent of contamination, and the assessment of human health and ecological risks to be conducted as part of the RI/FS. The rationale for the sampling design described below is provided in Section A7.

A6.1 Overview of Field Activities

Tasks that will be completed in the field, including related documentation and QA/QC activities, are described in detail in the FSP (Appendix A).

A6.1.1 UCR Samples

Eight transects (TC1–TC7, TC9) and one additional nearshore area (TC8) will be sampled in the UCR between the U.S.-Canadian border (RM 745) and RM 605 near the Grand Coulee Dam (Figure A-7). One or more sampling transects will be located in each of the six physiographic reaches identified for the UCR and many transects will coincide with focus areas delineated by EPA during its 2005 study (USEPA 2006d). Transect locations were selected based on river hydrology, proximity to potentially significant sources, and spatial patterns in sediment chemical concentrations.

Depending on transect width and underwater topography, two to four pairs of near-surface (~1 m below the water surface) and near-bottom (~1 m above the sediment

¹² The transitional portion of the Site extends between RM 730 and RM 700 (Reaches 2 and 3) and the lacustrine portion of the Site extends between RM 700 and RM 596 (Reaches 4, 5, and 6).

1 surface) offshore samples will be collected to assess risk to plankton, pelagic and
2 demersal fish, and aquatic-dependent wildlife. One sample pair will be located at the
3 thalweg or mid-channel and the remaining pairs will be located between the thalweg
4 and shoreline and where bottom topography is relatively flat. In addition, one sample
5 will be collected at each end of each transect, in shallow nearshore water roughly 0.5 m
6 deep. These samples will provide exposure information for nearshore ecological
7 receptors (both aquatic receptors and aquatic-dependent wildlife).

8 During each sampling event, three samples will be collected at each end of each transect
9 following sediment disturbance (representative of incidental ingestion while wading
10 and in-water play) to support the HHRA (Teck 2009), for a total of six samples per
11 transect. Sediments will be disturbed in the same manner and to the same degree at each
12 station according to an SOP, as described in the FSP (Appendix A). During each
13 sampling event, three samples will also be collected off Black Sand Beach following
14 sediment disturbance to support the HHRA.

15 **A6.1.2 Canadian Samples**

16 Limited surface water sampling in the Columbia River will occur above the Site in
17 British Columbia to help with the interpretation of Site data (Figure A-7). Samples will
18 be collected along a transect across the river at Birchbank, B.C. The Birchbank station
19 was selected because of two important attributes: it is upstream of the Trail facility and it
20 is one of the monitoring locations routinely occupied by the B.C. Ministry of the
21 Environment to assess water quality in the Columbia River north of the border. Both
22 near-surface and near-bottom samples will be collected at two offshore (i.e., channel)
23 locations. In addition, one sample will be collected at each end of the transect, in
24 shallow nearshore water roughly 0.5 m deep.

25 Surface water grab samples will also be collected from one location at Waneta, B.C.
26 (Figure A-7), before each sampling survey begins within the UCR to generate data on
27 short-term trends in the quality of water entering the Site. The parameters to be
28 analyzed in these samples are summarized in Tables 1-1 and 1-2 of the FSP
29 (Appendix A) and include total and dissolved metals, conventional parameters,
30 nutrients, and major ions. The Waneta data may be used to help with the interpretation
31 of data on water quality within the Site and are intended to help distinguish temporal
32 variation upstream of the Site from spatial variation within the site during the time
33 period sampled. By repeated sampling over time, an indication of the range of possible
34 water quality conditions that could exist within the system at the time of transect
35 sampling will be obtained. Samples will be collected weekly for the period of time that
36 represents the average hydraulic residence time for water entering the Site prior to the




initiation of the upcoming UCR survey; because the hydraulic residence times when the three surveys will be conducted will differ, the number of weeks over which sampling will occur at Waneta prior to each survey will also differ.

A6.1.3 Number of Sampling Events

Three major sampling events are planned. Sampling events, identified below, correspond to three key time periods that may influence COI concentrations in surface water:

1. Mid-October 2009: The first sampling event, between October 8 and 22, 2009, will provide data representing low flows and stable pool elevations within Lake Roosevelt (Figure A-6).
2. Late March/early April 2010: The second sampling event, between March 28 and April 8, 2010, will coincide with low flow when the water level in Lake Roosevelt is nearly at low pool (Figure A-6).
3. Late May/early June 2010: The third sampling event, between May 27 and June 10, 2010, will coincide with high flows on the UCR due to snowmelt within the drainage basin of the Columbia River, and the associated increase in pool elevation (Figure A-6).

UCR 2009/2010 Surface Water Sampling Schedule

	2009				2010																
	OCTOBER					MARCH				APRIL				MAY				JUNE			
Fall Low Flow																					
Spring Low Flow																					
Spring High Flow																					

All stations, with the exception of grab samples at Waneta, B.C., will be sampled once during each of the sampling events. Individual grab samples at Waneta, B.C., will be collected weekly prior to the initiation of each of the three sampling events in the Site. The duration of this weekly sampling program will be tied to the average hydraulic residence time for water moving into the Site at the initiation of each field event. For example, if the average hydraulic residence time is 50 days during a sampling event in the Site, then weekly samples will be collected at Waneta starting 50 days before Site sampling begins.

The start date for each sampling event will be determined following EPA approval of this QAPP. However, for planning purposes, it is anticipated that field sampling will begin in mid-October 2009.

A6.2 Field Analyses

Field measurements will be taken at all stations to describe the vertical distribution of several conventional water quality parameters. These measurements include water temperature, pH, dissolved oxygen, conductivity, turbidity, and oxidation-reduction potential (ORP) (note: Upon returning from the field, field staff will calculate reduction potential [Eh] from ORP readings). Parameters will be measured *in situ* at all sampling locations using a multi-probe sensor (see SOP SW-06 in Attachment A2 of Appendix A). The sensor will record a continuous profile of these parameters from approximately 1 m above the sediment surface to the surface of the water column.

A6.3 Laboratory Analyses

Laboratory analyses of surface waters will be conducted at five laboratories. Columbia Analytical Services (CAS; Kelso, Washington) will conduct the analysis of conventional parameters, major ions, nutrients, metals and metalloids, pesticides, PCB congeners, SVOCs, and PAHs. SGS Environmental Services (SGS; Wilmington, North Carolina) will conduct the analysis of PCB congeners and PBDEs. Frontier GeoSciences (FGS; Seattle, Washington) will conduct the analysis for arsenic. Isotech Laboratories (Isotech; Champaign, Illinois) will conduct the stable isotope analyses; while Pace Analytical Services Inc. (Pace; Pittsburgh, Pennsylvania) will conduct the radionuclide analyses. Current EPA analytical methods for analysis of total and dissolved metals and metalloids, organic compounds, conventional parameters, and nutrients and major ions will be used, in addition to *Standard Methods for the Examination of Water and Wastewater* (SM) (APHA 1998), as indicated in Table A-7. The following analytes or groups of analytes will be analyzed:

- Total recoverable and dissolved metals and metalloids in all samples.
 - EPA target analyte list (TAL) metals (aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, nickel, selenium, silver, thallium, vanadium, zinc), molybdenum, and uranium
- Total recoverable and dissolved other selected metals in all samples collected from transects at Northport (TC1), Marcus Flats (TC3), Inchelium (TC4), and downstream of the Spokane River (TC6), as well as in all samples collected at Birchbank, B.C. (CAN1). Relative distributions of metals in sediments in the

riverine portion¹³ of the Site differ from those in sediments in the lacustrine portion of the Site (Figures A-8 through A-13). The Spokane River is known to release elevated concentrations of cadmium, lead, and zinc into the UCR at Long Lake Dam (Butkus and Merrill 1999; Clark 2003). Consequently, selected metals will be analyzed at transects in the riverine and lacustrine portions of the site, and below the Spokane River.

- Bismuth, boron, cerium, cesium, dysprosium, erbium, europium, gadolinium, gallium, germanium, gold, holmium, indium, lanthanum, lithium, lutetium, neodymium, niobium, praseodymium, rubidium, samarium, scandium, strontium, tantalum, tellurium, terbium, thorium, thulium, tin, titanium, tungsten, ytterbium, yttrium, and zirconium

- Organic compounds in one near-surface and one near-bottom sample at the thalweg or mid-channel station along each Site transect, in one undisturbed nearshore sample along each transect, in one disturbed sediment surface water sample at each station proximate to beach sampling locations (TC1 [North Port Beach], TC2 [China Bend Beach], TC3 [Welly Bay], TC6 [Seven Bays Beach], and TC7 [Swallila Basin Beach]), in one disturbed sediment surface water sample at TC8 (Black Sand Beach), and in all samples collected at Birchbank, B.C. Existing surface water data (Appendix D of this QAPP) indicate few detected concentrations of organic compounds.

- Pesticides, semivolatile organic compounds (SVOCs), polycyclic aromatic hydrocarbons (PAHs), PCBs (as congeners), PBDEs

- Conventional parameters in all samples to help evaluate overall water quality
 - Alkalinity (as CaCO₃), dissolved organic carbon (DOC), hardness (as CaCO₃), total dissolved solids (TDS), total suspended solids (TSS), total organic carbon (TOC), pH, silica (as dissolved silicon dioxide [SiO₂])

- Stable isotopes of water in all samples collected within the Site to help evaluate variability in water quality data

- Deuterium and oxygen-18

- Nutrients and major ions in all samples to help evaluate overall water quality

- Ammonia, nitrate-nitrite, total phosphorus

- Calcium, magnesium, potassium, sodium, chloride, fluoride, sulfate

- Radionuclides in one disturbed sediment surface water sample at surface water stations proximate to beach sampling locations (TC1, TC2, TC3, TC6, TC7, and TC8)

- Radium-226 and uranium-238.

¹³ The riverine portion of the Site extends between RM 745 and RM 730 (Reach 1).

A7 QUALITY OBJECTIVES, CRITERIA, AND DESIGN RATIONALE

EPA's seven-step DQO process (USEPA 2006a) was used to guide the requirements and design rationale for surface water data collection activities. The DQO process is a tool to determine the type, quantity, and quality of data. It establishes performance and acceptance criteria to ensure that data collected support the goals of the study. A summary of the output from this DQO process is provided in Table A-8.

A7.1 Step 1—State the Problem

The UCR RI/FS was initiated by concerns regarding emissions from the Trail facility including but not limited to discharges of liquid effluent and granulated slag into the Columbia River. Additional surface water data are needed to assess water quality conditions in representative reaches of the UCR. The 2009/2010 surface water study is intended to determine whether surface water is an important exposure pathway for people, aquatic receptors, and aquatic-dependent wildlife.

Although both organic compounds and metals are COIs, metals are of central interest because of their association with a variety of sources to the UCR, particularly the Trail facility located approximately 11 river miles upstream of the U.S.-Canadian border. Other potentially important sources of metals include historical releases from the Le Roi/Northport smelter (the smelter operated intermittently from 1896 to 1921). Potential sources are described in the RI/FS work plan. In addition, historical releases of granulated slag and other particle-bound metals and COIs that have been deposited as sediments in the UCR are subject to physical, chemical, and biological processes within the UCR, and may serve as secondary or tertiary sources of COIs to surface water.

A7.1.1 Conceptual Model and Data Needs/Uses

The CSM (Figures A-2 and A-3) identifies surface water as a potentially important exposure medium and transport pathway for COIs. Most of the available data for COIs in Site surface water were collected at Northport, Washington. Comparisons to total metals data collected in Canada suggest the data from Northport are generally representative of conditions at the U.S.-Canadian border, which reflect surface water conditions in the UCR closest to the Trail facility, modified by mixing with the Pend Oreille River which enters the UCR just above the border (see Section A5 and Appendix D). The absence of significant sources of organic compounds supports the development of a surface water study that focuses primarily on metals and characterizes the general water quality conditions within the UCR. However, the data set for organic compounds within surface water of the UCR are limited, and therefore observations

1 regarding organic compounds are preliminary. Organic compounds will be analyzed as
2 part of the proposed sampling plan to allow further evaluation of these compounds in
3 the UCR.

4 More widespread surface water sampling is needed to facilitate the characterization of
5 exposures by ecological and human receptors. The proposed sampling program
6 identifies spatially representative reaches for the collection of surface water chemical
7 data for use in characterizing human and ecological exposures to this medium. Two
8 important aspects of evaluating this data are 1) the identification of spatially
9 representative subsets of the data, and 2) comparison of data from these subsets to risk-
10 based benchmarks. Identifying subsets of the data that are spatially representative of
11 areas larger than those represented by a single sample requires an evaluation of the
12 variability between samples, and comparison to benchmarks requires an estimate of the
13 variability within each spatially representative subset. A step-wise approach for
14 evaluating variability within and among samples will be used to refine the spatial and
15 temporal groups that can be used for comparisons to risk-based benchmarks for
16 evaluation of ecological exposures. Details of the analyses that will be conducted are
17 provided in Section A7.6.

18 Disturbed shallow surface water is the aquatic exposure medium of principal concern
19 for the HHRA. The HHRA will rely primarily on disturbed-sediment surface water
20 samples for evaluating exposure via pathways including inadvertent ingestion while
21 swimming, wading or playing at beaches, as well as for intentional (subsistence)
22 drinking water (e.g., filling a bottle from the river). Undisturbed pelagic surface water
23 data may additionally be used in the HHRA for evaluation of exposure pathways such
24 as swimmers from a boat.

25 **A7.1.2 Team Members and Roles**

26 Team members and their roles are described in Section A4.2 of this QAPP.

27 **A7.1.3 Resources and Deadline**

28 Three sampling events are planned, and sampling may continue into the future to
29 address additional questions and uncertainties. Pending results, and consistent with the
30 RI/FS process, refinement of the analyte list may be required as determined by EPA as
31 part of adaptive management.

A7.2 Step 2—Identify the Goal of the Study

Step 2 of the DQO process involves identifying the key questions that the study attempts to address, along with alternative actions or outcomes that may result from the answers. The primary goals of the surface water study are to characterize levels of exposure to ecological receptors and humans in major reaches of the UCR and determine whether surface water is an important exposure pathway for people and/or ecological receptors (a decision problem).

The CSM provides a general framework for considering the relationship between the major exposure media and exposure pathways to ecological receptors and people. The key questions related to potential exposures and related risks are as follows:

- Do COI concentrations exceed state, federal, or Tribal water quality benchmarks?
- Do COIs in surface water pose an unacceptable risk to aquatic life through direct contact, ingestion, and respiration?
- Do COIs in surface water pose an unacceptable risk to human health through dermal contact, inhalation (via sweat lodge use and showering) and ingestion?
- Do COIs in surface water pose an unacceptable risk to aquatic life and wildlife through food chain transfer?
- Do COIs in surface water pose an unacceptable risk to human health through food chain transfer?

The focus of the surface water study is on spatially representative reaches of the UCR and on time periods that represent extreme conditions of flow and water levels.

A7.3 Step 3—Identify Information Inputs

The third step of the DQO process identifies the types and sources of information needed to determine whether surface water is an important exposure pathway at the Site. The general types of information needed include the following:

1. Analytical data for total recoverable and dissolved metal/metalloid COIs, including non-TAL metals, in representative reaches of the UCR and at Birchbank and Waneta, B.C.
2. Analytical data for total and dissolved metal/metalloid COIs, including non-TAL metals, at extreme flow and water level conditions
3. Analytical data for organic COIs in representative reaches of the UCR, at Birchbank, B.C., and at seasonal extremes in flow conditions
4. Federal, state, and Tribal water quality benchmarks

- 1 5. Conventional data at most stations relevant to interpretation of metals data (i.e.,
2 alkalinity, hardness [as CaCO₃], TDS, TSS, TOC, DOC, pH, silica [as dissolved
3 SiO₂])
- 4 6. Nutrient and major ion data at most stations relevant to understanding water
5 homogeneity and bioavailability (i.e., ammonia, nitrate, nitrite, total phosphorus,
6 potassium, sodium, calcium, magnesium, fluoride, chloride, and sulfate)
- 7 7. Stable isotopes at most stations to help interpret water homogeneity (i.e.,
8 deuterium and oxygen-18)
- 9 8. Field parameters at all stations relevant to interpretation of all surface water data
10 (i.e., water temperature, pH, dissolved oxygen, conductivity, turbidity)

11 Items 1, 2, 3, 5, 6, 7, and 8 will be collected as part of the surface water study. Item 4 has
12 been compiled (see Section A5.3), and is central to selection of analytical methods that
13 will result in detection limits that are below benchmarks. The most significant
14 challenges associated with surface water sampling are 1) collecting uncontaminated
15 samples for trace metals analyses, 2) achieving detection limits that are less than
16 screening values and water quality benchmarks, 3) collecting and concentrating a
17 sufficient volume of water for organic analyses to achieve target detection limits,
18 4) collecting representative samples from the riverine portion of the UCR during high-
19 flow conditions, 5) collecting representative samples from near the sediment surface in
20 both the riverine and deep lacustrine portions of the Site, and 6) meeting holding time
21 requirements for nutrient measurements.

22 **A7.4 Step 4—Define the Boundaries of the Study**

23 In Step 4 of the DQO process, the spatial and temporal features pertinent for decision-
24 making or estimation are described. Each is discussed below.

25 **A7.4.1 Spatial Boundaries**

26 The Site includes the portion of the UCR that extends from the Canadian border to
27 Grand Coulee Dam and includes Lake Roosevelt. For the purposes of the UCR RI/FS,
28 the UCR site was subdivided into six river reaches that correspond to relatively distinct
29 physiographic units. The six reaches were selected based on geomorphic features (e.g.,
30 channel width, sinuosity, confluence with major tributaries), general hydrodynamic
31 characteristics (e.g., depth, location of the reservoir pool, riverbed characteristics, flow
32 velocity), and expectations regarding the principal mechanisms for transport or
33 deposition of particulate COIs. These units are described in detail in the RI/FS work

1 plan. The transects are located in areas that are considered representative of processes
2 governing water quality within each reach (discussed further in Section B1.1.1).

3 As discussed previously, available surface water data are generally limited to the area
4 near Northport. Consequently, geographic trends in surface water COI concentrations
5 by river reach are lacking. Figures A-4a through A-4e demonstrate the apparent
6 nominal variability in non-COI parameter averages throughout most of the Site. (The
7 raw data are not available but would allow for a more detailed analysis of temporal and
8 spatial variability.)

9 Nine representative sampling locations (eight transects and one nearshore sampling
10 station) are proposed (Figure A-7) within the six reaches of the Site identified and
11 described in the RI/FS work plan (USEPA 2008b). The definitions of these representative
12 reaches and their relationship to proposed surface water sampling are as follows
13 (additional rationale for transect placement is found in Section B1 of this QAPP):

14 **Reach 1** (U.S.-Canadian border at RM 745 to RM 730). This reach begins at the upstream
15 boundary of the Site and extends to approximately Onion Creek. This reach can be
16 characterized as a swift river environment (i.e., riverine) that is typically least affected by
17 the reservoir. As discussed above, existing metals COI data in surface water are
18 available for Northport, and a screening of these data results in few exceedances of
19 SEVs. Sediments in this part of the Site are coarse and tend to have elevated
20 concentrations of metals found in granulated slag (e.g., copper, lead, and zinc).
21 Transects TC9 (RM 745 at the border) and TC1 (RM 734 below Northport), and Station
22 TC8 (Black Sand Beach at RM 742) are in Reach 1.

23 **Reach 2** (RM 730 to RM 712). This reach extends to the vicinity of Evans and Powell,
24 and can be characterized as a narrow channel in the reservoir with few shoreline
25 embayments and irregularities. Sediments in this part of the Site are also coarse and
26 contained elevated concentrations of metals typically associated with granulated slag.
27 Transect TC2 (RM 724) is in Reach 2.

28 **Reach 3** (RM 712 to RM 700). This reach extends to just above Kettle Falls and, under
29 contemporary regulation of pool levels, is expected to be inundated much of the year.
30 This reach transitions from freely flowing to slowed waters during periods of
31 inundation, and can be characterized as a depositional area for coarse-grained sediments
32 in the historical river channel and for fine-grained sediments in many of the shallower
33 areas. Sediments have elevated concentrations of metals typically associated with
34 granulated slag. Transect TC3 (RM 704 at Marcus Flats) is in Reach 3.

Reach 4 (RM 700 to RM 640). This reach extends from a point upstream of the mouth of the Colville River to upstream of the mouth of the Spokane River. It can be further subdivided into Reaches 4a and 4b, with the boundary occurring at RM 676 near Inchelium and Gifford, where the width of the overall reach narrows considerably. Whereas bed sediments in Reach 3 are composed of 80 to 100 percent coarse particles, there is a pronounced shift in bed sediment grain size distributions towards finer-grained materials in Reach 4. Sediments in this region have elevated concentrations of cadmium and mercury, particularly in the mid-channel region. Two transects are within Reach 4: TC4 upriver of Inchelium (RM 678) and TC5 upriver of the Spokane River (RM 642).

Reach 5 (RM 640 to RM 617). This reach extends to above the mouth of the Sanpoil River, and can be characterized as a lacustrine environment. Sediments are generally fine-grained, especially in the mid-channel. As in Reach 4, cadmium and mercury concentrations in the mid-channel are elevated relative to the riverine portion of the Site. Transect TC6 (RM 637), near Seven Bays, is in Reach 5.

Reach 6 (RM 617 to Grand Coulee Dam near RM 597). This reach extends to the downstream boundary of the Site at Grand Coulee Dam, and can be characterized as a lacustrine environment. Sediments are generally fine-grained, especially in the mid-channel. As in Reaches 4 and 5, cadmium and mercury concentrations in the mid-channel are elevated relative to the riverine portion of the Site. Transect TC7 (RM 605), located at Plum Point, is in Reach 6.

In addition to stations within the Site, surface water samples will be collected along a transect at Birchbank, B.C. (CAN1; RM 762), and at a shoreline location at Waneta, B.C. (CAN2; RM 746). Results will provide information to help with interpretation of Site data.

A7.4.2 Temporal Boundaries

As described in the RI/FS work plan, both flow through and water levels within the UCR vary temporally. As shown in Figure A-6, pool elevation varies annually to control flooding, with a significant drawdown in the winter followed by a refilling in late spring during the spring freshet. A second, smaller drawdown occurs in late summer to accommodate out-migrating juvenile kokanee. Flow also varies annually, with the lowest flows occurring in March/April and late summer. Maximum flow occurs in June during the spring freshet (Figure A-6).

Representative sampling times reflect extreme conditions in flow and water level, with the goal of capturing a range of COI concentrations at each station. The time periods were selected to reflect extreme conditions:

- Fall low flow (high pool, low flow)
- Spring low flow (decreasing pool, low flow)
- Spring high flow (increasing pool, high flow).

The timing of these events relative to flow and water level is illustrated in Figure A-6. The temporal component of this sampling design will enable risk to be evaluated under different water flow and dam management regimes.

The surface water sampling program is not designed to capture episodic high concentrations of chemicals that are unrelated to seasonal or annual hydrological variations. These are not addressed in the surface water study design and are not embodied in the DQOs developed for the surface water sampling program. As shown in Figure A-14 (a through f), pulses of high concentrations of COIs have not been observed by past sampling efforts. In the unlikely event of an accidental release from the Trail facility, the British Columbia Ministry of Public Safety and Solicitor General has established and tracks such incidences through the Provincial Emergency Program (PEP), and during the course of the RI/FS, Teck has agreed to a rapid response protocol requested by EPA to notify EPA and participating party project managers of any accidental spills or releases.

A7.5 Step 5—Identify the Analytical Approach

Step 5 of the DQO process involves developing an analytical approach that will guide how study results are analyzed to reach conclusions about surface water. The important study questions developed in Step 2 of the DQO process relate to specific decisions regarding exposure, risk, and consideration of remedial action.

Surface water data initially will be compared to SEVs. Nonbioaccumulative COIs whose concentrations are less than their respective SEV in all samples will be removed from the ecological COI list. Statistical comparisons will be performed if possible, following evaluation of the similarity of samples within and across transects. Evaluation of the similarity of adjacent samples (laterally, vertically, and longitudinally) will provide an estimate of the statistical confidence level associated with comparisons to benchmark values, and may minimize the number of comparisons needed; it may also provide insight into any vertical or lateral differences in water quality conditions throughout the study area (further discussed in Sections A7.6.1–A7.6.4). COIs for which an SEV has not

1 been established, COIs that exceed their respective SEVs, and bioaccumulative COIs will
2 be evaluated in more detail to quantify potential risk to ecological receptors (via contact,
3 ingestion, respiration, or bioaccumulation). All analytical results will be provided to
4 assess risk to humans (via dermal contact, inhalation, or ingestion) associated with
5 short-term or long-term exposures to COIs in surface waters, as described in the HHRA
6 work plan. The results of analyses evaluating the extent of statistical similarity within
7 and between transects (described in the next section) will also guide how exposures are
8 calculated within exposure areas for receptors in the BERA. In the event one or more
9 COIs are associated with predictions of unacceptable risk, future actions will be
10 considered.

11 **A7.6 Step 6—Specify Performance or Acceptance Criteria**

12 Key decision questions related to the goals of the surface water study (described in
13 Step 2 of the DQO process) can be evaluated using statistical methods. This section
14 summarizes the statistical approaches that may be used to evaluate the data for the
15 ecological risk assessment. Surface water data generated specifically for the HHRA will
16 be evaluated by EPA and are not addressed further in this QAPP.

17 Two important aspects of the data evaluation are 1) the identification of spatially
18 representative subsets of the data, and 2) comparison of data from these subsets to risk-
19 based benchmarks. Identification of subsets of the data that are spatially representative
20 of areas larger than those represented by a single sample requires an evaluation of the
21 variability between samples, and comparison to benchmarks requires an estimate of the
22 variability within each spatially representative subset.

23 Estimates of variability will be based on both field replicate (including triplicate)
24 measurements and measurements made on multiple samples from a given transect or
25 reach. Field replicates will be collected from near-surface and near-bottom water, in
26 both the riverine and reservoir segments of the site and upriver from Trail, B.C. Field
27 replicates will be used to determine the CV for each COI, for both dissolved and total
28 measurements, and separately for surface and bottom water samples. These measures
29 of variability will be used to evaluate whether individual samples along a transect are
30 statistically equivalent as described below in Section A.7.6.1. The equivalence of near-
31 surface and near-bottom transect samples will be evaluated separately. If individual
32 samples along a transect are not statistically significantly different from one another, the
33 samples will be pooled¹⁴ to produce an estimate of variability over the spatial extent of

¹⁴ “Pooling” of samples is a statistical process of aggregation, and is not to be confused with compositing; samples are analyzed by the laboratory on an individual basis, and are not pooled prior to analysis.

the transect in either near-surface or near-bottom water. This stepwise approach of using CVs to compare individual samples, and using pooling to compare groups of samples, will be extended as appropriate to evaluate the similarity of samples from different depths on a transect, and then, as appropriate, to evaluate the similarity of samples from adjacent transects.

Following the statistical evaluations of similarity among surface water samples, the samples will be pooled as appropriate for the purposes of evaluating the key study questions (i.e., statistical comparison to benchmark values) and for use in the risk assessment. Pooling will increase the power of statistical tests and will reduce the number of distinct conditions (e.g., locations) that must be considered during comparison to benchmarks and the risk assessment.

As noted previously, the appropriateness of pooling samples will be evaluated in three steps. In the first step, all near-surface (or, separately, near-bottom) samples from each transect will be evaluated to determine if they are statistically equivalent. In the second step, near-surface and near-bottom samples from each transect will be evaluated to determine if they are statistically equivalent. In the third step, adjacent transects will be evaluated to determine if they are statistically equivalent. All evaluations will be carried out separately for each analyte. These steps are illustrated in Figures A-15a through A-15d; the comparison procedures are described more fully in the following sections.

A7.6.1 Evaluation of the Similarity of Near-surface Samples on a Transect

To evaluate whether near-surface samples on each transect should be pooled, the left bank, mid-channel, and right bank samples will be compared to one another. This comparison will include nearshore samples where they are taken on the same transect, if collection methods are equivalent. If the near-surface samples (including nearshore samples) are found not to be equivalent, then the offshore near-surface samples (i.e., not including the nearshore samples) will be compared to determine if they are equivalent.

These comparisons will use an estimate of inter-sample variability derived from field replicate results. Field replicates will be collected in near-surface, nearshore, and near-bottom locations downstream of the Spokane River (TC6) in the reservoir portion of the site. In addition, triplicate samples will be collected at all 10 stations at Marcus Flats (TC3), which is located in the transitional portion of the site and at all 6 stations at Birchbank, B.C. (CAN1), which is located downriver from Castlegar, B.C., and upriver of Trail, B.C. (see Section 2.1 of Appendix A for information on sampling scheme). (Note: Field triplicate samples will be collected during the first sampling event. The field triplicate data from TC3 and CAN1 will be assessed and it will be determined through

1 adaptive management whether field triplicate samples will be collected in subsequent
2 sampling events.)

3 The method anticipated for evaluation of statistical equivalence is a Monte Carlo
4 permutation procedure (Manly 1991). This method will be used to test the maximum
5 difference between the three to six samples against a distribution with a mean identical
6 to that of the three to six samples, and a CV identical to that of the field replicates. The
7 CV of field replicates from near-surface water and the mean of the transect
8 measurements will be used to select 10,000 random sets of three to six samples. The
9 difference between the largest and smallest of these samples will be tabulated. An
10 example of the distribution of such differences is shown in Figure A-16. The actual
11 difference between the largest and smallest of the three to six transect measurements to
12 be evaluated will be compared to this distribution to determine the probability of
13 finding a difference as large as was actually observed.

14 This analysis will be carried out separately for each COI and for dissolved and total
15 measurements. Because testing multiple COIs for the same set of samples elevates the
16 probability of a false positive determination, a multiple-comparison correction will be
17 applied to the critical p value¹⁵ (a Bonferroni correction). With this multiple-comparison
18 adjustment applied, a statistically significant difference for any analyte would be an
19 indication that the samples on the transect are not equivalent. If samples from the near-
20 surface transect are not statistically different from one another, these three to six samples
21 will be treated as replicates for subsequent analyses.

22 **A7.6.2 Evaluation of the Similarity of Near-Bottom Samples on a Transect**

23 Near-bottom samples on each transect will be compared to one another using the same
24 method used for near-surface samples.

25 **A7.6.3 Evaluation of Similarity of Near-Surface and Near-Bottom Samples on a** 26 **Transect**

27 Near-surface and near-bottom samples on each transect will be evaluated to determine
28 whether samples can be pooled across depths. The statistical method used for this
29 evaluation depends on whether the near-surface samples can be pooled together, and
30 whether the near-bottom samples can be pooled together. If the near-surface samples
31 can be pooled and the near-bottom samples can be pooled, then a two-sample t -test (or
32 nonparametric equivalent) will be used to compare the two groups of samples. When

¹⁵ Each statistical test has an associated null hypothesis; the p -value is the probability that the sample could have been from the population(s) being tested given the assumption that the null hypothesis is true. A p -value of 0.05, for example, indicates that there would be only a 5 percent chance of collecting the sample being tested if the null hypothesis were actually true.

either the near-surface samples cannot be pooled or the near-bottom samples cannot be pooled, the cause might be distinct conditions near either bank (e.g., as might be the case downstream of a tributary) or in the center. Consequently, when pooling of either all near-surface or all near-bottom samples cannot be done, the pair of near-surface and near-bottom samples from each location on the transect will be compared using a Monte Carlo permutation method. The various combinations of near-surface and near-bottom pooling conditions that may be found, and the action to be taken in each case to evaluate pooling across depth, are summarized in Table A-9. The results of these actions will include one or more of the following:

- All near-surface and near-bottom samples can be pooled across depth
- Left bank samples can be pooled across depth
- Channel center samples can be pooled across depth
- Right bank samples can be pooled across depth
- No samples can be pooled across depth.

The first and last of these results are exclusive: if either of these holds, no other result can also hold. However, the middle three results are not exclusive: more than one of these may hold. If samples can be pooled across depth (i.e., any of the first four bullets above), those samples will be treated as replicates for further data analyses.

A7.6.4 Evaluation of Similarity across Transects

COI concentrations may vary between transects as a result of both temporal variation in the characteristics of water entering the study area at its upper boundary and as a result of processes within the study area that add COIs to, or remove COIs from, the water column. Water entering the site will be characterized by measurements made in a time series at the Waneta, B.C., sampling station. The time series of grab samples to be collected at Waneta is intended to help distinguish potential temporal variation upstream of the Site from spatial variation within the Site during the time period sampled. The similarity of water from different transects will be evaluated relative to both the temporal variability of incoming water and the possible influence of factors within the site that alter water quality characteristics. Transects will be considered equivalent if chemical concentrations are not statistically significantly different from one another (Figure A-15, Table A-10) or if the CV of concentrations of individual chemicals between them is equivalent to the CV of concentrations in water entering the site. Homogeneity of the coefficients of variation will be tested between transects within the study area and Waneta data (Zar 1996). Samples from different transects will also be

1 directly compared to one another using an analysis of variance (ANOVA) (or a
2 nonparametric equivalent).

3 Comparisons of data from different transects will be carried out for all subsets of
4 transect data that can be pooled equivalently on adjacent transects. Table A-10
5 summarizes the comparisons that will be performed depending on if or how samples
6 can be pooled across depth on each of two adjacent transects. In addition to the
7 conditions shown in Table A-10, comparisons will also be performed if laterally distinct
8 (left bank, center, or right bank) near-surface and near-bottom samples can be pooled
9 equivalently on adjacent transects. Comparisons will be performed over the largest
10 possible number of adjacent transects with equivalently pooled results—for example, if
11 all near-surface samples can be pooled on each of four adjacent transects, then the
12 equivalence of near-surface samples on all four transects will be tested.

13 Extension or modification of this general testing approach will be carried out as needed,
14 as dictated by characteristics of the data collected (e.g., use of transformed data).
15 Additional analyses, such as a factorial ANOVA, may be carried out to evaluate whether
16 the variability between depths and between transects is equivalent, if sufficient
17 replication within transects is found to be appropriate. To ensure a balanced design,
18 field replicates and triplicates will be averaged prior to the ANOVAs. Additional
19 replication in the form of field splits and replicate laboratory analyses will be carried out
20 as part of the quality control program; these will also be averaged prior to statistical
21 analyses. Data will be averaged first across laboratory replicates, then across field splits,
22 and then across field replicates and triplicates prior to the statistical analyses. If only
23 one of any pair of splits or replicates or if one or more of the triplicates is undetected,
24 then one-half of the detection limit for the undetected value will be averaged with the
25 detected replicate or triplicate. If a fraction of any set of replicates or triplicates to be
26 used for statistical testing is undetected, regression on order statistics or a comparable
27 estimation method (Helsel 2005) will be used to estimate values for the undetected
28 measurements.

29 After an appropriate estimate of variability has been established for each sample or for
30 group of samples, the key study questions will be evaluated as described in the
31 following sections. When surface water samples can be pooled, the analysis will be
32 carried out for each set of pooled samples, and the individual samples within each
33 pooled set will be treated as replicates for the purpose of statistical comparisons to
34 benchmark values. In such cases, the comparisons will be carried out using one-sample
35 *t*-tests, with a one-sided alpha level of 0.05. The target power level for these comparisons
36 will be 80 percent. Analysis of existing water quality data from the monitoring station at

Northport indicates that this power will be achieved with sample sizes as small as two (Table A-11). Although concentrations measured in other parts of the UCR in 2009 may differ from those previously observed at Northport, this analysis indicates that a power of at least 80 percent can be achieved with an alpha level of 0.05. Initial data collection in October 2009 will allow this variability to be assessed, and sampling plans modified if necessary, prior to the next sampling event in spring 2010.

Any surface water samples that cannot be pooled with any other samples will simply be directly compared to the benchmark values. Key study questions for the ecological risk assessment are addressed below. These descriptions of the evaluation method for each type of comparison are appropriate for a set of pooled samples that is to be compared to a benchmark.

Are the Levels of COIs in Surface Water from the UCR Site Greater Than Benchmarks for the Survival, Growth, or Reproduction of Fish?

Risk assessment thresholds are expected to be set by SEVs appropriate to each species to be examined. Therefore, as for benchmark values, the following approaches will be taken: 1) for initial comparisons to SEVs, point-to-point comparisons will be compiled and reported prior to applying the decision framework (Table A-8); 2) for baseline evaluations, a one-sample Student's *t* test will be conducted with a one-sided null hypothesis that the site data are less than or equal to the SEV; 3) to assist interpretation of the *t*-test results, the upper 95 percent confidence limit on measured concentrations will be reviewed relative to the SEVs.

An experiment-wise false rejection probability (alpha) of 0.05 will be used. If the data are not normally distributed, or cannot be transformed to be normal using a logarithmic or Box-Cox transformation, a nonparametric Wilcoxon test will be used instead of the *t*-test. The 90th percentile of the differences between field replicates or triplicates will be used as the minimum detectable difference (MDD) for which the power of the *t* test will be evaluated. The comparison-wise false acceptance error rate must be no more than 0.20 for results that are greater than the SEV by more than the MDD, but are not significantly different from the SEV. Results that do not meet this false acceptance error criterion will be regarded as inconclusive.

Do COI Concentrations in Surface Water Pose Unacceptable Risk to Aquatic Life and Wildlife through Direct Contact or Ingestion?

The approach to be followed for aquatic life and wildlife is identical to that previously described for fish, with the substitution of SEVs appropriate for each fish species.

Do COI Concentrations in Surface Water Pose an Unacceptable Risk to Aquatic Life and Wildlife Through Food Chain Transfer?

If the hazard quotient for a COI and receptor is greater than 1.0, based on exposure via a food web model, the food web model will be applied in a Monte Carlo fashion to evaluate the incremental risk of the COI concentration in surface water. That is, the model will be run with and without the surface water pathway, using site data to characterize surface water exposure. The difference in hazard quotient distributions with and without the surface water pathway represents the incremental risk due to the COI concentration in surface water. The difference in mean hazard quotient values will be tested to determine if it is statistically significantly different from zero, using a two-sample one-sided *t* test (or nonparametric equivalent) of the hazard quotient distributions, at an experiment-wise false rejection probability of no more than 0.05.

A7.7 Step 7—Develop the Plan for Obtaining Data

A summary of the output from this DQO process is provided in Table A-8, and detailed discussions of the various study components are presented in Sections A7 and B of this document.

A8 SPECIAL TRAINING/CERTIFICATES

Teck has assembled a technical team with the requisite experience and technical skills to successfully complete the 2009/2010 surface water study. All technical team personnel involved in sample collection have extensive environmental sampling experience. Minimum training and certification requirements for laboratory personnel will be provided in the laboratory QA plans (to be submitted under separate cover).

Sampling personnel who enter the exclusion zone and contaminant reduction zone (see Appendix A, Attachment A1 for definition and discussion of these zones) will be required to have completed the 40-hour Hazardous Waste Operations and Emergency Response standard training course and 8-hour refresher courses (see draft general site health and safety plan [SHSP] [TCAI 2007] for further explanation). The training provides employees with knowledge and skills that enable them to perform their jobs safely and with minimum risk to their personal health. Training is also consistent with the requirements of the Washington Industrial Safety and Health Act. Documentation of course completion will be maintained in personnel files.

A9 DOCUMENTATION AND RECORDS

Records will be maintained to document all activities and data associated with field sampling and with chemical analysis at the laboratories. Results of data verification and validation activities will also be documented. Procedures for documentation of these activities are described in this section. Components of field documentation are discussed in Section 3 of the FSP (Appendix A).

The QAPP, FSP (Appendix A), SHSP (TCAI 2007), and the SHSP addendum (Attachment A1 to Appendix A) will be provided to each person listed in Section A3. Any revisions or amendments to any of the documents that make up the FSP will also be provided to these individuals.

The reporting schedules are discussed further in the RI/FS work plan and in Section 5.3 of the FSP (Appendix A).

A9.1 Field Documentation

The Teck technical team field supervisor will ensure that the field team receives the final approved version of the QAPP (including the FSP and SHSP) prior to the initiation of field activities. A relational database will be used to manage the field data as described in the RI/FS work plan. Field records that will be maintained include the following:

- Field logbooks
- Photo documentation
- Field data forms
- Sample tracking/chain-of-custody (COC) forms.

The content and use of these documents are described in Section 3 of the FSP. The field reporting schedules are discussed further in Section 5.3 of the FSP (Appendix A).

A9.2 Laboratory Documentation

All activities and results related to sample analysis will be documented at each laboratory. Internal laboratory documentation procedures will be described in the laboratory QA plans (to be submitted following laboratory selection).

The analytical chemistry laboratory will provide a data package for each sample delivery group or analysis batch that is comparable in content to a full Contract Laboratory Program package. It will contain all information required for a complete QA review, including the following:

- 1 • A cover letter discussing analytical procedures and any difficulties that were
2 encountered
- 3 • A case narrative referencing or describing the procedures used and discussing
4 any analytical problems and deviations from SOPs and this QAPP
- 5 • COC and cooler receipt forms
- 6 • A summary of analyte concentrations (to two significant figures for results < 10,
7 three significant figures for results > 10), MRLs, and method detection limits
8 (MDLs)
- 9 • Laboratory data qualifier codes appended to analyte concentrations, as
10 appropriate, and a summary of code definitions
- 11 • Sample preparation, digestion, extraction, dilution, and cleanup logs
- 12 • Instrument run logs
- 13 • Initial and continuing calibration data, including instrument printouts and
14 quantification summaries, for all analytes
- 15 • Results for method and calibration blanks
- 16 • Results for all QA/QC checks, including serial dilutions, laboratory control
17 samples (LCSs), matrix spike samples, laboratory duplicate or triplicate samples,
18 and any other QC procedures required by applicable method protocols and
19 laboratory SOPs
- 20 • Original data quantification reports for all analyses and samples
- 21 • All laboratory worksheets and standards preparation logs.

22 Full laboratory data reports will be provided in both hard copy and electronic format to
23 the task QA coordinator, who will oversee data verification and validation and for
24 archiving the final data and data quality reports in the project file. Electronic data
25 deliverables (EDDs) will be in spreadsheet format and will be compatible with the Teck
26 technical team's database. A relational database will be used to manage the laboratory
27 data as described in the RI/FS work plan.

28 **A9.3 Data Quality Documentation**

29 Data verification (i.e., confirming the accuracy and completeness of field and laboratory
30 data) will be completed by the Teck technical team for data generated in the field, and
31 by each laboratory for the data that it generates. Data validation and data quality
32 assessment for this task will be completed by an independent validation firm and
33 provided to the task QA coordinator.

- 1 The accuracy of the laboratory EDDs will be verified by, or under the direction of, the
- 2 database administrator. All changes to data stored in the database will be recorded in
- 3 the database change log. Any data tables prepared from the database for data users will
- 4 include all qualifiers that were applied by the laboratories and during data validation.

SECTION B: DATA GENERATION AND ACQUISITION

B1 SAMPLING PROCESS DESIGN AND RATIONALE

As previously stated, the overall objective of the 2009/2010 surface water study is to generate data for the assessment of risks to ecological receptors and people. The detailed sampling design and rationale are provided in this section.

B1.1 Sampling Locations

B1.1.1 Transects within the Site

The following factors were considered when selecting locations of transects for sampling:

- **Hydrodynamic regime:** Water currents can resuspend sediment-bound COIs depending on physical characteristics of the sediment. Therefore, transects were located over the range of assumed hydrodynamic conditions, including in the riverine reach and in the lacustrine portion of the Site.
- **Existence of historical surface water data.** Expanding the data record where existing historical data were collected was considered a priority to improve the evaluation of temporal variability in COI concentrations. Consequently, sampling at Northport was considered a priority.
- **Existence of historical sediment and fish tissue data.** Creation of a comprehensive data set in concentrated areas of the UCR will be beneficial when multiple lines of evidence are evaluated to determine whether unacceptable risks to ecological receptors or people are present. Consequently, collection of samples along transects sampled by EPA during the Phase I sediment investigation, and within EPA focus areas where fish tissues were also collected, was considered a priority.
- **Sources of COIs:** COIs may enter the UCR water column from two general sources—sediment resuspension and tributaries—both of which were considered when selecting transect locations. Additional pathways of COI entry, including porewater flux/groundwater discharge and releases of bank storage, are also possible sources of COIs to the UCR. Erosion of soils in the UCR drainage basin may also contribute to conditions in the UCR. Sediments may be resuspended by fast-moving water (particularly in the riverine reach where water current velocities are assumed to be the highest), by wave action and reservoir drawdown (in nearshore areas), and by biological activity, especially in areas with fine-grained sediments. The tributary with the greatest potential to contribute COIs in surface water is the Spokane River, primarily because of its

1 upriver municipalities and historical mining activities. Transect locations were
2 placed in areas potentially influenced by these various sources.

3 • **Variability in water column COIs.** COI concentrations in water entering the site
4 from B.C., the major tributaries (see Appendix D), and Northport, Washington
5 do not exhibit substantial geographic variability. Consequently, surface water
6 samples will be collected along transects representing broad reaches of the Site.

7 • **Variability in sediment-bound COIs.** The existing sediment data set contains
8 substantial variability in the concentrations and relative distributions of metals
9 (Figures A-8 through A-13). Metals associated with granulated slag tend to be
10 elevated in sediments from the border to Marcus Flats. In the lacustrine portion
11 of the UCR, fine-grained sediments tend to have elevated cadmium and mercury
12 concentrations. Surface water data will be collected in the riverine and lacustrine
13 portions of the Site along transects where the relative concentrations of sediment
14 COIs differ with depth and sediment grain size.

15 Samples will be collected along eight transects that run perpendicular to the shoreline,
16 from the U.S.-Canadian border through Plum Point (upstream of Grand Coulee Dam)
17 (Figure A-7). The rationale for each transect is provided in Table A-12. In addition,
18 most of these transects correspond to transects where sediment samples were collected
19 by EPA in 2005 (USEPA 2006e). Sediment grain size (as percent fines) and COI
20 concentrations vary along these transects as shown in Figures B-1 through B-7. Each is
21 briefly described below:

22 • **Transect TC9 (RM 745 at the border):** At the border, one sample was collected
23 in the channel and single samples were collected in shallower areas on either side
24 of the channel by USEPA. All samples had low percent fines. Concentrations of
25 copper and zinc were considerably elevated at the mid-channel station, and were
26 higher at the shallow station along the western shoreline than at the shallow
27 station along the eastern shoreline.

28 • **Transect TC1 (RM 734 at Northport; Figure B-1):** Water depth was similar for
29 the two samples collected at RM 734 by EPA. Both samples had low percent
30 fines; however, the sample with greater percent fines also had higher
31 concentrations of metals.

32 • **Transect TC2 (RM 724 at China Bend; Figure B-2):** Although water depth was
33 similar for the three sediment samples collected by EPA at RM 724, the range in
34 percent fines was greater than at Northport. The relative distributions of metals
35 associated with granulated slag were similar whereas mercury was considerably
36 more elevated at the mid-channel station.

- 1 • **Transect TC3 (RM 704 at Marcus Flats; Figure B-3):** Marcus Flats is also a
2 relatively shallow part of the Site. Metals typically associated with granulated
3 slag (i.e., copper, zinc, and lead) had the greatest concentrations in the thalweg
4 where sediments were coarsest. Cadmium and mercury followed a different
5 spatial trend.
- 6 • **Transect TC4 (RM 678 upstream of Inchelium; Figure B-4):** Below Kettle Falls,
7 Lake Roosevelt becomes substantially deeper and wider, and offshore sediments
8 tend to be much finer. Nearshore sediments tend to be coarser than offshore
9 sediments and have lower metals concentrations. Concentrations of cadmium,
10 lead, and zinc at RM 678 had relative distributions that were similar to each
11 other.
- 12 • **Transect TC5 (RM 642 upstream of Spokane River; Figure B-5):** As for
13 Inchelium, metals concentrations were lowest in nearshore areas where sediment
14 grain size was coarser than in deep water areas. Cadmium, lead, mercury, and
15 zinc had similar relative distributions among stations.
- 16 • **Transect TC6 (RM 637 downstream of Spokane River; Figure B-6):** Trends in
17 concentrations below the confluence with the Spokane River were similar among
18 metals. Concentrations were lower in shallower waters with coarser sediments.
- 19 • **Transect TC7 (RM 605 Plum Point; Figure B-7):** Similar trends in metals
20 distributions among stations along this transect were observed, with low
21 concentrations associated with coarse-grained sediment.

22 Three samples not associated with a surface water sampling transect will also be
23 collected. These samples will be collected at Black Sand Beach (sampling location TC-8)
24 off the left river bank (looking downriver) following sediment disturbance. These data
25 will be representative of incidental ingestion while wading and in-water play to support
26 the HHRA.

27 **B1.1.2 Samples Collected in Canada**

28 Two sets of surface water samples will be collected in Canada to help with interpretation
29 of Site data. A surface water transect (CAN1) will be located at Birchbank, B.C.
30 (RM 762). This location is downriver from Castlegar, B.C., and upriver of Trail, B.C. A
31 nearshore station (CAN2) will be located at Waneta, B.C. (RM 746). Samples at CAN2
32 will be collected weekly before each sampling event within the Site. The duration of this
33 weekly sampling will correspond to the average hydraulic residence time for water
34 entering the Site at the time of the UCR survey; because the hydraulic residence times of
35 the three planned surveys will differ, the number of weeks over which sampling will
36 occur at Waneta prior to each survey will also differ. These data will represent the likely
37 range of upstream water quality conditions just before the time of the survey.

B1.2 Locations of Samples along Transects within the Site

Samples will be collected along each transect to generate data to assess exposure to aquatic receptors, aquatic-dependent wildlife, and people. The exposures in the preliminary CSM that each sample will be used to assess are shown in Table A-12.

One undisturbed sample will be collected at each end of each transect, in shallow nearshore water roughly 0.5 m deep. These samples will provide exposure information for nearshore receptors (both aquatic and water-dependent) and human health. Three additional nearshore samples will be collected at each end of each transect following sediment disturbance to support an additional exposure scenario in the HHRA. Three or four pairs of near-surface (~1 m below the water surface) and near-bottom (~1 m above the sediment surface) samples will be collected to assess risk to plankton, pelagic and demersal fish (e.g., burbot), and aquatic-dependent wildlife. The rationale for sampling at each these water depths is provided below:

Undisturbed nearshore: Undisturbed nearshore samples (i.e., sediment will not be disturbed prior to the collection of these samples) will be collected from the midpoint of the water column in shallow water approximately 0.5 m deep. Minnows, juvenile fish, and rapidly-colonizing invertebrates may inhabit nearshore water, and aquatic-dependent wildlife and people may also come into contact with nearshore surface water. This water depth is sufficient to permit sampling using either a peristaltic pump with tubing or a bottle; a bottle could not be used in shallower water. The midpoint of this sampling depth will be targeted for sample collection because it is close to both the water and sediment surfaces and is expected to represent the conditions to which receptors would be exposed. Because these samples will be located in shallow water, their geographic locations over the three sampling periods are expected to differ (i.e., they will be relocated along the transect perpendicular to the shoreline) as river and pool elevation rises and falls.

Disturbed nearshore: Surface water samples will be collected from approximately 0.25 m below the water surface following sediment disturbance that would reflect shallow water (i.e., 1 m) play during recreation or other nearshore human activity, to support the HHRA. Sampling will be conducted 0.25 m below the water surface to reflect the depth most likely associated with incidental ingestion. Three discrete samples will be collected at each end of each transect at each nearshore location and at Black Sand Beach to represent a range of potential exposures. Disturbed nearshore water samples will be collected after all undisturbed nearshore samples have been collected.

1 **Offshore near-surface:** Near-surface samples will be collected approximately 1 m below
2 the water surface. This depth will ensure samples are collected beneath floating debris
3 and beneath a surface microlayer if it exists. This depth is considered representative of
4 water to which aquatic-dependent wildlife and people may be exposed, is within the
5 photic zone occupied by plankton, and is within the vertical column occupied by pelagic
6 fish.

7 **Offshore near-bottom:** Near-bottom samples will be collected approximately 1 m above
8 the sediment surface; collection of surface water closer to the sediment surface via
9 peristaltic pump with tubing or a bottle is not considered feasible because of elevated
10 water currents, obstructions, and debris. Near-bottom water data will be used to
11 evaluate exposure to demersal fish (e.g., burbot). The near-bottom data may also
12 provide information on potential resuspension of sediments and the release of COIs
13 from the sediment; however, these are not primary objectives of this data collection
14 effort. Specific DQOs related to sediments as sources of COIs to the water column will
15 be presented in a QAPP for sediment sampling.

16 As noted in Section B1.1.1 of this QAPP, one of the considerations for placement of the
17 seven transects was variability in sediment concentrations as determined by EPA's
18 Phase I study (e.g., Figures A-8 through A-13). Variability in sediment COI
19 concentrations was also considered during placement of the offshore stations (composed
20 of one near-surface sample and one near-bottom sample) along each transect.
21 Figures B-1 through B-7 demonstrate considerable variability in COI concentrations
22 along each transect. In the lacustrine portion of the Site, concentrations were often
23 highest on either side of the thalweg (i.e., the deepest portion of the site where the
24 former river channel was located; for example, Transects TC5, TC6, and TC7 [Figures B-5
25 through B-7], respectively)). Closer to the riverine portion of the Site, concentrations of
26 some metals were highest in the thalweg (e.g., copper, lead, and zinc along Transect TC3
27 [Figure B-3]; copper along transect TC4 [Figure B-4]). In response to the observed trends
28 in sediment COI concentrations, offshore surface water stations were placed at the
29 thalweg and at two or three other offshore locations along each transect. The non-
30 thalweg stations were generally situated in areas where the slope of the sediment bed is
31 relatively flat because it is assumed that these areas may accumulate more sediment
32 than areas on steep slopes. Nearshore stations will be located close to shore in 0.5 m of
33 water. Undisturbed nearshore station locations to support the ecological risk assessment
34 and disturbed nearshore samples to support the HHRA will move along the transect
35 depending on water elevation at the time of each sampling event.

Station placement along each transect is shown on cross-sectional figures (Figures B-8 through B-14). Each cross-section was generated from historical bathymetric records. The rationale for station placement along each transect is described below and summarized in Table A-12.

Transect TC-9 (Appendix A Figure 1-3h). Transect TC9 is located at RM 745, at the international border in Reach 1 (i.e., the riverine portion of the Site).¹⁶ Consequently, little vertical change in water elevation is expected relative to the lacustrine portion of the Site. The nearshore stations will be located along either end of the transect in 0.5 m of water. Their locations may have minor adjustments along the transect in response to varying river elevation over the course of the study to ensure that samples are collected in 0.5 m of water. Offshore stations are located at the thalweg, which is on the left side of the river (looking downstream), and at two stations to the right of the thalweg in deep areas of the river.

Transect TC1 (Figure B-8 and Appendix A Figure 1-3a). Transect TC1 is located at RM 734 (Northport), which is in Reach 1 (i.e., the riverine portion of the Site). Consequently, little vertical change in water elevation is expected relative to the lacustrine portion of the Site. The nearshore stations will be located along either end of the transect in 0.5 m of water. Their locations may have minor adjustments along the transect in response to varying river elevation over the course of the study to ensure that samples are collected in 0.5 m of water. The offshore stations are located equidistantly across the river because the depth of the river channel is relatively uniform (i.e., a distinct deep thalweg is absent).

Transect TC2 (Figure B-9 and Appendix A Figure 1-3b). Transect TC2 is located at RM724 (China Bend) in Reach 2 (i.e., the riverine portion of the Site). A thalweg is evident at this transect. Offshore stations are located at and to the right of the thalweg (when looking downriver). Because the thalweg is adjacent to the left bank when pool elevation is low, there is no offshore station to the left of the thalweg. The nearshore stations, especially the station to the right of the thalweg, will move several hundred meters toward the thalweg at low pool to remain in 0.5 m of water.

Transect TC3 (Figure B-10 and Appendix A Figure 1-3c). Transect TC3 is located at RM 704 (Marcus Flats) in Reach 3 (i.e., the transitional portion of the Site). The transect is located between the confluence of the Kettle River and Kettle Falls. There are periodic changes in sediment bed elevations across the transect that may correspond to drainage

¹⁶ The proposed sampling location for TC9 is located in a high energy environment at close proximity to a rock outcrop. Should the field crew determine that this location presents difficult sampling conditions, the transect may need to be relocated downstream.

1 channels, and stations are located in these areas to ensure that samples can be collected
2 at low pool. Nearshore stations will also move along the transect to remain in 0.5 m of
3 water.

4 **Transect TC4 (Figure B-11 and Appendix A Figure 1-3d).** Transect TC4 is located in
5 Reach 4 above Inchelium in the lacustrine portion of the Site. This transect is
6 characterized by a deep thalweg (~180 ft deep) and a broad bench to the left of the
7 thalweg. Offshore samples are placed at the thalweg, over the broad bench to the left of
8 the thalweg, and over a smaller bench feature to the right of the thalweg where slopes
9 are relatively flat. Given the rather steep nearshore topography to the right of the
10 thalweg, the location of the nearshore sample on the right bank will not change
11 appreciably with pool elevation; that on the left bank will be relocated by several
12 hundred feet.

13 **Transect TC5 (Figure B-12 and Appendix A Figure 1-3e).** Transect TC5 is also located
14 in Reach 4, and upstream of the confluence with the Spokane River. There is a
15 pronounced thalweg extending to a depth of approximately 250 feet along this transect.
16 Samples will be taken at and along either side of the thalweg. The nearshore stations,
17 especially along the left bank, will move considerably toward the thalweg during the
18 sampling at low pool.

19 **Transect TC6 (Figure B-13 and Appendix A Figure 1-3f).** Transect TC6 is located in
20 Reach 5, and downstream of the confluence with the Spokane River. A pronounced
21 thalweg exists to a depth of nearly 300 ft. Offshore samples will be placed at the thalweg
22 and to its left. Offshore samples will not be placed to the right of the thalweg because of
23 the steep slope. Nearshore stations will be sampled along both banks; the nearshore
24 sample along the right bank will move considerably toward the thalweg during low
25 pool sampling.

26 **Transect TC7 (Figure B-14 and Appendix A Figure 1-3g).** Transect TC7 is located in
27 Reach 6 near Plum Point. Along this transect, the thalweg reaches a depth of
28 approximately 350 ft. Offshore samples will be placed at the thalweg and at benches on
29 either side of the thalweg. The nearshore sample along the right bank will move several
30 hundred meters toward the thalweg at during the low pool sampling.

31 **B1.3 Locations of Samples Collected in Canada**

32 Transect CAN1 (Figure B-15 and Appendix A Figure 1-3j) is located at RM 762 and is
33 upstream of the Trail facility. Two sets of offshore stations are located equidistantly
34 across the river because the depth of the river channel, based on available bathymetric
35 data, appears to be relatively uniform. Samples will be collected from near-surface (i.e.,

1 1 m below the surface) and near-bottom (i.e., 1 m above the water–sediment interface)
2 water. Nearshore stations will be located along either end of the transect in 0.5 m of
3 water. Their locations may have minor adjustments along the transect in response to
4 varying river elevation over the course of the study to ensure that samples are collected
5 in 0.5 m of water.

6 The grab samples collected at Station CAN2 (Figure A-7) at Waneta, B.C., will be
7 collected from a shoreline location at approximately RM 746.

8 **B1.4 Sampling Events**

9 With the exceptions of the individual grab samples at Waneta, B.C., which will be
10 collected weekly prior to the initiation of each of the three sampling events in the Site,
11 each station will be sampled once during each of three sampling events. Sampling
12 events are timed to correspond with different water flow conditions and pool elevations
13 (Figure A-6) that may influence COI concentrations in surface water in the UCR. These
14 time periods are as follows:

- 15 • Mid-October 2009: The first sampling event, between October 8 and 22, will
16 provide data representing low flows and stable pool elevations in Lake Roosevelt
17 when water column productivity is still high.
- 18 • Late March/early April 2010: The second sampling event, between March 28 and
19 April 8, will coincide with the final stage of the spring drawdown, when the
20 water level in Lake Roosevelt is nearly at low pool.
- 21 • Late May/early June 2010: The third sampling event, between May 27 and June
22 10, will coincide with high flows on the UCR due to snowmelt within the
23 drainage basin of the Columbia River, and the associated increase in pool
24 elevation.

25 Surface water data collected from the Columbia River at Waneta, B.C., just north of the
26 study area, were evaluated to determine whether there are other times of the year at
27 which COI concentrations are elevated in water entering the site. Data collected
28 between 1995 and 2007 were evaluated. Data from each year of sampling were
29 aggregated to produce a weekly average value for each COI. Data from all years were
30 then combined to calculate the mean and variance of each COI concentration for each
31 week of the year. These data were plotted to evaluate the seasonal changes in COI
32 concentrations relative to the sampling times. Results are shown in Figures A-14a
33 through A-14f. Error bars on these figures represent 95 percent confidence limits on the
34 mean. Maximum concentrations of metals are generally found in either April or June,
35 and lower concentrations are usually found in October. The proposed schedule of

sampling events therefore will include likely periods of elevated COIs in surface water of the study area.

B1.5 Sample Type

All samples will be discrete samples (i.e., samples will not consist of water collected from more than one sampling location). Depending on the volume of water required and the sampling equipment used, water from one or more grabs at an individual station may need to be composited, or water from a designated time period may need to be collected using a peristaltic pump and tubing, to obtain an adequate sample volume. Detailed information on sample compositing is provided in Appendix A.

B2 SAMPLING METHODS

Field sampling methods are described in Section 2 of the FSP (Appendix A) and include the following topics:

- Field equipment and supplies (Section 2.2.3)
- Station positioning (Sections 2.2.4)
- Sampling methods (Section 2.2.5)
- Sample containers and labels (sample labels, sample identifiers, custody seals, sample custody/tracking procedures) (Section 3)
- Field documentation and procedures (field logbooks, photo documentation, COC form) (Section 3).

SOPs for each sampling method are provided in Attachment A2 to the FSP.

In the event that unanticipated or changed circumstances occur in the field, the field supervisor will institute the necessary corrective actions, complete a corrective action record (see Appendix A, Attachment A3), and ensure that the appropriate procedures are followed. If corrective actions require a departure from the FSP, these changes will be documented on a field change request form (see Appendix A, Attachment A3). In any other circumstances where sampling conditions are unexpected, the appropriate sampling actions consistent with this task's objectives will be conducted. This change will be noted in the field log, and a change request form will be completed for the project files. Any problems that cannot be easily resolved or that affect the final quality of the work product will be brought to the attention of the Teck technical team coordinator and Teck project coordinator. EPA will be notified of any problems that may affect the final outcome of this task, according to the Agreement. Additional

information regarding corrective actions and related documentation is provided in Section C1.

To measure low levels of organic compounds in surface water, high volume sampling techniques may be employed. High volume sampling is planned for PCB congeners and is discussed in the FSP (Appendix A). If high volume sampling is necessary for other parameters, similar methods will be used.

B3 SAMPLE HANDLING AND CUSTODY

Requirements for sample containers, sample preservation, storage temperature, and holding times are summarized in Table B-1. All containers for samples submitted for chemical analyses will have screw-type lids to ensure adequate sealing.

Commercially available, precleaned bottles will be used for chemistry samples, and the laboratory will maintain a record of certification from the suppliers. The bottle shipment documentation will record batch numbers for the bottles. With this documentation, bottles can be traced to the supplier. The bottle documentation from the laboratory will be included in the project file.

Principal documents used to identify samples and to document possession will be field logbooks and COC records. Custody will be documented for all samples at all stages of the analytical or transfer process. COC procedures for sample handling prior to delivery to the laboratories are outlined in Sections 2.3, 2.4, and 3.2 of the FSP.

Upon receipt of samples at each laboratory, the physical integrity of the containers and seals will be checked, and the samples will be inventoried by comparing sample labels to those on the COC forms. The laboratory will include the COC and shipping container receipt forms in the data package. Any breaks in the COC or nonconformances will be noted and reported in writing to the laboratory coordinator within 24 hours of receipt of the samples. Each laboratory QA plan (to be provided under separate cover) includes procedures used for accepting custody of samples and documenting samples at the laboratory. The laboratory project manager will ensure that a sample-tracking record is maintained; this record will follow each sample through all stages of sample processing at the laboratory.

Samples will be stored in accordance with Table B-1. Samples for chemical analyses will be stored under refrigeration ($4 \pm 2^{\circ}\text{C}$). Laboratories will maintain COC documentation and documentation of proper storage conditions for the entire time that the samples are in their possession.

The laboratories will not dispose of the samples for this task until authorized to do so by the task QA coordinator. The laboratories will dispose of samples, as appropriate, based on analytical results, and information received from the client.

B4 ANALYTICAL METHODS

Surface water samples collected for this study will be analyzed for field and chemical parameters including dissolved and total metals and metalloids, conventional parameters, and nutrients and major ions as shown in Table A-7 and as listed in Section A6.2. Selected other metals and metalloids will be analyzed in samples collected from transects at Northport (TC1), Marcus Flats (TC3), Inchelium (TC4), downstream of the Spokane River (TC6), and at Birchbank (CAN1). Organic compounds and analytes unique to the beach sampling effort (e.g., radionuclides) will be analyzed in samples in one near-surface and one near-bottom sample at the thalweg of each transect, in one undisturbed nearshore sample from each transect, in one disturbed-sediment surface water sample from stations proximate to beach sampling locations (TC1, TC2, TC3, TC6, and TC7), in one disturbed-sediment surface water sample from Black Sand Beach (TC8), and in all samples from Birchbank (CAN1). Field parameters (i.e., temperature, pH, dissolved oxygen, conductivity, turbidity, and ORP) will be measured *in situ* at all sampling locations. (Note: Upon returning from the field, field staff will calculate Eh from ORP readings.)

Laboratory methods that will be used to complete the respective analyses are described below.

B4.1 Chemical Analyses

Surface water samples will be analyzed for dissolved and total metals and metalloids, organic compounds, conventional parameters, and nutrients and major ions.

Consistent with the DQOs identified in Section A7, the analytical concentration goals for the 2009/2010 surface water study are lower than conservative benchmarks and literature-derived values for aquatic and terrestrial ecological receptors and human health. To determine the reporting limit goals, available guidelines and historical reporting limits were compiled and compared to the expected reporting limit. For aquatic ecological receptors, reporting limit goals were developed using the EPA National Aquatic Life Chronic Criteria (USEPA 2006b), Colville Confederated Tribes Aquatic Life Chronic Criteria (40 CFR 131.35), the Ecology Aquatic Life Chronic Criteria (WAC 173-201A), and the Spokane Tribe of Indians Aquatic Life Chronic Criteria (Spokane Tribe of Indians 2003). Wildlife drinking values are from Oak Ridge National

Laboratory Toxicological Benchmarks for Wildlife: 1996 Revision (ORNL 1996). EPA provided risk-based concentrations for human health (Woodbury 2008, pers. comm.). Reporting limits from Paulson et al. (2006) were also tabulated because they include metals not routinely analyzed and for which SEVs are lacking. To allow future comparisons of data collected by this surface water study with the Paulson et al. (2006) data, analytical concentration goals also consider the reporting limits generated by Paulson et al. (2006).

The screening values and required MRLs for samples collected during the 2009/2010 surface water study are provided in Table B-2. The goal is for MRLs from the analytical laboratories to be equal to or below one-fifth of the lowest screening value for each analyte.

MRLs are generally equivalent to the concentration of the lowest calibration standard (i.e., the practical quantification limit) and represent the low end of the calibration range. Analytes that are detected at concentrations below the reporting limit but above the detection limit will be reported, but will be qualified as estimated (i.e., a “J” qualifier will be applied to the result by the laboratory).

Laboratory methods for sample preparation and analysis are summarized in Table A-7 and described in the following sections. Sample containers, preservation, and holding times are provided in Table B-1.

B4.1.1 Total Recoverable and Dissolved Metals

Standard metals and metalloids (EPA TAL metals), molybdenum, and uranium will be analyzed in samples collected at all of the stations. Selected other metals (i.e., bismuth, boron, cerium, cesium, dysprosium, erbium, europium, gadolinium, gallium, germanium, gold, holmium, indium, lanthanum, lithium, lutetium, neodymium, niobium, praseodymium, rubidium, samarium, scandium, strontium, tantalum, tellurium, terbium, thorium, thulium, tin, titanium, tungsten, ytterbium, yttrium, and zirconium) will be analyzed in samples collected at all stations at Transects TC1, TC3, TC4, TC6, and CAN1.

Three methods will be used to analyze samples for total recoverable and dissolved metals and metalloids (Table A-7). Digestion with nitric and hydrochloric acids will be used to prepare samples for analysis of metals other than mercury. Analysis for these metals and metalloids will be completed by inductively coupled plasma/mass spectrometry (ICP/MS) and inductively coupled plasma/atomic emission spectrometry (ICP/AES), according to EPA Methods 6020 and 6010B, respectively.

Mercury samples will be oxidized with the addition of bromine chloride and analyzed by stannous chloride reduction, followed by gold amalgamation, thermal desorption, and atomic fluorescence spectroscopy according to EPA Method 1631.

B4.1.2 Organic Compounds

Organic compounds will be analyzed in samples collected at near-surface and near-bottom thalweg (or mid-channel) stations and at one undisturbed nearshore station at each transect (TC1–TC7, TC-9; 24 samples) within the Site, in one disturbed-sediment surface water sample from stations proximate to beach sampling locations (TC1, TC2, TC3, TC6, and TC7), in one disturbed-sediment surface water sample from Black Sand Beach (TC8), and in all samples collected along Transect CAN1 (6 samples).

Pesticides will be extracted from samples using a separatory funnel or continuous liquid-liquid extraction. Florisil® column cleanup will be performed on the sample extracts. Samples will be analyzed by gas chromatography with an electron capture detector (GC/ECD) according to EPA Method 8081B. Aroclor standards will be analyzed as interference checks to evaluate the pesticide chromatograms for PCB interferences, as described in EPA Region 10 guidance for organochlorine pesticide analysis (USEPA 2006f). PCB interference check standards will be analyzed with each pesticide initial calibration and will be used to determine which column to use to quantify the pesticides in the case when the PCBs only interfere on one column. The PCB interference check standards will be reviewed during validation to evaluate the laboratory's quantification of pesticide results and to qualify data when interference is present. In addition, pesticide detections will be confirmed by gas chromatography/mass spectrometry (GC/MS) when sample concentrations are 1 mg/L or greater.

Sample extractions for SVOCs and PAHs will be completed using a separatory funnel or continuous liquid-liquid extraction. SVOCs will be analyzed by GC/MS according to EPA Method 8270C. Analyses for PAHs will be completed by GC/MS with selected ion monitoring (SIM) according to EPA Method 8270C-SIM.

Analyses for dioxins and furans will be completed by high-resolution gas chromatography/high-resolution mass spectrometry (HRGC/HRMS) according to EPA Method 1613B. Cleanup procedures for chlorinated dioxins and furans will include sulfuric acid cleanup and silica/carbon column cleanup. Additional cleanup procedures will be used, as necessary, to remove analytical interferences. As described in EPA Method 1613B, detection limits are calculated on an individual compound and sample basis and depend on the signal-to-background ratio for the specific labeled isomer.

Samples for PCB congener analyses will be collected using a polyurethane foam (PUF) sampling system as described in the FSP (Appendix A). The PUF sampling devices will be prepared, cleaned, and spiked with carbon-13 labeled standards by the laboratory prior to sampling. Suspended particulates will be removed by a vortex separator and extracted separately from the PUF sample; however, the extracts will be combined prior to analysis to yield total PCB congeners (i.e., the dissolved and particulate phases will not be analyzed separately). Analyses for PCB congeners will be conducted by HRGC/HRMS according to EPA Method 1668A. Gel permeation chromatography, layered acid/base/silica gel column cleanup, and Florisil® column cleanup will be performed on the sample extracts as needed. Additional cleanup procedures will be used, as necessary, to remove analytical interferences.

Analyses for PBDEs will be conducted by HRGC/HRMS according to EPA Method 1614. Layered acid/base/silica gel column cleanup, gel permeation chromatography, Florisil® column cleanup, and alumina column cleanup will be performed on the sample extracts.

B4.1.3 Conventional Parameters

Conventional parameters that will be analyzed in the surface water samples will include alkalinity as CaCO_3 , DOC, hardness as CaCO_3 , TDS, TSS, TOC, pH, and silica as dissolved SiO_2 . *Standard Methods for the Analysis of Water and Wastewater* (SM) (APHA 1998) will be used, as shown in Table A-7.

Alkalinity and hardness as CaCO_3 will be determined titrimetrically according to SM 2320B and 2340C, respectively. TDS and TSS will be determined gravimetrically according to SM 2540.

TOC and DOC will be analyzed by SM 5310C; organic carbon in surface water samples will be oxidized and the evolved carbon dioxide (CO_2) will be analyzed using an infrared detector.

B4.1.4 Stable Isotopes

Stable isotopes, including deuterium and oxygen-18, will be analyzed in all surface water samples collected within the Site. Deuterium will be analyzed using the Indiana Zinc Method and oxygen-18 will be analyzed using the CO_2 Equilibration Method.

B4.1.5 Nutrients

Nutrients to be analyzed in surface water samples include ammonia as nitrogen, nitrate, nitrite, and total phosphorus. EPA and SM methods will be used as shown in Table A-7.

Nitrate and nitrite as nitrogen will be determined by ion chromatography according to EPA Method 300.0.

Ammonia as nitrogen will be determined colorimetrically according to SM 4500-NH₃ G.
Total phosphorus will be determined colorimetrically according to EPA Method 365.3.

B4.1.6 Major Ions

Major ions to be analyzed in surface water samples include calcium, magnesium, potassium, sodium, chloride, fluoride, and sulfate. EPA and SM methods will be used as shown in Table A-7.

Chloride, fluoride, and sulfate will be determined by ion chromatography according to EPA Method 300.0.

Samples being analyzed for calcium, magnesium, potassium, and sodium will be digested with nitric and hydrochloric acids and analyzed using ICP/AES, according to EPA Method 6010B.

B4.1.7 Radionuclides

Surface water samples will be analyzed for two radionuclides: radium-226 and uranium-238. EPA methods will be used as shown in Table A-7. Radium-226 will be determined by alpha spectrometry according to EPA method 903.1. Uranium-238 will be determined by alpha spectrometry according to EPA method 908.0.

B4.2 Field Measurements

In addition to surface water collection for chemical analysis at the testing laboratory, a vertical profile of general water quality parameters (i.e., water temperature, pH, dissolved oxygen, conductivity, turbidity, and ORP) will be measured *in situ* at all sampling locations. Upon returning from the field, Eh will be calculated from ORP readings.

B5 QUALITY CONTROL

QC samples will be prepared in the field and at the laboratories to monitor the bias and precision of the sample collection and analysis procedures.

B5.1 Field Quality Control Samples

Field QC samples for this study will include field replicate samples, field triplicate samples, field split samples, and equipment rinsate blanks. In addition, the instrument used to collect water quality measurements in the field will be calibrated at the beginning and end of each sampling day.

Field replicate samples will be collected at a minimum frequency of 20 percent of the sample total (see Section 2.2.6 of Appendix A for information on sampling scheme). At a minimum, one standard reference material sample will be submitted from the field and run for each batch of samples. Field triplicate samples will be collected at all of the stations at Marcus Flats (Transect TC3) and at Birchbank, B.C. (CAN1) (see Section 2.2.6 of Appendix A for information on sampling scheme). (Note: Field triplicate samples will be collected during the first sampling event. After field triplicate data from TC3 and CAN1 are assessed, it will be determined through adaptive management whether field triplicate samples will be collected in subsequent sampling events.) Field split samples will be collected at a minimum frequency of 5 percent of the sample total (see Section 2.2.6 of Appendix A for information on sampling scheme).

Equipment rinsate blanks will be generated for all chemical parameter groups at approximately 5 percent of the surface water sampling stations. It is anticipated that three equipment rinsate blanks will be collected during each sampling event. These rinsate blanks will be collected at some of the same stations as the field replicates, thus maximizing the amount of information available to distinguish laboratory and environmental variability.

Procedures for preparing field replicate samples, field triplicate samples, field split samples, and equipment rinsate blanks are presented in Section 2.2.6 of the FSP. Validation criteria and procedures for field QC samples are described in Sections D1 and D2 of this QAPP.

B5.2 Laboratory Quality Control

Extensive and detailed requirements for laboratory QC procedures are provided in the EPA and SM methods that will be used for this study (Table A-7). Every method protocol includes descriptions of QC procedures, and many incorporate additional QC requirements by reference to separate QC sections. QC requirements include control limits and requirements for corrective action in many cases. QC procedures will be completed by the laboratories, as required in each protocol and as indicated in this QAPP.

The frequency of analysis for laboratory control samples, matrix spike samples, laboratory duplicates, and method blanks will be one for every 20 samples or one per extraction or analysis batch, whichever is more frequent. Calibration procedures will be completed at the frequency specified in each method description.

As required for EPA SW-846 methods (USEPA 2008a), performance-based control limits have been established by the laboratories. These and all other control limits specified in

the method descriptions will be used by the laboratories to establish the acceptability of the data or the need for reanalysis of the samples. Laboratory control limits for recovery of internal standards, matrix spikes, and laboratory control samples, and for relative percent difference of laboratory duplicates, are provided in the analytical laboratory's QA manual (to be submitted following laboratory selection).

B5.3 Data Quality Indicators for Laboratory

The overall quality objective for this task is to develop and implement procedures that will ensure the collection of representative data of known and acceptable quality. The QA procedures and measurements that will be used for this task are based on EPA and SM guidance. Data quality indicators such as the PARCC parameters (i.e., precision, accuracy or bias, representativeness, completeness, comparability) and analytical sensitivity will be used to assess conformance of data with quality control criteria (USEPA 2002b). Data quality indicators and quality control objectives are described in this section.

Measurement quality objectives (MQOs) for the quantitative PARCC parameters are provided in Table B-3. Definitions and levels of effort for the PARCC data assessment parameters are provided in the following sections.

Precision reflects the reproducibility between individual measurements of the same property. Precision will be evaluated using the results of laboratory duplicates, field splits, field replicates, and field triplicates. Precision is expressed in terms of the relative standard deviation for three or more measurements and the relative percent difference (RPD) for two measurements. The following equation is used to calculate the RPD between measurements:

$$RPD = \frac{|C_1 - C_2|}{(C_1 + C_2)/2} \times 100$$

Where: RPD = relative percent difference
C₁ = first measurement
C₂ = second measurement

The relative standard deviation is the ratio of the standard deviation of three or more measurements to the average of the measurements, expressed as a percentage. Completeness will be calculated as the ratio of usable data (i.e., unqualified data and

J-qualified data¹⁷) to requested data, expressed as a percentage. Additional laboratory QC procedures will be evaluated to provide supplementary information regarding overall quality of the data, performance of instruments and measurement systems, and sample-specific matrix effects.

Accuracy or bias represents the degree to which a measured concentration conforms to the reference value. The results for matrix spikes, laboratory control samples, field blanks, and method blanks will be reviewed to evaluate bias of the data. The following calculation is used to determine percent recovery for a matrix spike sample:

$$\%R = \frac{M - U}{C} \times 100$$

Where: %R = percent recovery

M = measured concentration in the spiked sample

U = measured concentration in the unspiked sample

C = concentration of the added spike

The following calculation is used to determine percent recovery for a laboratory control sample or reference material:

$$\%R = \frac{M}{C} \times 100$$

Where: %R = percent recovery

M = measured concentration in the reference sample

C = established reference concentration

Results for field and method blanks can reflect systematic bias that results from contamination of samples during collection or analysis. Detection of any target analytes detected in field or method blanks will be evaluated as potential indicators of bias.

QC samples and procedures are specified in each method protocol (Table A-7). All QC requirements will be completed by the laboratories as described in the protocols, including the following (as applicable to each analysis):

- Initial calibration
- Initial calibration verification

¹⁷ Analytes detected at concentrations between the MRL and the MDL will be reported with a “J” qualifier to indicate that the value is an estimate (i.e., the analyte concentration is below the calibration range).

- 1 • Continuing calibration
- 2 • Calibration or instrument blanks
- 3 • Method blanks
- 4 • Laboratory control samples
- 5 • Internal standards
- 6 • Serial dilutions
- 7 • Matrix spikes
- 8 • Laboratory duplicates.

9 To alert the data user to possible bias or imprecision, data qualifiers will be applied to
10 reported analyte concentrations when associated QC samples or procedures do not meet
11 control limits. Laboratory control limits for the methods that will be used for this study
12 will be provided in each laboratory's quality assurance plan, and will be submitted
13 under separate cover. Data validation criteria and procedures are described in
14 Sections D1 and D2 of this QAPP.

15 MRLs reflect the sensitivity of the analysis. Methods selected for this study are expected
16 to provide sufficient sensitivity to yield MRLs that are one-fifth of the lowest reference
17 value (Table B-2) for this study.

18 The laboratory will determine a method detection limit for each analyte, as required by
19 USEPA (2004). MDLs are statistically derived and reflect the concentration at which an
20 analyte can be detected in a clean matrix with 99 percent confidence that a false positive
21 result has not been reported. The analytical laboratory will have established MRLs at
22 levels above the MDLs for the task analytes. These values are based on the laboratory's
23 experience analyzing environmental samples, reflect the typical sensitivity obtained by
24 the analytical system, and represent the level of analyte above which concentrations are
25 accurately quantified. Analyte concentrations for this study will be reported to the
26 MDL. Analytes detected at concentrations between the MRL and the MDL will be
27 reported with a "J" qualifier to indicate that the value is an estimate (i.e., the analyte
28 concentration is below the calibration range). Non-detects will be reported at the MRL
29 and will be adjusted by the laboratory as necessary to reflect sample dilution or matrix
30 interference. For HRGC/HRMS methods (PCB congeners by EPA Method 1668A, PBDEs
31 by EPA Method 1614) sample-specific detection limits will be reported as described in
32 the EPA methods.

33 **Representativeness** and comparability are qualitative QA/QC parameters.
34 Representativeness is the degree to which data represent a characteristic of an

environmental condition. In the field, representativeness will be addressed primarily in the sampling design, by the selection of sampling sites and sample collection procedures. In the laboratory, representativeness will be ensured by the proper handling and storage of samples and initiation of analysis within holding times.

Comparability is the qualitative similarity of one data set to another (i.e., the extent to which different data sets can be combined for use). Comparability will be addressed through the use of field and laboratory methods that are consistent with methods and procedures recommended by EPA and SM.

Completeness is a measure of the amount of valid data obtained from the analytical measurement system and the complete implementation of defined field procedures. The target completeness objective will be 90 percent; the actual completeness may vary depending on the intrinsic nature of the samples. The completeness of the data will be assessed during QC reviews.

Completeness is defined as follows for all measurements:

$$\%C = \frac{V}{T} \times 100$$

Where: %C = percent completeness
 V = number of measurements judged valid
 T = total number of measurements

B6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE

Analytical instrument testing, inspection, maintenance, setup, and calibration will be conducted by the laboratories in accordance with the requirements identified in the laboratories' SOPs and manufacturer instructions. In addition, each of the specified analytical methods provides protocols for proper instrument setup and tuning and critical operating parameters. Instrument maintenance and repair will be documented in the maintenance log or record book.

B7 INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY

B7.1 Field Calibration Procedures

Field measurements will be collected during each of the surface water sampling events. The following water quality parameters will be collected in the field: temperature, pH,

1 dissolved oxygen, conductivity, turbidity, ORP. (Note: Eh values will be calculated
2 using the ORP measurement.) The meters used to obtain these measurements will be
3 calibrated twice daily: before the start of work and at the end of the sampling day. Any
4 instrument “drift” from prior calibration will be recorded in a field notebook.
5 Calibration will be in accordance with procedures and schedules outlined in the
6 particular instrument’s operations and maintenance manual (see Section 2.2.6 of the FSP
7 for further discussion of field calibration).

8 Calibrated equipment will be uniquely identified by using either the manufacturer’s
9 serial number or other means. A label with the identification number and the date when
10 the next calibration is due will be physically attached to the equipment. If this is not
11 possible, records traceable to the equipment will be readily available for reference. In
12 addition, the results of calibrations and records of repairs will be recorded in a logbook.

13 Scheduled periodic calibration of testing equipment does not relieve field personnel of
14 the responsibility of employing properly functioning equipment. If an individual
15 suspects an equipment malfunction, the device must be removed from service and
16 tagged so that it is not inadvertently used, and the appropriate personnel notified so that
17 a recalibration can be performed or a substitute piece of equipment can be obtained. An
18 extra or backup meter will be taken into the field to replace the inoperable unit.

19 Results of measurements performed using equipment that has failed recalibration will
20 be evaluated. If the measurement results are adversely affected, the results of the
21 evaluation will be documented, the data qualified appropriately, and the data users
22 notified.

23 **B7.2 Laboratory Calibration Procedures**

24 Laboratory instruments will be properly calibrated, and the calibration will be verified
25 with appropriate check standards and calibration blanks for each parameter before
26 beginning each analysis. Instrument calibration procedures and schedules will conform
27 to analytical protocol requirements and descriptions provided in the laboratories’ QA
28 plans.

29 All calibration standards will be obtained from either the EPA repository or a
30 commercial vendor, and the laboratories will maintain traceability back to the National
31 Institute of Standards and Technology. Stock standards will be used to make
32 intermediate standards and calibration standards. Special attention will be given to
33 expiration dating, proper labeling, proper refrigeration, and prevention of
34 contamination. Documentation relating to the receipt, mixing, and use of standards will
35 be recorded in a laboratory logbook. All calibration and spiking standards will be

checked against standards from another source, as specified in the methods and the laboratory QA manual.

B8 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

The quality of supplies and consumables used during sample collection and laboratory analysis can affect the quality of the data. All equipment that comes into contact with the samples and extracts must be sufficiently clean to prevent detectable contamination, and the analyte concentrations must be accurate in all standards used for calibration and quality control purposes.

The quality of laboratory water used for decontamination will be documented at the laboratory. As discussed in Section B2, cleaned and documented sample containers will be provided by the laboratory. All containers will be visually inspected prior to use, and any suspect containers will be discarded.

Reagents of appropriate purity and suitably cleaned laboratory equipment will also be used for all stages of laboratory analyses. Details for acceptance requirements for supplies and consumables at the laboratories are provided in the laboratory SOPs and QA plans. All supplies will be obtained from reputable suppliers with appropriate documentation or certification. Supplies will be inspected to confirm that they meet use requirements, and certification records will be retained by the field supervisor (i.e., for supplies used in the field) or the laboratory QA manager (i.e., for supplies used in the laboratory).

B9 NON-DIRECT MEASUREMENTS

Existing chemical data from previous studies will be used for this study (see Appendix D). Historical data will be evaluated on the basis developed during Phase I of the RI/FS in which data were evaluated on a number of quality assurance/quality control (QA/QC) measures such as traceability comparability, sample integrity, and availability of laboratory QC data. Based on this evaluation, the data are grouped into one of four categories (e.g., Category 1 – data of known quality). For the surface water study, data quality will be based on achievement of the DQOs specified herein. Specifically, this will include an evaluation of sample collection techniques (including precautions to minimize contamination), analytical methods and related detection limits, the age of the data, and the sampling and analytical records associated with the data.

B10 DATA MANAGEMENT

Data for this task will be generated both in the field and at the analytical laboratory. The final repository for sample information for the sample collection efforts described in the FSP will be a relational database. Procedures to be used to transfer data from the point of generation to the database are described in this section. The final database will include historical as well as current data.

The Teck technical team will follow the data management plan (DMP) established for the Site in the RI/FS work plan. The DMP establishes standard procedures for the management of all documents and environmental data (field and laboratory) generated during the UCR RI/FS. The DMP describes data management procedures relating to the creation, acquisition, handling, storage, and distribution of task-related data. The data management systems and procedures described below are intended to establish and maintain an efficient organization of large volumes of complex environmental information for a diverse combination of data types. To accomplish this task, four management systems will be used to provide organized and efficient data management and retrieval:

- **Project database**—Stores environmental sampling and analysis data; information pertaining to geographic information system (GIS) files; and citations of documents related to collection, analysis, or interpretation of environmental data that are stored in the database. A relational¹⁸ database will be used to facilitate data retrieval and interpretation. Both current and historical data will be stored in the project database.
- **Geographic information system**—Stores spatial data and enables the cartographic presentation of data trends and patterns.
- **Hard copy files**—Maintains a record and archive of documents from field studies, contractual agreements, and resulting reports. Teck and its technical team will use various document and reference management software to organize hard copy documents.
- **Web site**—Documents, electronic data, and other project information will be available via the secure project web site. Users with appropriate privileges will be able to download electronic data and documents.

Many of the UCR RI/FS activities will use spatial data sets and analyses for planning, data interpretation, decision support, and data presentation. An inventory of spatial data sets will be maintained in the project database. Links between data in the project

¹⁸ A relational database stores distinct types of data (e.g., station descriptions, sample descriptions, and analytical results) in different data tables, where the tables are linked, or related, through shared information (e.g., station identifiers and sample identifiers).

database and GIS files will be established via common identifiers for sampling locations and other geographic features. Spatial data analyses and maps will be prepared using ESRI (or compatible) software.

B10.1 Field Data

Data that are generated during surface water collection and sample preparation will be manually entered into the field logbook and COC forms. Data from these sources will be entered into the project database directly from the field logbook. These data include sample collection coordinates, station names, sampling dates, sample identifiers and numbers, and additional station and sample information (e.g., water depth, if applicable, sample type, field replicate number, field triplicate number). All entries will be reviewed for accuracy and completeness by a second individual, and any errors will be corrected before the data are approved for release to data users.

B10.2 Laboratory Data

A variety of manually entered and electronic instrument data will be generated at the laboratories. Data are manually entered into the following records:

- Standard logbooks
- Storage temperature logs
- Balance calibration logs
- Instrument logs
- Sample preparation and analysis worksheets
- Maintenance logs
- Individual laboratory notebooks
- Results tables for conventional parameters.

All manual data entry into the laboratory information management system will be proofed at the analytical laboratories. All data collected from each laboratory instrument, either manually or electronically, will be reviewed and confirmed by analysts before reporting. The laboratories will archive all hard copy and electronic instrument data for a period of 10 years. A detailed description of procedures for laboratory data management and data review and verification is provided in the laboratory QA plans (Appendix E).

Laboratory data will be prepared in hard copy, PDF, and EDD formats. Laboratory data will be entered directly into the project database from the EDD. A database printout

- 1 will be used to verify database entries against the hard-copy laboratory data packages.
- 2 Data management procedures for this project are provided in the RI/FS work plan.

SECTION C: ASSESSMENT AND OVERSIGHT

This task will rely on the knowledge and expertise of the Teck technical team, as described in the RI/FS work plan. The field team and laboratories will stay in close verbal contact with the task manager and the task QA coordinator during all phases of this task. This level of communication will serve to keep the management team apprised of activities and events, and will allow for informal but continuous task oversight. Few scheduled assessment activities are planned for this task because the scope of the sampling and analysis effort and the size of the team are relatively small.

C1 ASSESSMENTS AND RESPONSE ACTIONS

Laboratories were audited prior to the award contracts for services. Assessment of ongoing laboratory performance will be monitored through the submission of field replicate and split samples, performance evaluation samples, and, if included, inter-laboratory split samples. Other assessment activities will include readiness reviews prior to sampling and prior to release of the final data to the data users, and internal review while work is in progress. An informal technical systems audit may be conducted if problems are encountered during any phase of this task.

The selected laboratories were audited by Environmental Standards, Inc. to evaluate the laboratories quality assurance procedures and technical capabilities to perform the analyses described in this document. In addition, prior to laboratory contract awards, Environmental Standards, Inc., executed an aqueous single-blind performance evaluation study (CAS for various wet chemistry and total metals analytes and FGS for speciated arsenic). The recoveries reported by the aforementioned laboratories were within the limits designated by the performance evaluation provider (with the exception of one marginal outlier for silica). Copies of the performance evaluation sample results are available on request.

Performance evaluation samples may be submitted to the laboratories on a single-blind or double-blind basis. A single-blind performance evaluation sample is defined as a performance evaluation sample aliquot submitted for analysis to a laboratory that is aware that the sample is for performance evaluation but does not know the actual target analytes or the target analyte concentrations at the time of analysis. A double-blind performance evaluation sample is defined as a performance evaluation sample aliquot submitted for analysis to a laboratory that is not aware that the sample is for performance evaluation at the time of analysis.

1 The task QA coordinator will coordinate the manufacture and submission of
2 performance evaluation samples to the laboratory. A performance testing sample
3 provider approved by the National Environmental Laboratory Accreditation Conference
4 will be used to obtain the performance evaluation samples. Performance evaluation
5 sample studies will be conducted annually for laboratories analyzing samples associated
6 with the project. The requested analytes will be determined based on the nature of the
7 work performed by that laboratory for the project.

8 Upon receipt of results from the performance evaluation sample analyses, the task QA
9 coordinator will evaluate the data relative to the certified “true values,” acceptance
10 limits, and will prepare a comprehensive report (including a discussion of non-
11 analytical issues, such as data package preparation and presentation). The performance
12 evaluation study report will contain a detailed account of any results that are outside of
13 the established acceptance limits. The laboratories will be contacted to explain any
14 discrepancies between the reported concentrations outside acceptance limits based on
15 the “known” (true) concentrations of the analytes in the performance evaluation
16 samples and to provide corrective actions in accordance with the corrective action
17 process described in Section C1. Performance evaluation sample documentation,
18 inclusive of corrective action responses, will be maintained as part of the project file.

19 Inter-laboratory split samples are samples used to evaluate the project laboratory
20 performance. Inter-laboratory split samples may be used to complement the other
21 quality assurance samples (e.g., field duplicates, performance evaluation samples). At
22 the direction of the Teck project coordinator, split samples will be collected and
23 submitted to an independent third-party laboratory (i.e., outside of the Project sampling
24 and monitoring program) for analysis. The field team will obtain split samples by
25 collecting double sample volume for a sample and submit the additional aliquot to a
26 third-party laboratory for analysis. The third-party laboratory will be required to
27 adhere to the requirements of this QAPP. The results of the split samples will be
28 evaluated using the field duplicate evaluation criteria.

29 Readiness reviews are conducted to ensure that all necessary preparations have been
30 made for efficient and effective completion of each critical phase of work. The first
31 readiness review will be conducted prior to field sampling. The field supervisor will
32 verify that all field equipment is ready for transfer to the site. The field supervisor will
33 also verify that the field team and subcontractor(s), as required, have been scheduled
34 and briefed (including review of the SHSP) and that the contract for the subcontractor
35 has been signed by both parties. Any deficiencies noted during this readiness review
36 will be corrected prior to initiation of sampling activities.

1 The second readiness review will be completed before final data are released for use.
2 The database administrator will verify that all results have been received from the
3 laboratories, data validation and data quality assessment have been completed for all of
4 the data, and data qualifiers have been entered into the database and verified. Any
5 deficiencies noted during this review will be corrected by the database administrator,
6 the task QA coordinator, or their designee. Data will not be released for final use until
7 all data have been verified and validated. No report will be prepared in conjunction
8 with the readiness reviews. However, the Teck technical team coordinator and data
9 users will be notified when the data are ready for use.

10 Technical review of intermediate and final work products generated for this task will be
11 completed throughout the course of all sampling, laboratory, data validation, data
12 management, and data interpretation activities to ensure that every phase of work is
13 accurate and complete and follows the QA procedures outlined in this QAPP. Any
14 problems that are encountered will be resolved between the reviewer and the person
15 completing the work. Any problems that cannot be easily resolved or that affect the
16 final quality of the work product will be brought to the attention of the Teck technical
17 team coordinator and Teck project coordinator. EPA will be notified of any problems
18 that may affect the final outcome of this task, according to the Agreement.

19 The laboratories will be required to have implemented a review system that serves as a
20 formal surveillance mechanism for all laboratory activities. Each phase of work is
21 reviewed by a supervisor before it is approved for release. Details are provided in the
22 laboratory QA plans (Appendix E).

23 Technical system audits may be conducted if serious problems are encountered during
24 sampling or analysis operations. If completed, these audits will be conducted by the
25 task QA coordinator or designee, or by the analytical laboratory, as appropriate. These
26 audits may consist of onsite reviews of any phase of field or laboratory activities or data
27 management. Results of any audits will be provided in the field sampling report.

28 If minor deviations from the QAPP that do not require a corrective action become
29 necessary for any reason, the deviation will be documented using a sample alteration
30 form. For example, if insufficient volume of a sample is available to analyze all
31 parameters, the sample alteration form would be initiated by the task team member who
32 identifies this issue. The Task QA coordinator will review these forms, approve the
33 deviation, and maintain a complete record of QC issues and sample alterations.

34 Any task team member who discovers or suspects a nonconformance is responsible for
35 reporting the nonconformance to the task manager, the task QA coordinator, or the

laboratory project or QA manager, as applicable. The task QA coordinator will ensure that no additional work dependent on the nonconforming activity is performed until a confirmed nonconformance is corrected. Any confirmed nonconformance issues will be relayed to the Teck technical team coordinator.

When a non-conformance is identified, a corrective action plan will be prepared. The plan will include identifying the corrective action, the person or organization responsible for implementing the corrective action, and procedures for confirming that the desired results are produced. The corrective measures will be appropriate to the severity of the non-conformance and realistic in terms of the resources required for implementation.

Corrective action records (see Appendix A, Attachment A3) will be used to document non-conformances and subsequent corrective actions. The task QA coordinator will review these reports, approve the corrective action, ensure that the corrective action is implemented, and maintain a complete record of QC issues and corrective actions. The Teck technical team coordinator may also submit the corrective action records to Teck or EPA, as appropriate. The laboratory project managers and QA managers are responsible for maintaining records of QC issues related to laboratory work.

C2 REPORTS TO MANAGEMENT

The laboratories will keep the appropriate technical team laboratory coordinator(s) and QA manager(s) apprised of their progress on a weekly basis. The laboratories will provide the following information:

- Inventory and status of samples held at the laboratory in spreadsheet format by sample delivery group
- Summaries of out-of-control laboratory QC data and any corrective actions implemented
- Descriptions and justification for any significant changes in methodology or QA/QC procedures.

The technical team laboratory coordinator and QA managers will provide this information to the task QA coordinator, who in turn will provide this information to the Teck technical team coordinator.

The laboratory will be required to have implemented routine systems of reporting nonconformance issues and their resolution. These procedures are described in the laboratory QA manuals (to be submitted following laboratory selection). Laboratory

1 nonconformance issues will also be described in the field sampling report if they affect
2 the quality of the data.

3 Data packages and EDDs will be prepared by the laboratory upon completion of
4 analyses for each sample delivery group. The case narrative will include a description of
5 any problems encountered, control limit exceedances (if applicable), and a description
6 and rationale for any deviations from protocol. Copies of corrective action reports
7 generated at the laboratory will also be included with the data package. The first two
8 data packages generated for each chemical analysis type will be submitted to EPA in
9 PDF format. Additional data packages may be submitted to EPA upon request.

10 As required by the Agreement, validated data will be provided electronically to EPA
11 within 90 days of completion of receipt of all laboratory data packages for each survey.
12 These data will be provided with a field sampling report containing an overview of the
13 field event, a sampling location map, sample collection methods used, rationale for any
14 deviations from the FSP and QAPP, validated data and data validation report, and if
15 appropriate, recommendations for changes to the sampling design for upcoming
16 surveys.

17 A final data evaluation report will be prepared by the Teck technical team and
18 submitted to EPA within 150 days following submission of the third (i.e., final) field
19 sampling report. The data evaluation report will include an evaluation of longitudinal
20 and temporal trends in chemical concentrations, comparisons with conservative risk
21 benchmarks or literature-based values, and an evaluation of longitudinal and temporal
22 trends in the risk comparisons.

SECTION D: DATA VALIDATION AND USABILITY

Data generated in the field and at the laboratories will be verified and validated according to criteria and procedures described in this section. Data quality and usability will be evaluated, and a discussion will be included in the data validation report.

D1 DATA REVIEW, VERIFICATION, AND VALIDATION

Field and laboratory data for this task will undergo a formal verification and validation process. All entries into the database will be verified. All errors found during the verification of field data, laboratory data, and the database will be corrected prior to release of the final data.

Data verification and validation by an independent data validation firm will be completed according to methods described in the following EPA guidance documents for data validation:

- *Guidance on Environmental Data Verification and Validation* (USEPA 2002b)
- *EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review* (USEPA 1999)
- *EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (USEPA 2004)
- *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use* (USEPA 2009)
- *EPA Region 10 SOP for the Validation of Method 1668 Toxic, Dioxin-like PCB Data* (USEPA 1995)
- *EPA Region 10 SOP for the Validation of Polychlorinated Dibenzo-dioxin (PCDD) and Polychlorinated Dibenzofuran (PCDF) Data* (USEPA 1996).

Data will be qualified as estimated as necessary if results for surrogates, laboratory control samples, matrix spike samples, matrix spike duplicates, or laboratory duplicates do not meet method-specified control limits, including performance-based control limits. Results for other QC procedures will be qualified if they do not meet control limits outlined in EPA's functional guidelines and SOPs for data validation (USEPA 1995, 1996, 1999, 2004). Data will be qualified as undetected based on concentrations of target analytes detected in laboratory or field blanks, according to EPA's functional guidelines and SOPs for data validation.

Performance-based control limits are established periodically by the laboratories as required for the selected methods. Current values will be provided in the laboratory QA plans as applicable (Appendix E).

No guidelines are available for validation of data for TSS, TOC, DOC, and PBDEs. The TSS, TOC, and DOC data will be validated using procedures described in the functional guidelines for inorganic data review (USEPA 2004), as applicable. Data will be qualified as estimated, as necessary, if results for quality control samples do not meet performance-based control limits. PBDE data will be validated using general procedures in EPA Region 10's SOP for PCBs (USEPA 1995) and details provided in EPA Method 1614.

Results for field split samples will be evaluated using control limits of 35 percent. Data will not be qualified as estimated if the MQOs are exceeded, but RPD results will be tabulated and any exceedances will be discussed in the field sampling report. Equipment rinse blanks will be evaluated and data qualifiers will be applied in the same manner as method blanks, as described in the functional guidelines for data review (USEPA 1995, 1996, 1999, 2004).

Data will be rejected if control limits for acceptance of data are not met, as described in USEPA (1995, 1996, 1999, 2004).

D2 VERIFICATION AND VALIDATION METHODS

Field data will be verified during preparation of samples and COC forms. Field data and COC forms will be reviewed daily by the field supervisor. After field data are entered into the project database, 100 percent verification of the entries will be completed to ensure the accuracy and completeness of the database. Any discrepancies will be resolved before the final database is released for use.

Approximately 10 percent, including the first two data packages generated for each chemical analysis type, of the chemistry data will be undergo Stage 4 data validation (USEPA 2009). The remaining data will undergo Stage 2B data validation. Procedures for verification and validation of laboratory data and field QC samples will be completed as described in the functional guidelines and SOPs for data validation (USEPA 1995, 1996, 1999, 2004, 2009) and summarized in Section D1, above. All data will be labeled in accordance with EPA guidance (USEPA 2009) to indicate the level of data validation.

The Stage 2B data validation effort will include evaluation of compliance with the analytical methodology, holding times, potential contamination, surrogate recoveries,

LCS results, duplicate analyses, MS/MSD results, serial dilutions, post-digestion spike results, initial calibration performance, initial calibration verification performance, continuing calibration standard performance, instrument tune checks, DDT/endrin breakdown checks, ICP/MS low-level initial calibration standard recoveries, ICP/MS interference check sample standard results, ICP/MS serial dilution results, and field duplicate precision.

Stage 4 data validation is a full data validation effort which includes evaluation of instrument raw data, confirmation of the reported sample and quality control results, and evaluation of all quality control results.

A data validation chemist with Environmental Standards, Inc., will perform a completeness review and data validation. Analytical data will be qualified or rejected based on the national functional guidelines referenced above. The data validation qualifiers listed below will be used for all project samples.

- Organic Data Validation Qualifiers

- | | |
|------|--|
| U* | This compound should be considered “not detected” because it was detected in a trip, field, equipment rinsate, or laboratory blank at a similar level. |
| J | Quantitation is approximate due to limitations identified during data validation |
| R | Unusable result; analyte may or may not be present in sample. |
| UJ | This analyte was not detected, but the reporting limit may or may not be higher due to a bias identified during data validation. |
| EMPC | This congener should be considered an estimated maximum possible concentration as all identification criteria were not met. |

- Inorganic Data Validation Qualifiers

- | | |
|----|--|
| U* | This result should be considered “not detected” because it was detected in a field, equipment rinsate, filter, or laboratory blank at a similar level. |
| R | Unusable result; analyte may or may not be present in sample. |

- J Quantitation is approximate due to limitations identified during data validation.
- J- Quantitation is approximate but may be biased low due to limitations identified during data validation.
- J+ Quantitation is approximate but may be biased high due to limitations identified during data validation.
- UJ This analyte was not detected, but the reporting limit may or may not be higher due to a bias identified during data validation.

1
2 A data validation chemist with Environmental Standards, Inc., who has appropriate
3 experience and expertise, at the direction of the task QA coordinator, will complete the
4 Stage 2B data validation within 10 business days and the Stage 4 data validation within
5 20 business days of the receipt of the complete data package.

6 If problems or questions are encountered during validation, the laboratory will be
7 contacted for resolution. Additional Stage 4 validation will be completed if required to
8 fully assess the quality of the data or to verify that laboratory errors have been
9 addressed.

10 The data validation firm will submit a report discussing the results of the data validation
11 and describing any findings that result in data qualification or rejection. In addition,
12 assigned data qualifiers will be added to the laboratory EDD for inclusion in the
13 database.

14 The complete data validation report will be prepared in easy-to-understand language in
15 the following general format as applicable to the validation level:

16 A. Introduction

17 This section will briefly state the number of samples analyzed, the
18 laboratory that performed the analyses, the parameters for which the
19 samples were analyzed, the analytical methods used, and the data
20 validation level.

21 B. Laboratory Compliance

22 This section will specify any reporting and/or procedural issues that
23 affect data usability and that were identified relative to the requirements
24 and deliverables specified in the method(s) performed. Appropriate
25 citations will be provided for each item listed. This section will be
26 subdivided into reporting issues and procedural issues.

C. Data Qualifiers

This section will present qualifiers that should be considered for the data to be best utilized. For every statement made in this section, there will be a subsequent finding that justifies the qualifying statement. These qualifiers/findings will be presented as bulleted items in order of importance relative to their impact on the data set.

D. Supporting Documents

The quality assurance review will be fully supported by a documentation appendix. Copies of laboratory data will be included to support each of the data validation chemist's comments concerning the qualifiers and deficiencies identified in the review.

The accuracy and completeness of each data set will be verified at the laboratory when the EDDs are prepared and again as part of data validation. Ten percent of entries to the database from the laboratory EDDs will be checked against the hard-copy data packages.

In addition to verification of field and laboratory data and information, data qualifier entries into the database will be verified. Any discrepancies will be resolved before the final database is released for use.

MRL goals for this task are provided in Table B-2. Reporting limits for non-detects will be compared to the MRL goals to evaluate method sensitivity for each sample. Any exceedance of actual MRLs over the target MRLs will be discussed in the data validation report.

D3 RECONCILIATION WITH USER REQUIREMENTS

The goal of data validation is to determine the quality of each data result and to identify those that do not meet the task MQOs. Nonconforming data may be qualified as estimated (i.e., a "J" qualifier will be applied to the result) or rejected as unusable (i.e., an "R" qualifier will be applied to the result) during data validation if criteria for data quality are not met. Data may also be qualified as undetected during validation based on laboratory and field blank results. Rejected data will not be used for any purpose. A summary of the qualified data and the reasons for qualification will be included in the data validation report.

Data qualified as estimated will be used for all intended purposes and will be appropriately qualified in the final project database. However, these data are less

1 precise or less accurate than unqualified data. Data users, in cooperation with the Teck
2 technical team coordinator and the task QA coordinator, are responsible for assessing
3 the effect of the inaccuracy or imprecision of the qualified data on statistical procedures
4 and other data uses. The data quality discussion in the data validation report will
5 include information regarding the direction or magnitude of bias or the degree of
6 imprecision for qualified data to facilitate the assessment of data usability. The data
7 validation report will also include a discussion of data limitations and their effect on
8 data interpretation activities.

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FIGURES

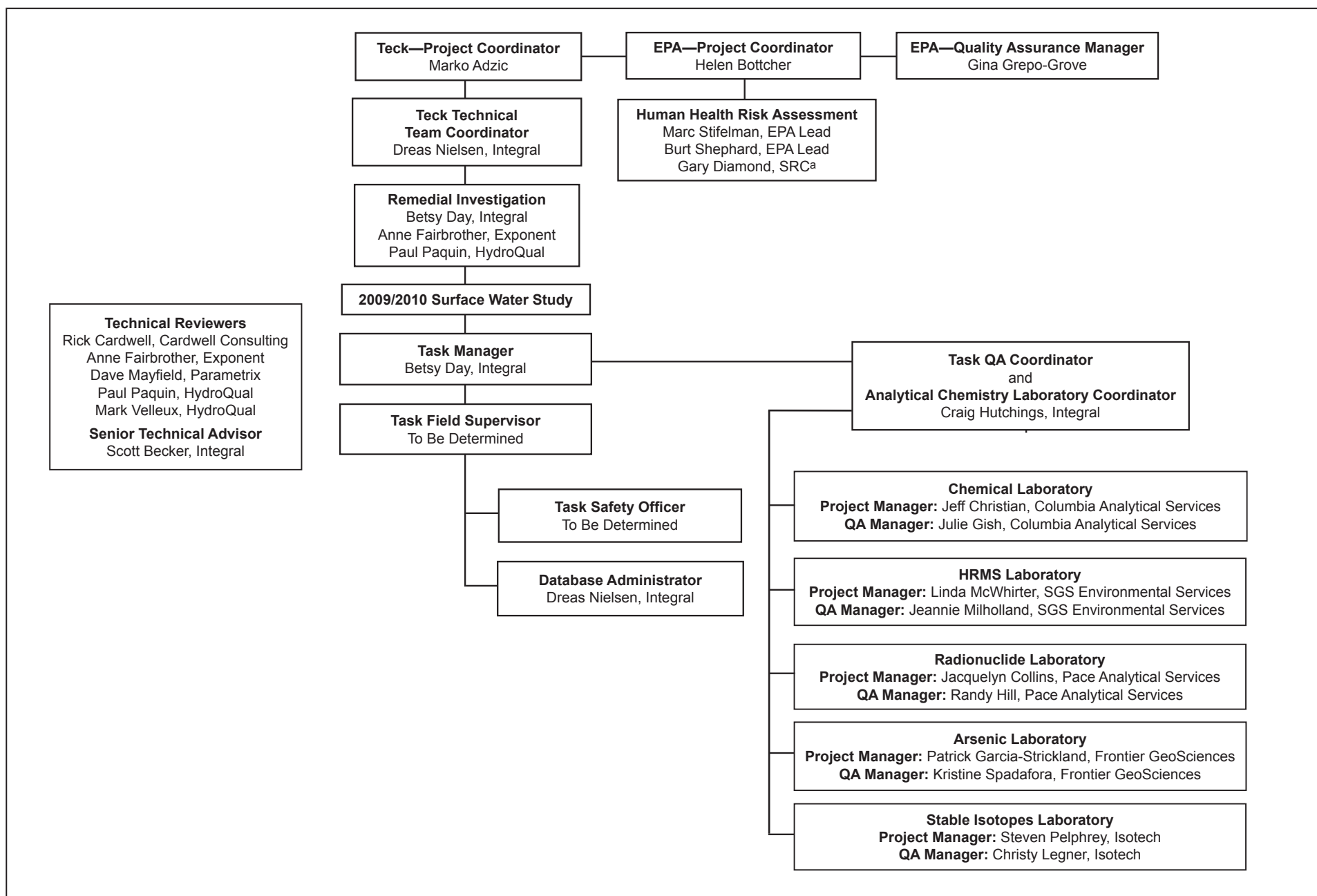


Figure A-1. Organization Chart
for the 2009/2010 Surface Water Study.
Note: ^aSRC = Syracuse Research Corporation.
^bAINW = Archaeological Investigations Northwest, Inc.

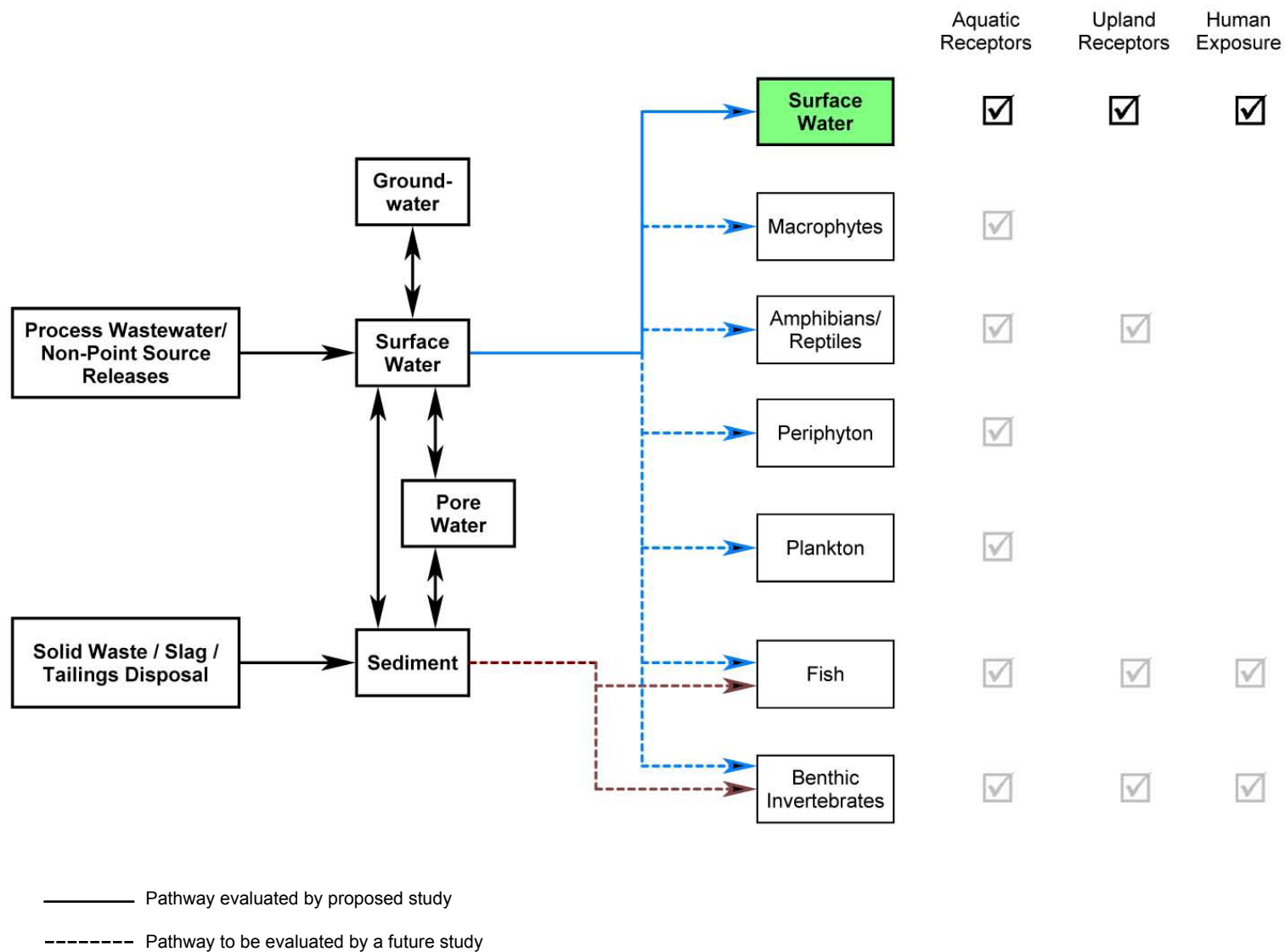


Figure A-3. Surface Water Conceptual Site Model.

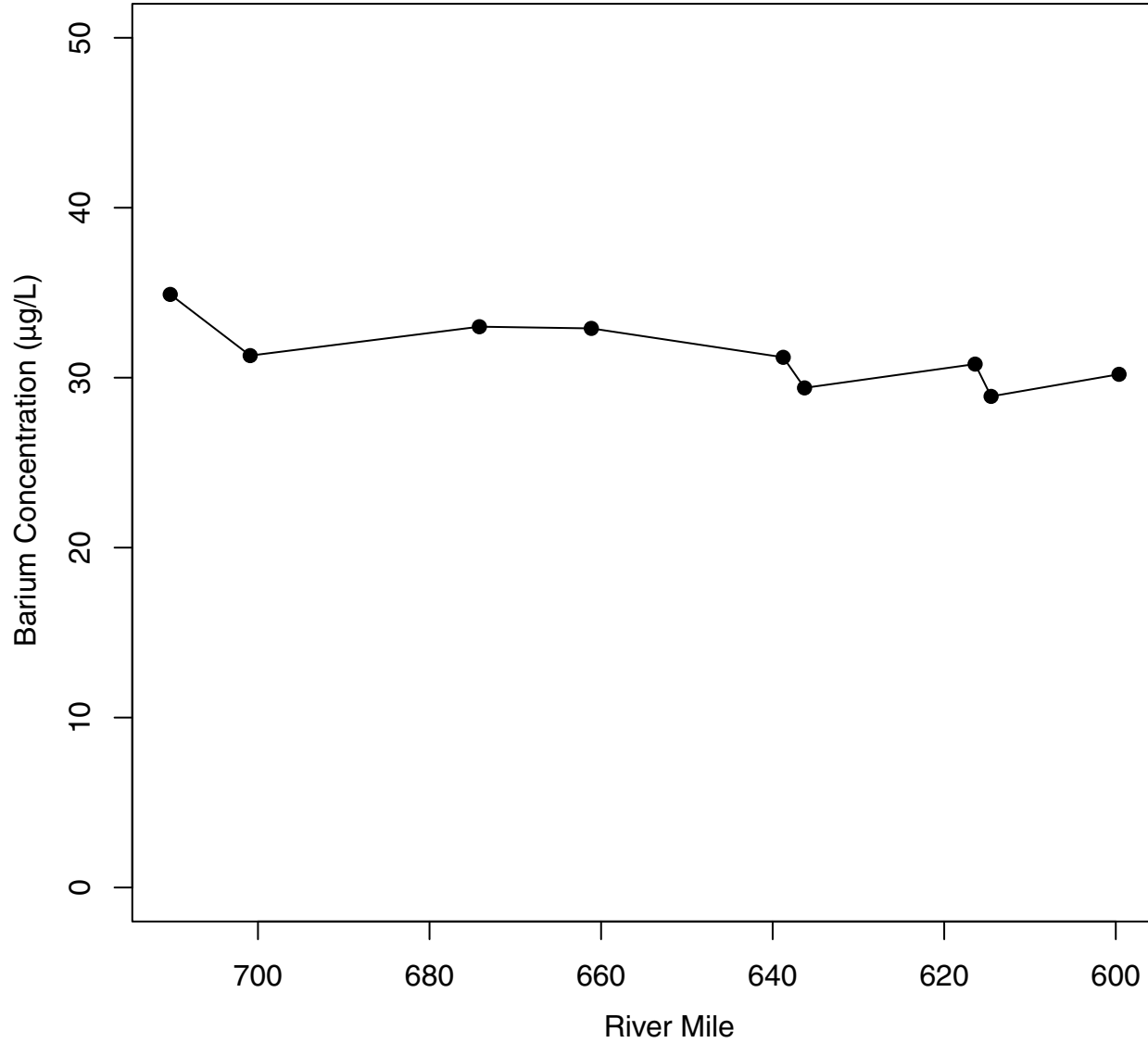


Figure A-4a. Concentrations of Barium at Multiple Locations Spanning the Length of the UCR.
Source: Scofield and Pavlik-Kunkel (2007).

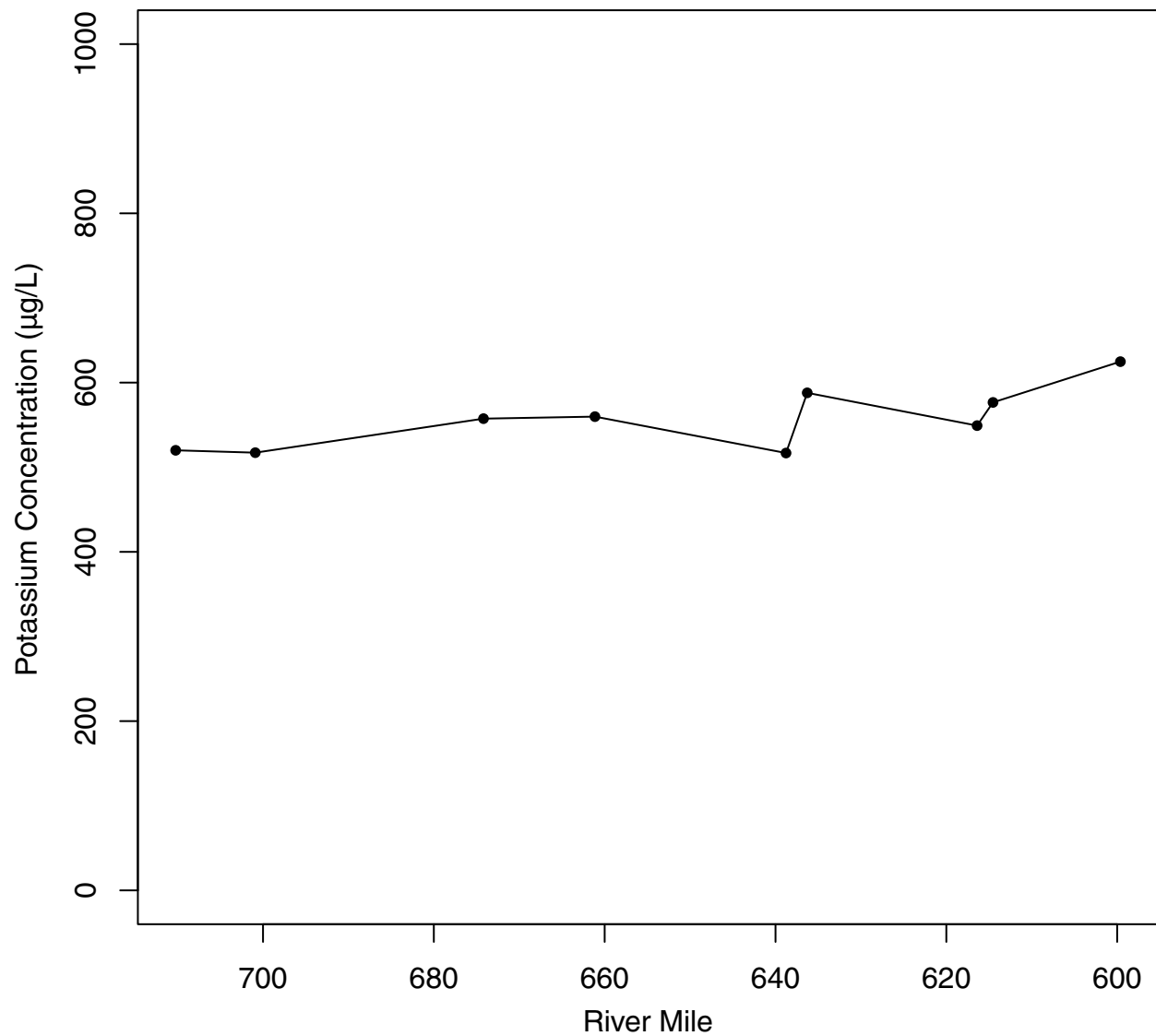


Figure A-4b. Concentrations of Potassium at Multiple Locations Spanning the Length of the UCR.
Source: Scofield and Pavlik-Kunkel (2007).

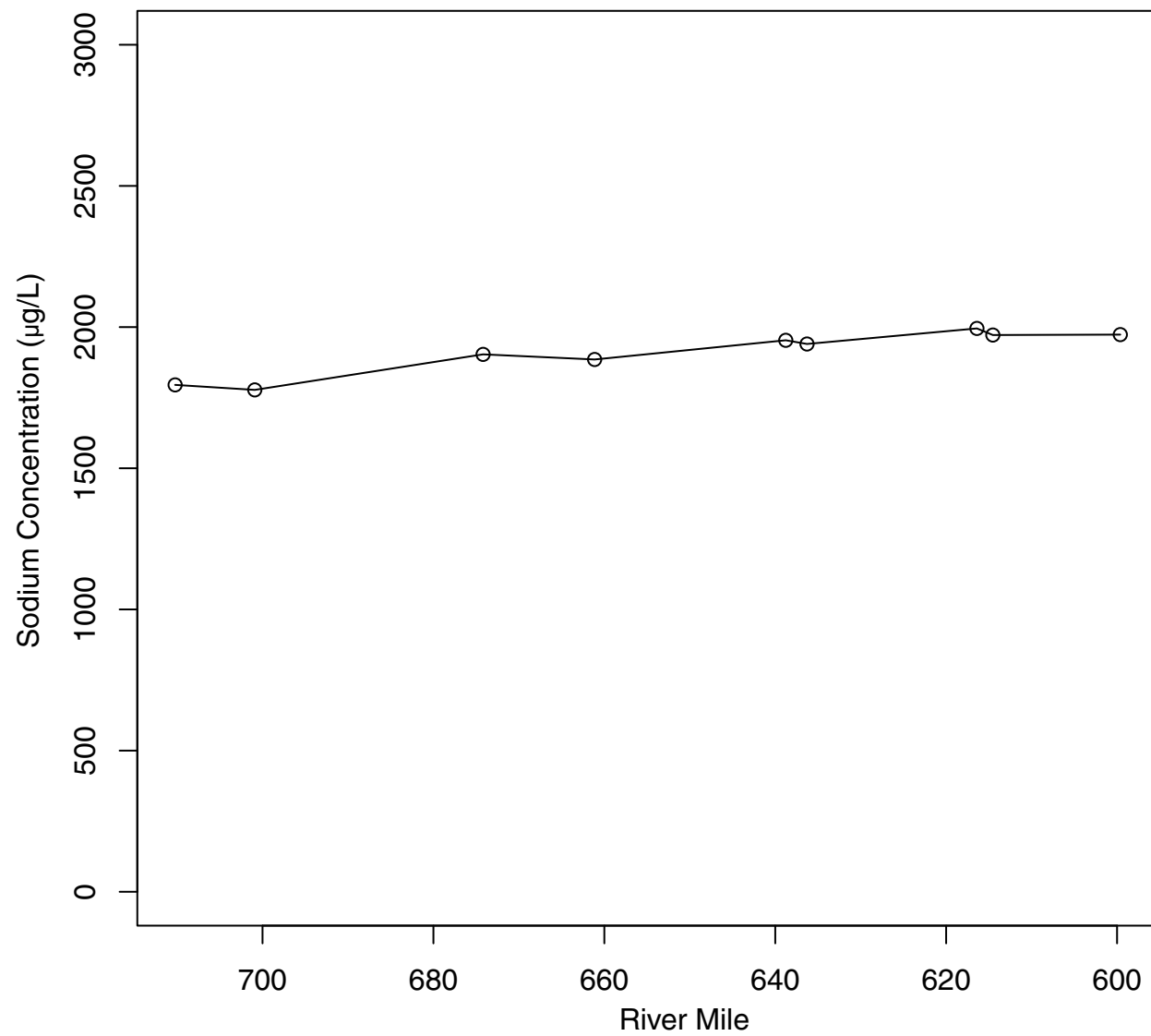


Figure A-4c. Concentrations of Sodium at Multiple Locations Spanning the Length of the UCR.
Source: Scofield and Pavlik-Kunkel (2007).

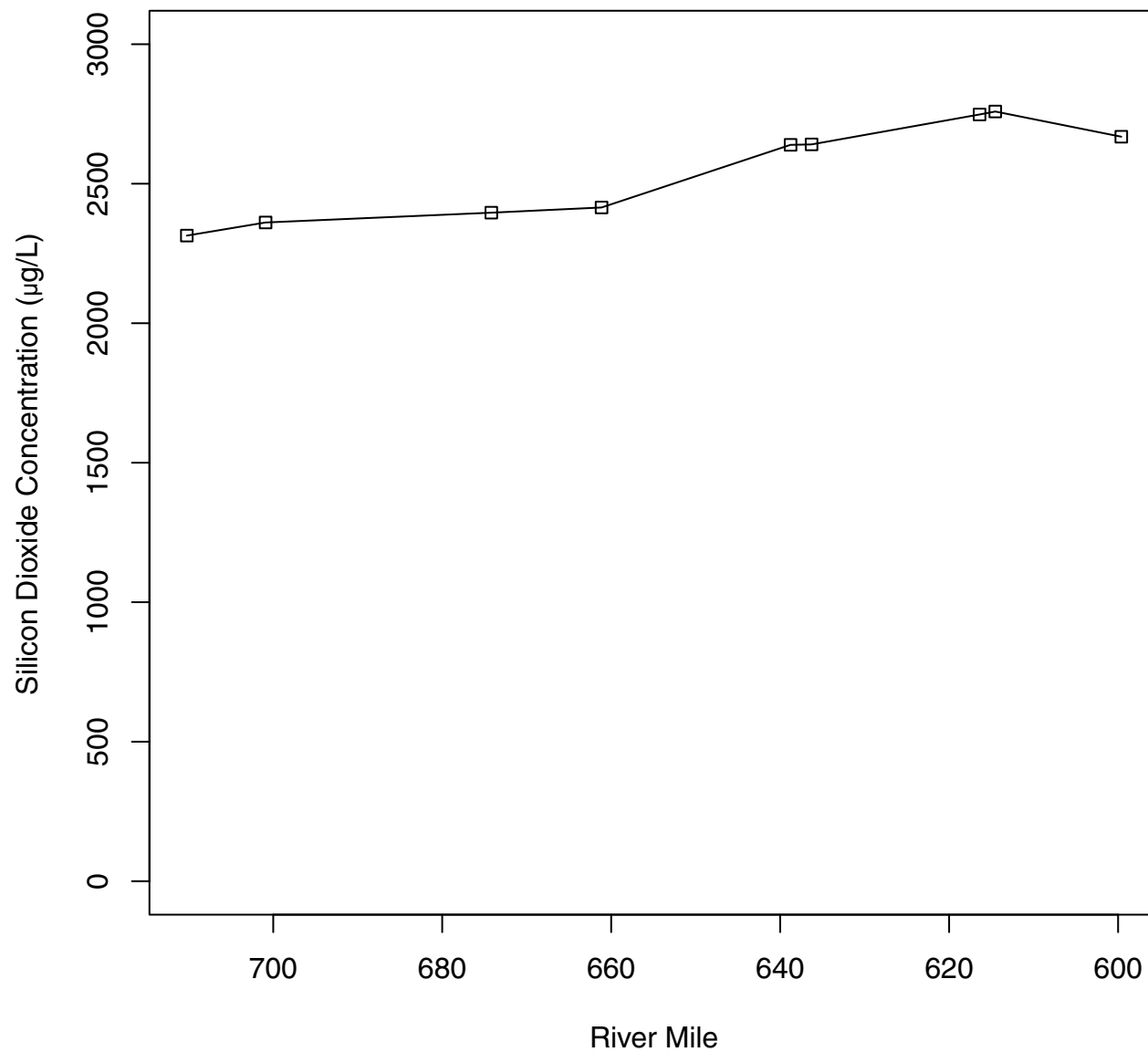


Figure A-4d. Concentrations of Silicon Dioxide at Multiple Locations Spanning the Length of the UCR.
Source: Scofield and Pavlik-Kunkel (2007).

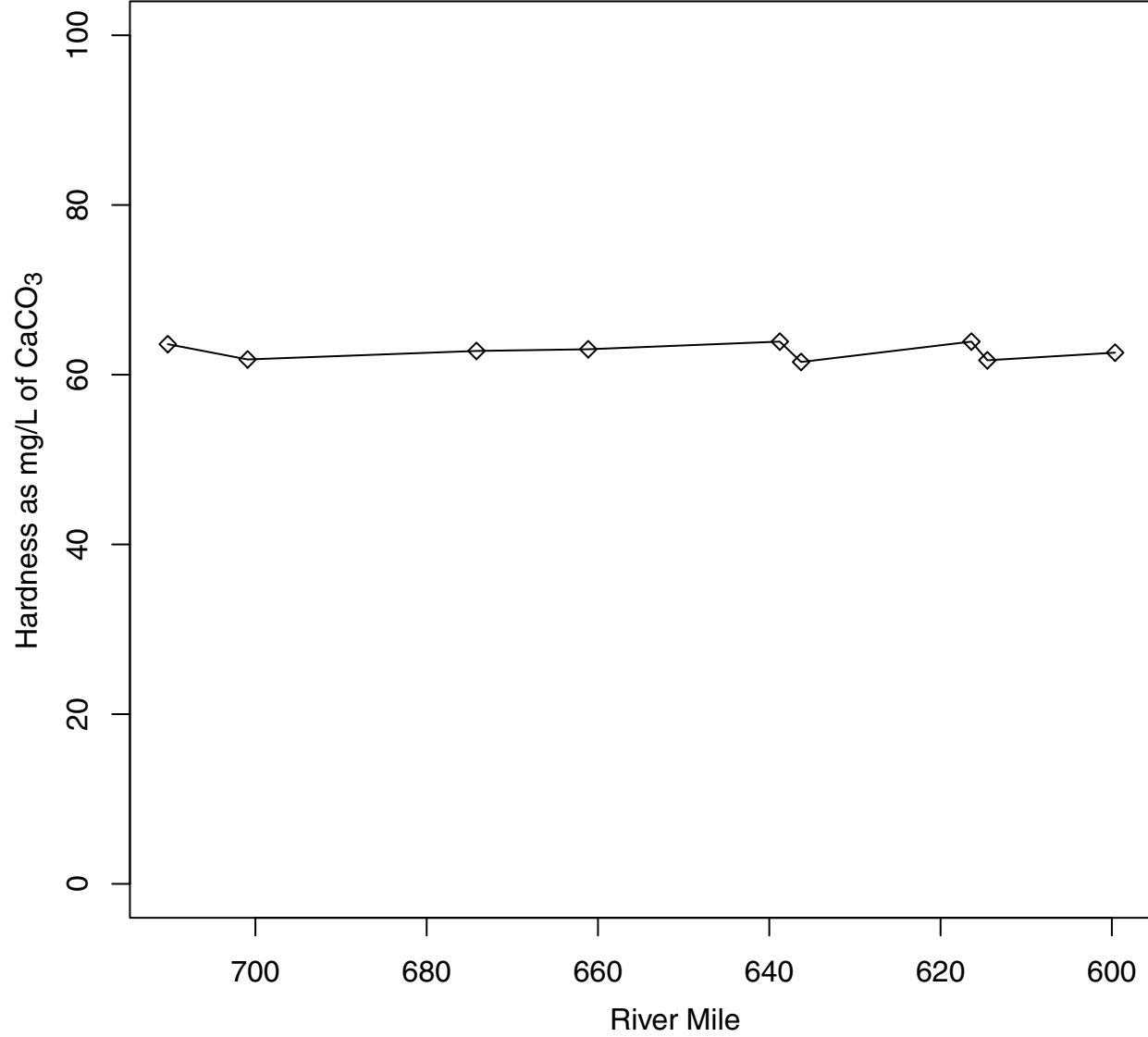


Figure A-4e. Concentrations of Hardness at Multiple Locations Spanning the Length of the UCR.
Source: Scofield and Pavlik-Kunkel (2007).

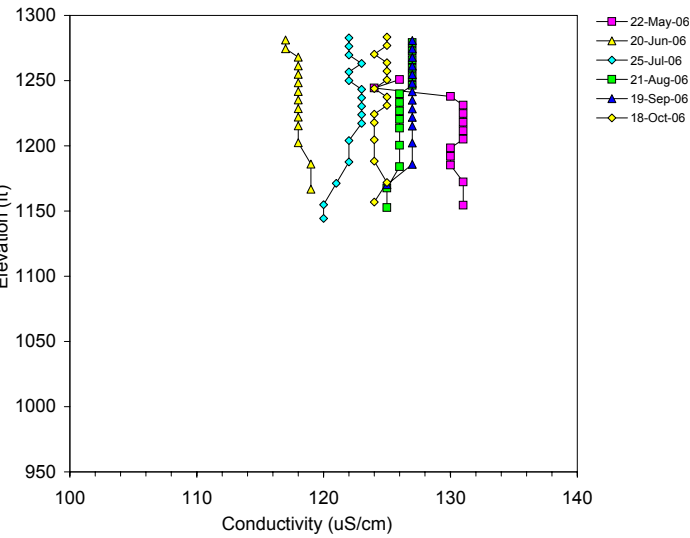
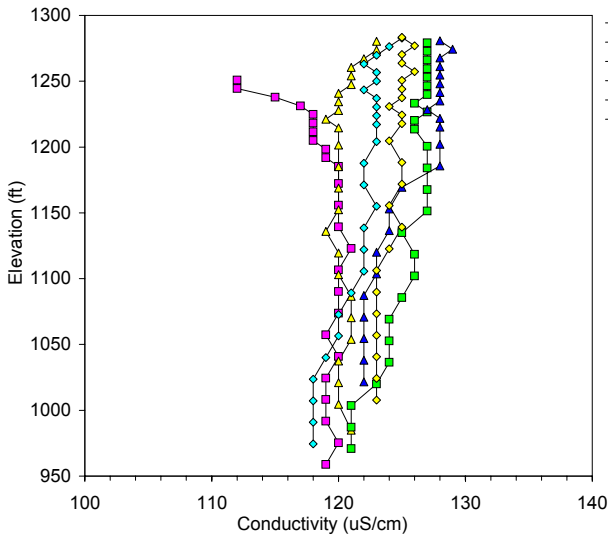
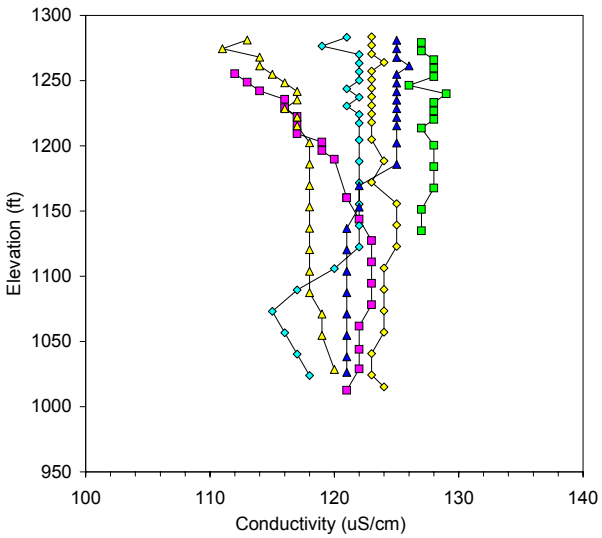
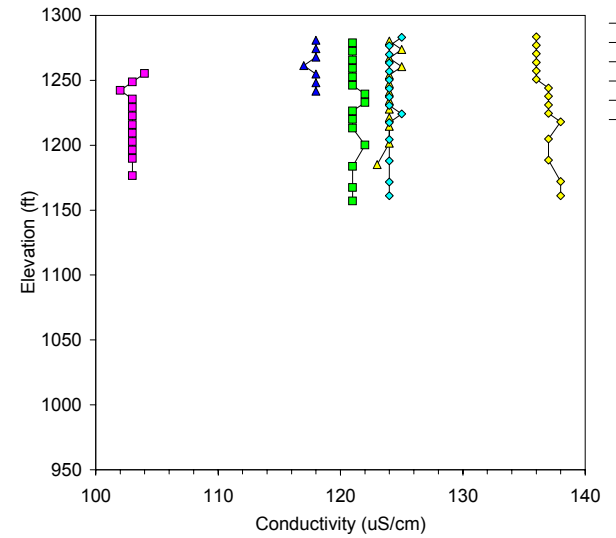
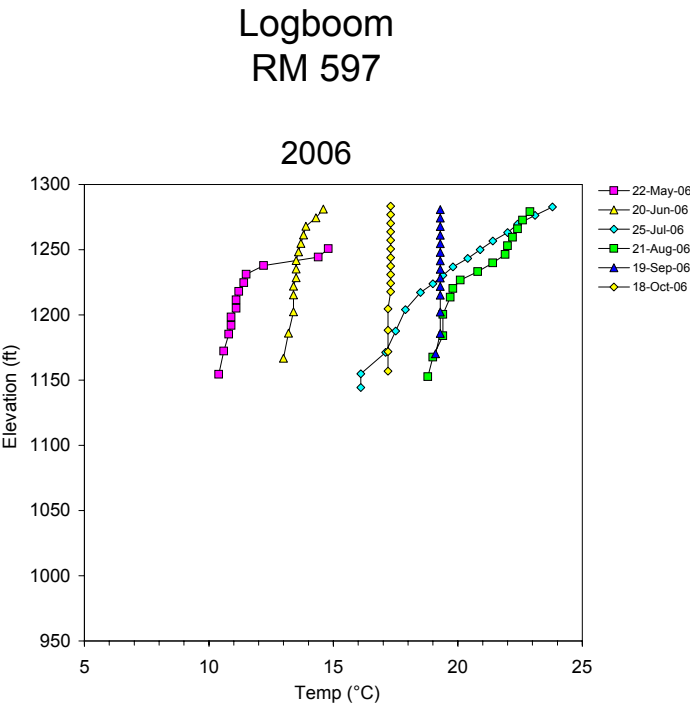
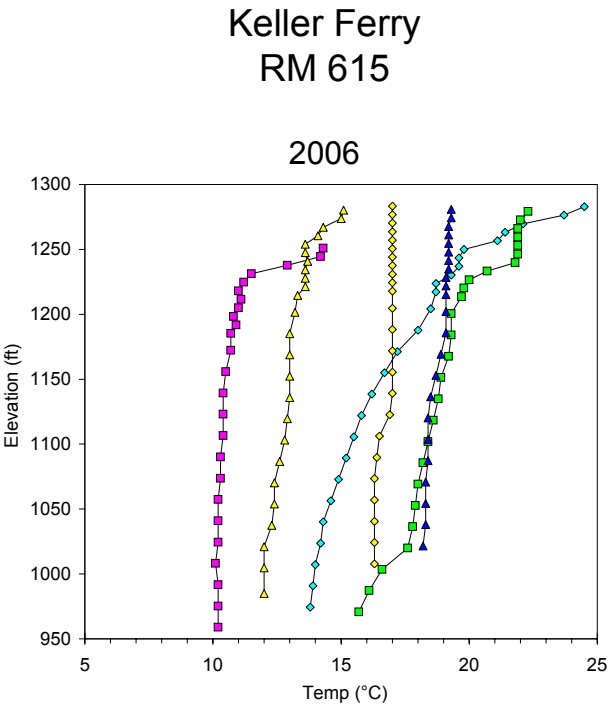
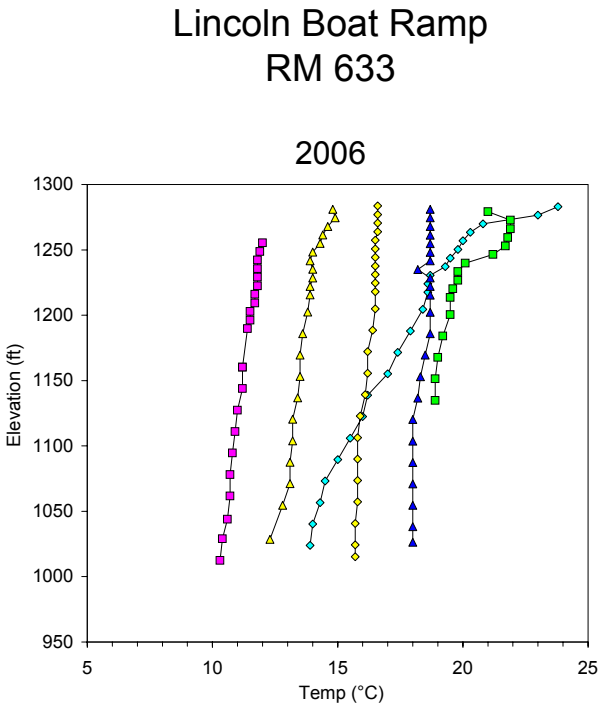
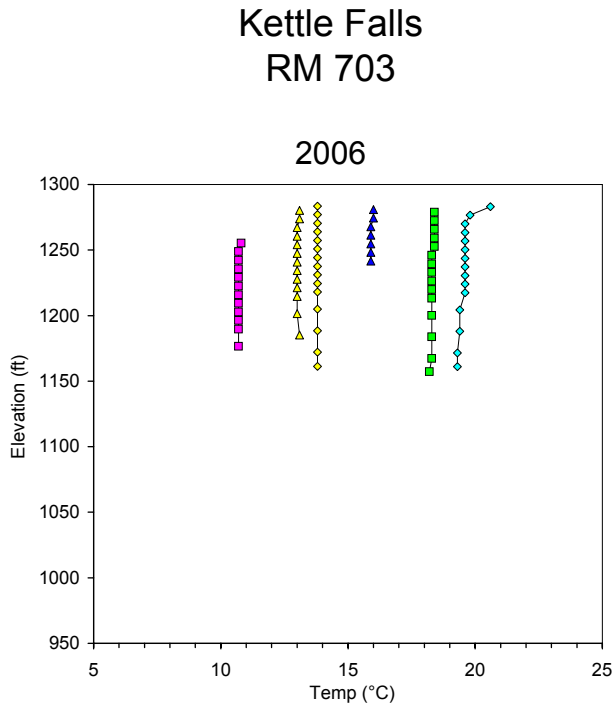


Figure A-5. Vertical Profiles of Temperature and Conductivity at Four UCR Monitoring Stations in 2006.

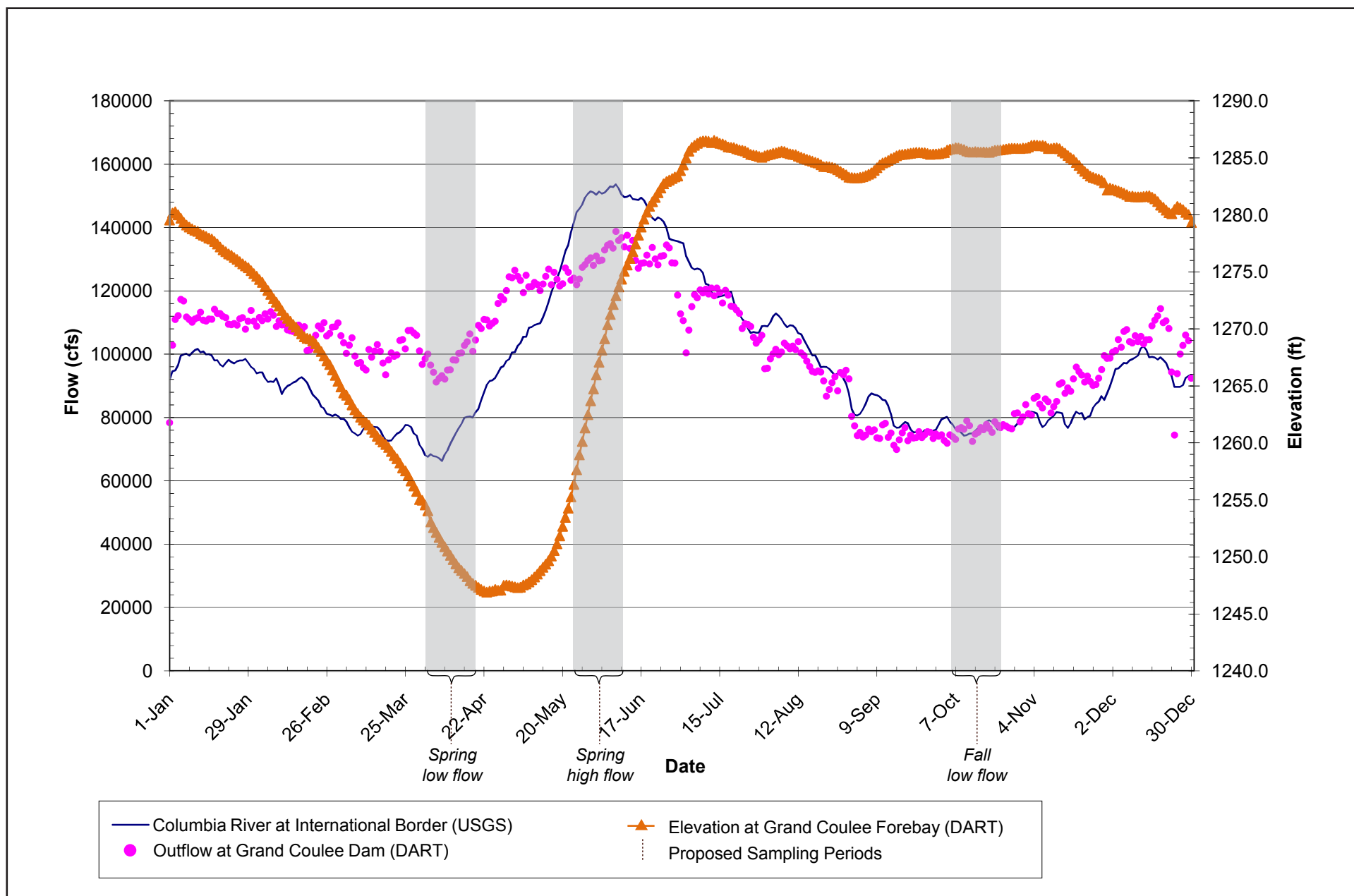
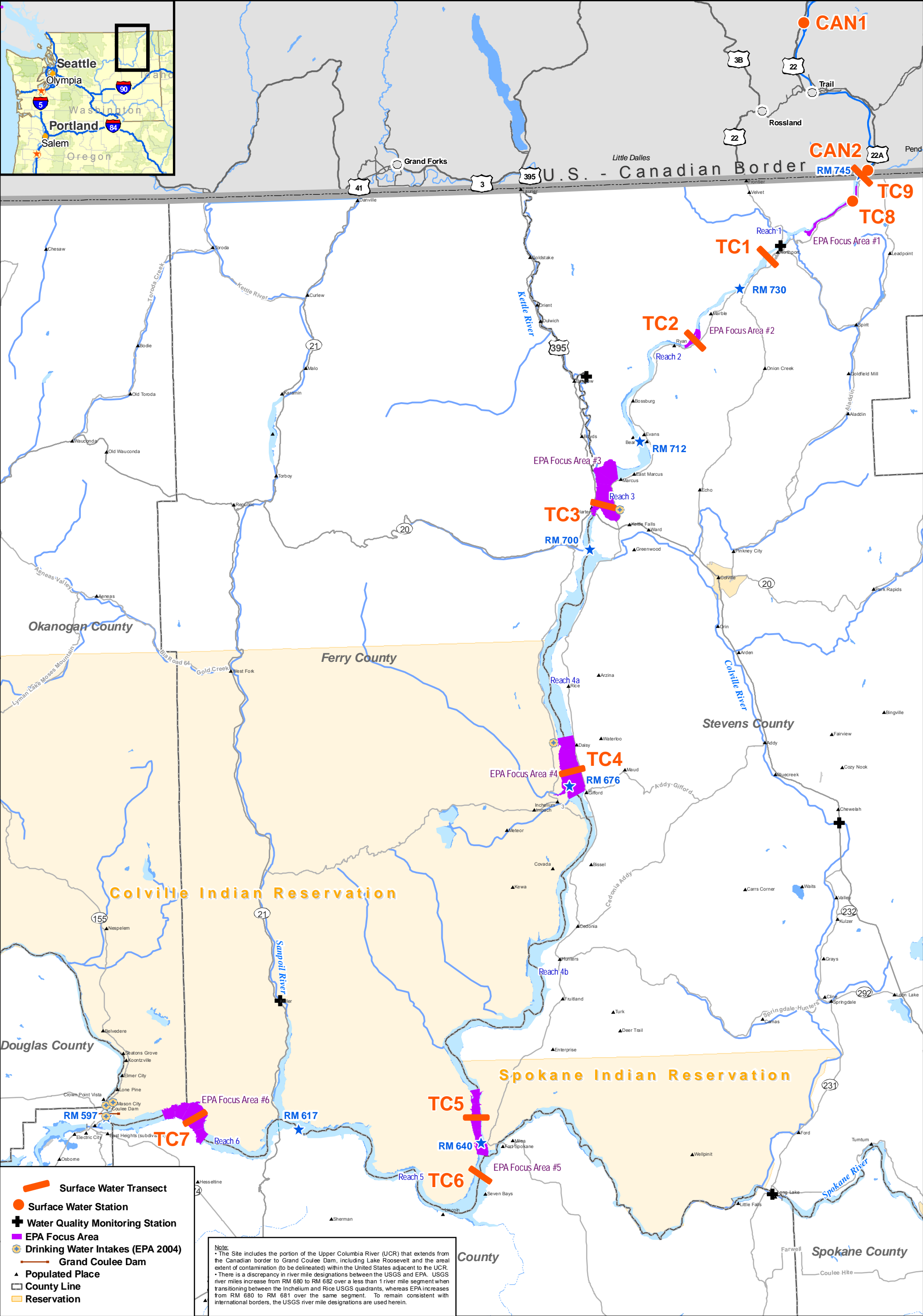


Figure A-6. Lake Roosevelt Daily Average Inflow, Outflow and Pool Elevation: 1978–2007.



Integral Parametrix

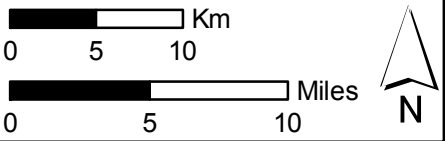


Figure A-7. Proposed 2009/2010 Surface Water Sampling Locations

Upper Columbia River, WA

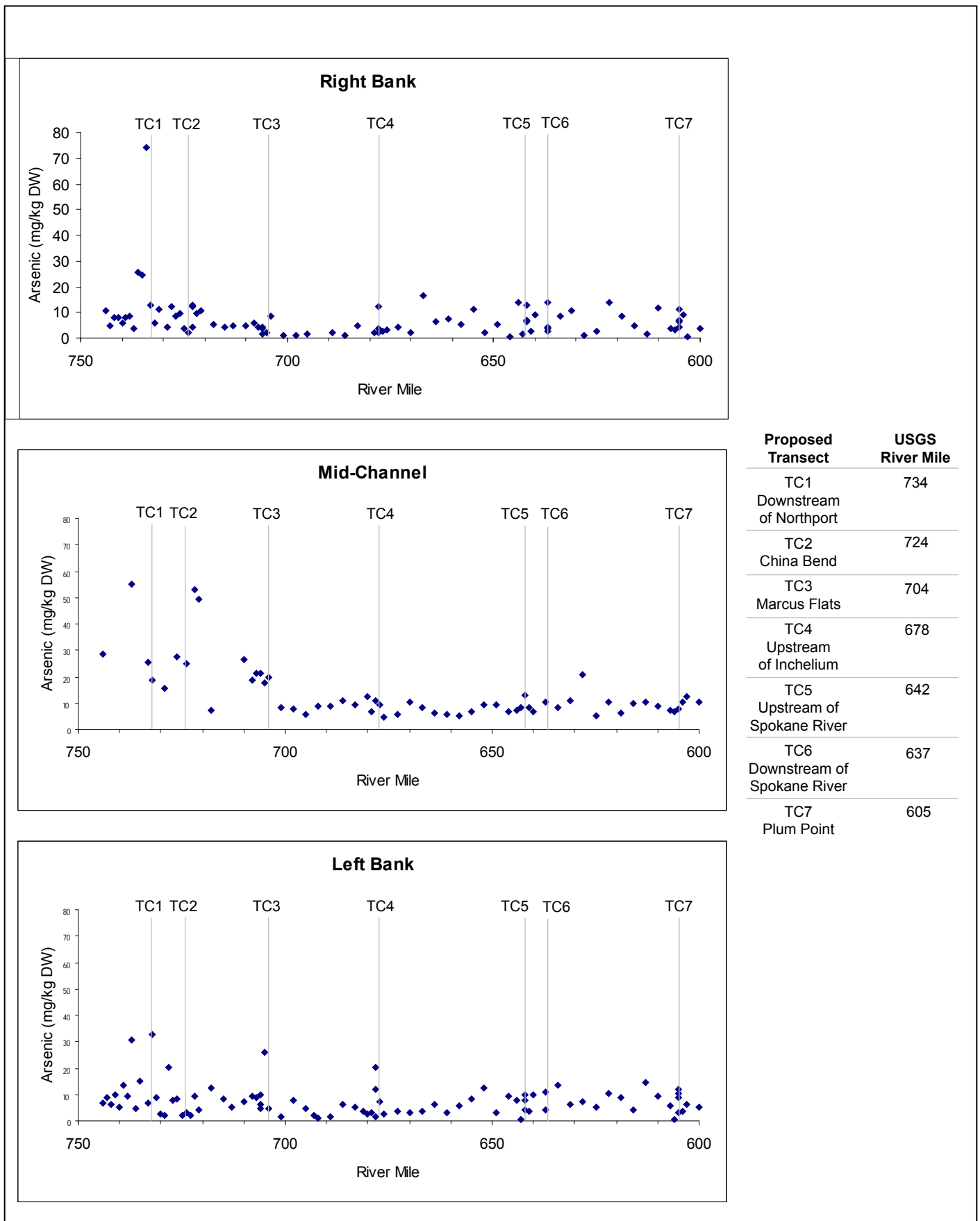
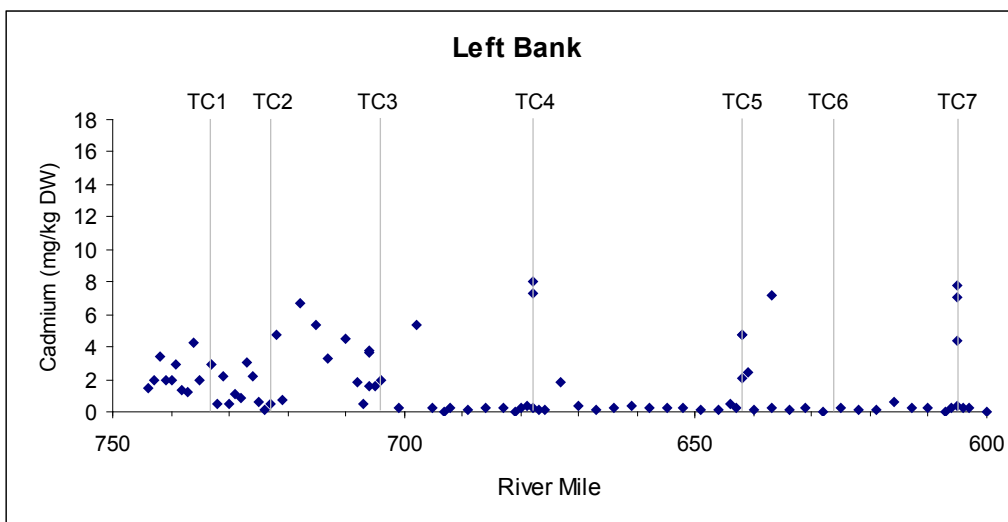
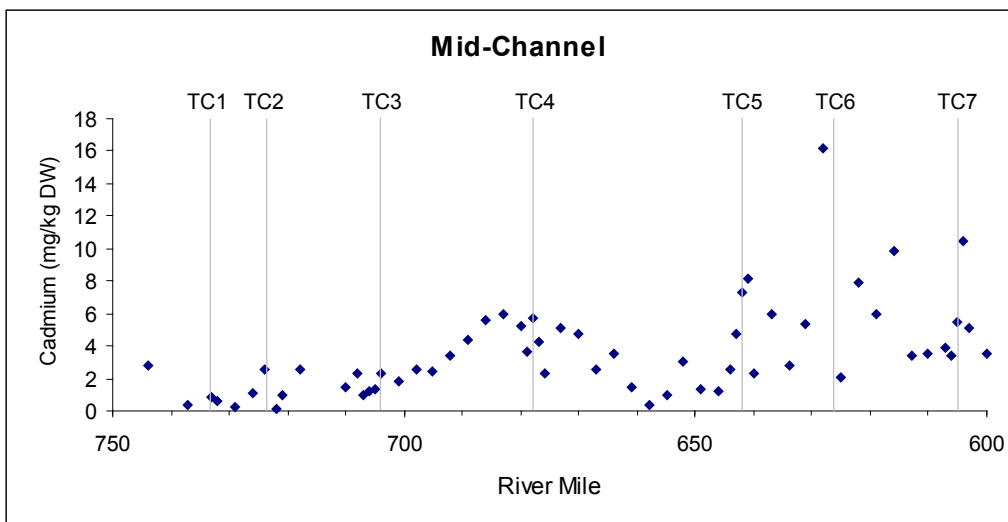
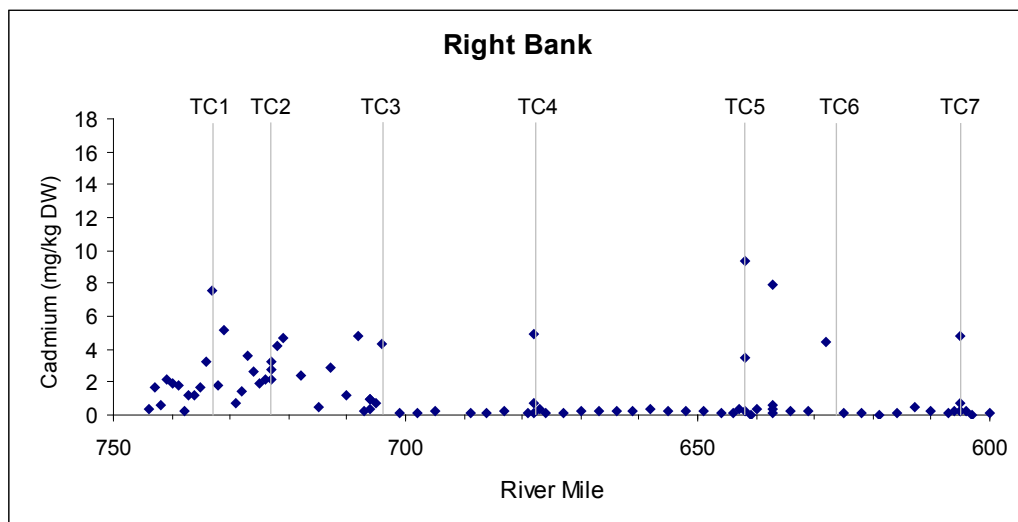


Figure A-8. Longitudinal Distribution of Arsenic Concentrations in Surface Sediments of the UCR in 2005.
Source: USEPA (2006).
Note: Grey Vertical Lines Represent Approximate River Mile of Proposed Surface Water Stations Listed in the Side Table.

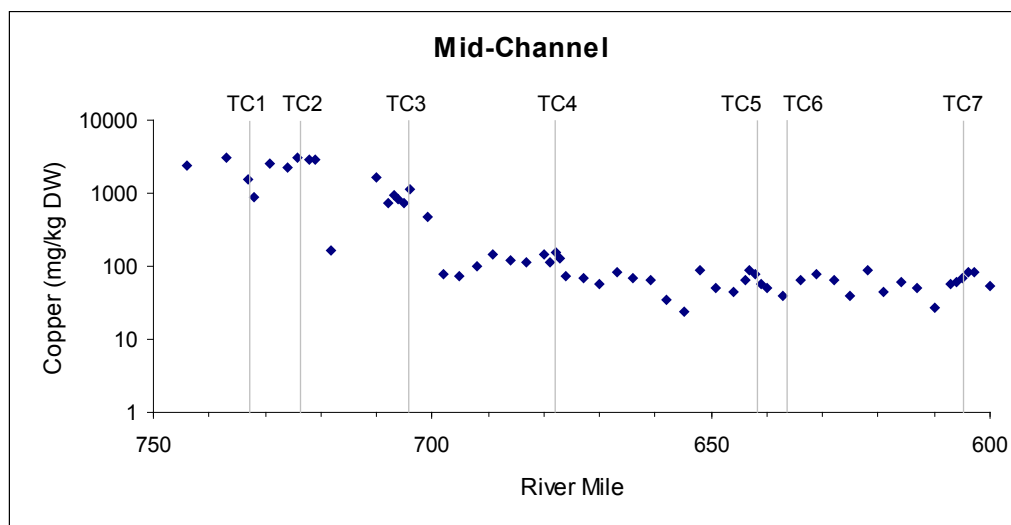
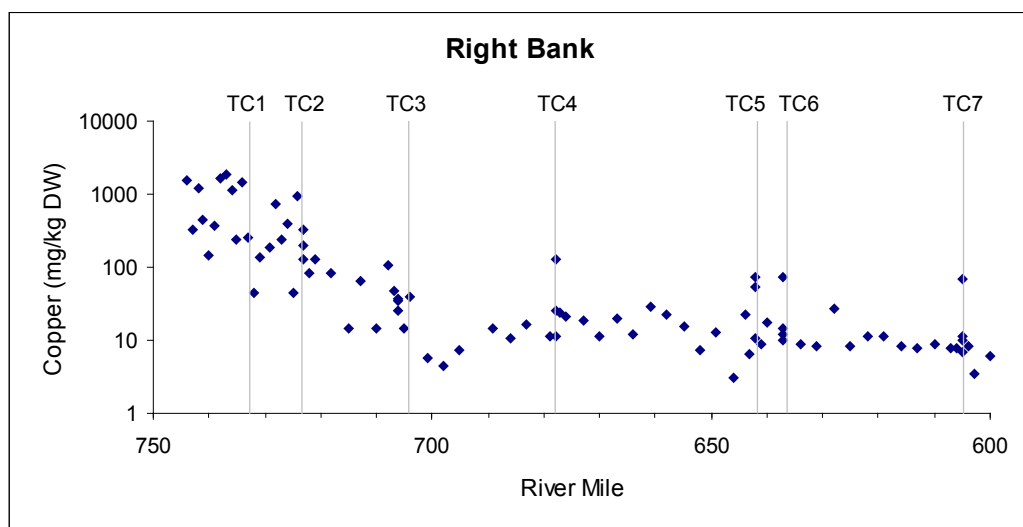


Proposed Transect	USGS River Mile
TC1 Downstream of Northport	734
TC2 China Bend	724
TC3 Marcus Flats	704
TC4 Upstream of Inchelium	678
TC5 Upstream of Spokane River	642
TC6 Downstream of Spokane River	637
TC7 Plum Point	605

Figure A-9. Longitudinal Distribution of Cadmium Concentrations in Surface Sediments of the UCR in 2005.

Source: USEPA (2006).

Note: Grey Vertical Lines Represent Approximate River Mile of Proposed Surface Water Stations Listed in the Side Table.



Proposed Transect	USGS River Mile
TC1 Downstream of Northport	734
TC2 China Bend	724
TC3 Marcus Flats	704
TC4 Upstream of Inchelium	678
TC5 Upstream of Spokane River	642
TC6 Downstream of Spokane River	637
TC7 Plum Point	605

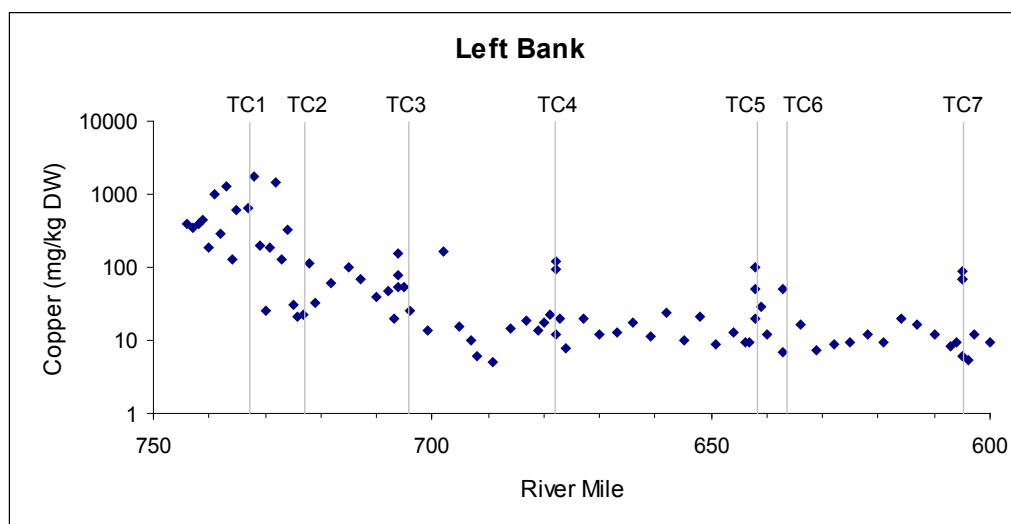
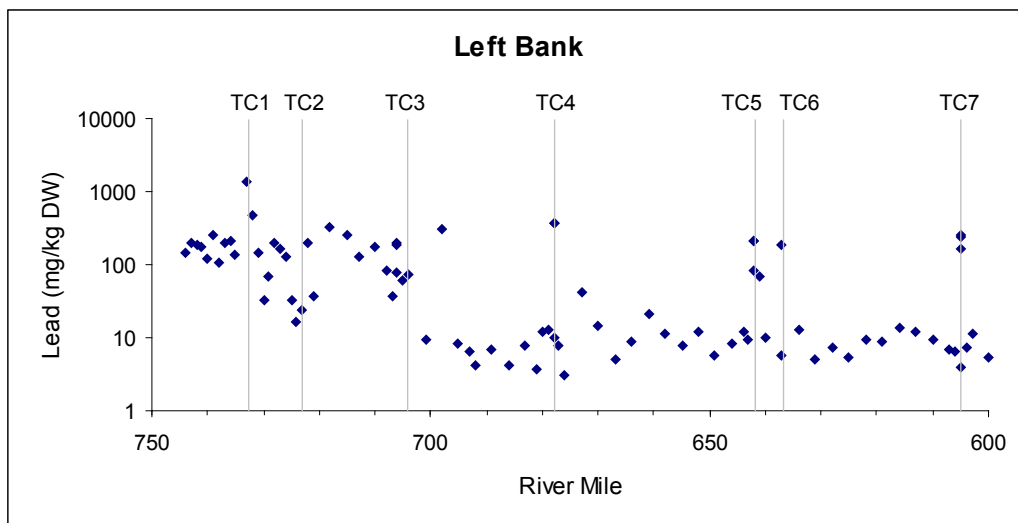
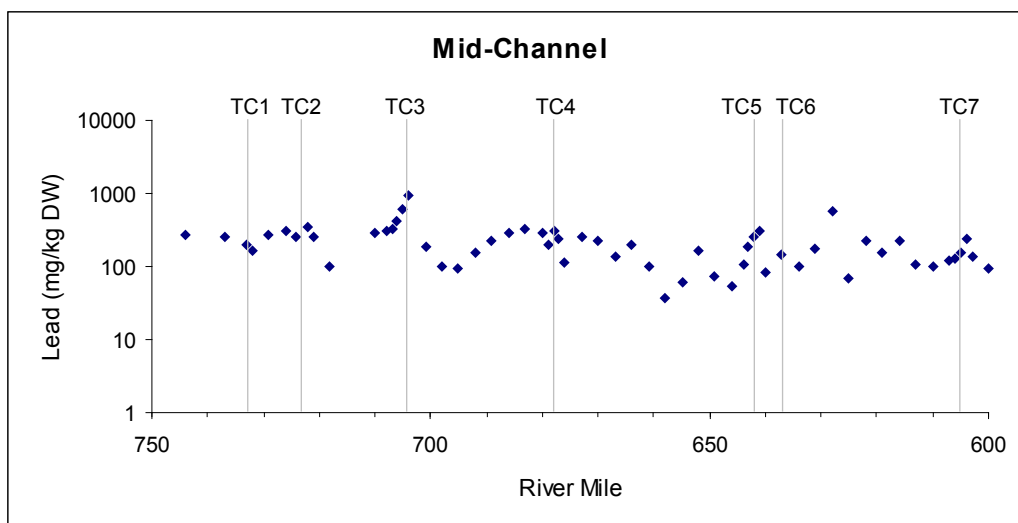
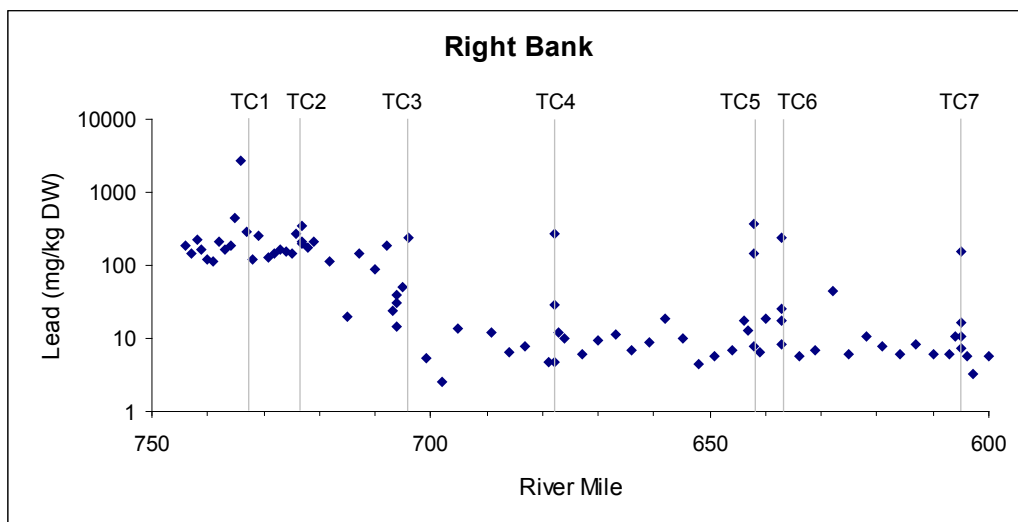


Figure A-10. Longitudinal Distribution of Copper Concentrations in Surface Sediments of the UCR in 2005.

Source: USEPA (2006).

Note: Grey Vertical Lines Represent Approximate River Mile of Proposed Surface Water Stations Listed in the Side Table.

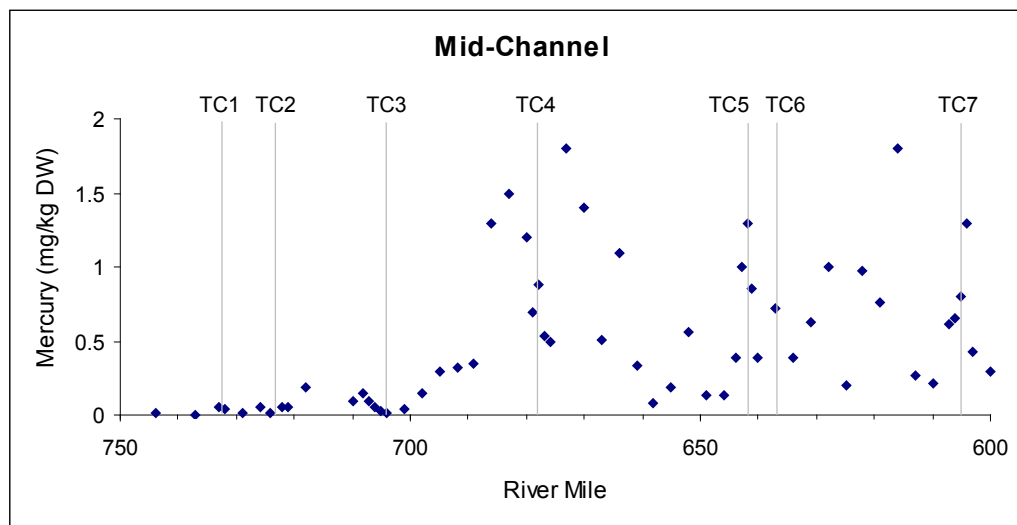
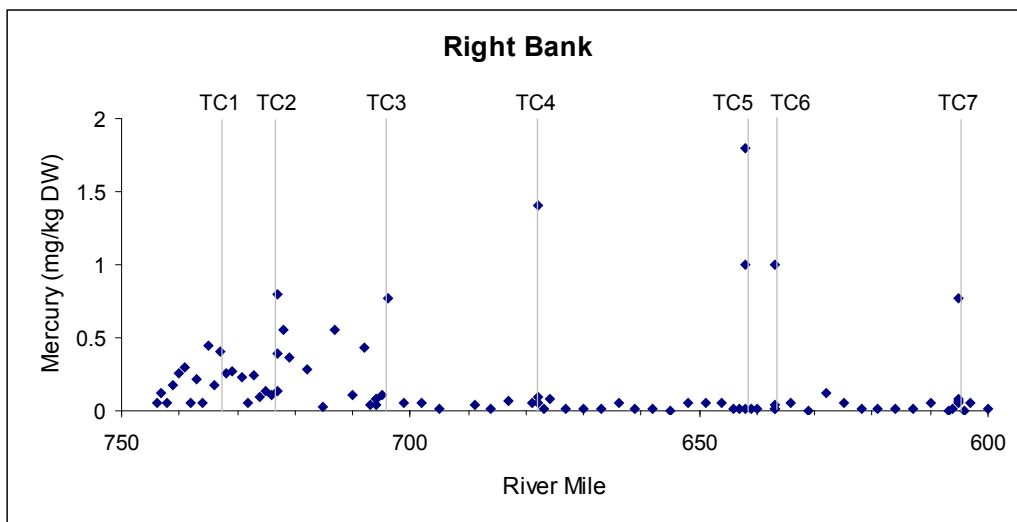


Proposed Transect	USGS River Mile
TC1 Downstream of Northport	734
TC2 China Bend	724
TC3 Marcus Flats	704
TC4 Upstream of Inchelium	678
TC5 Upstream of Spokane River	642
TC6 Downstream of Spokane River	637
TC7 Plum Point	605

Figure A-11. Longitudinal Distribution of Lead Concentrations in Surface Sediments of the UCR in 2005.

Source: USEPA (2006).

Note: Grey Vertical Lines Represent Approximate River Mile of Proposed Surface Water Stations Listed in the Side Table.



Proposed Transect	USGS River Mile
TC1 Downstream of Northport	734
TC2 China Bend	724
TC3 Marcus Flats	704
TC4 Upstream of Inchelium	678
TC5 Upstream of Spokane River	642
TC6 Downstream of Spokane River	637
TC7 Plum Point	605

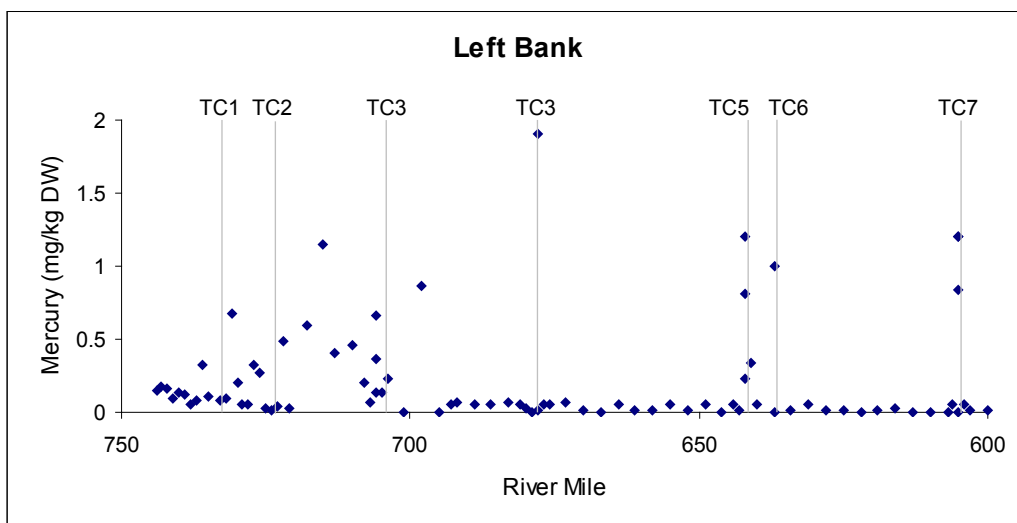


Figure A-12. Longitudinal Distribution of Mercury Concentrations in Surface Sediments of the UCR in 2005.

Source: USEPA (2006).

Note: Grey Vertical Lines Represent Approximate River Mile of Proposed Surface Water Stations Listed in the Side Table.

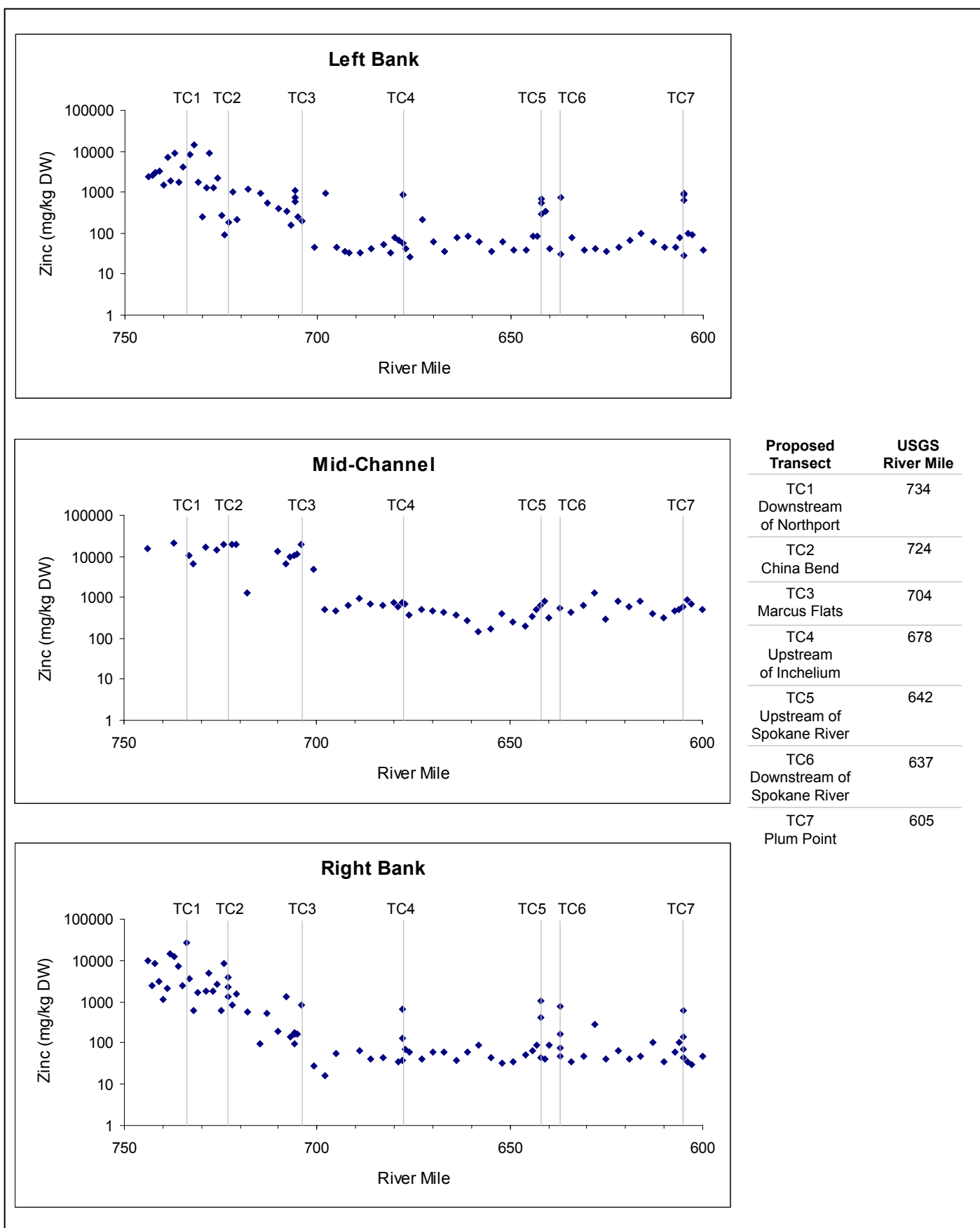


Figure A-13. Longitudinal Distribution of Zinc Concentrations in Surface Sediments of the UCR in 2005.

Source: USEPA (2006).

Note: Grey Vertical Lines Represent Approximate River Mile of Proposed Surface Water Stations Listed in the Side Table.

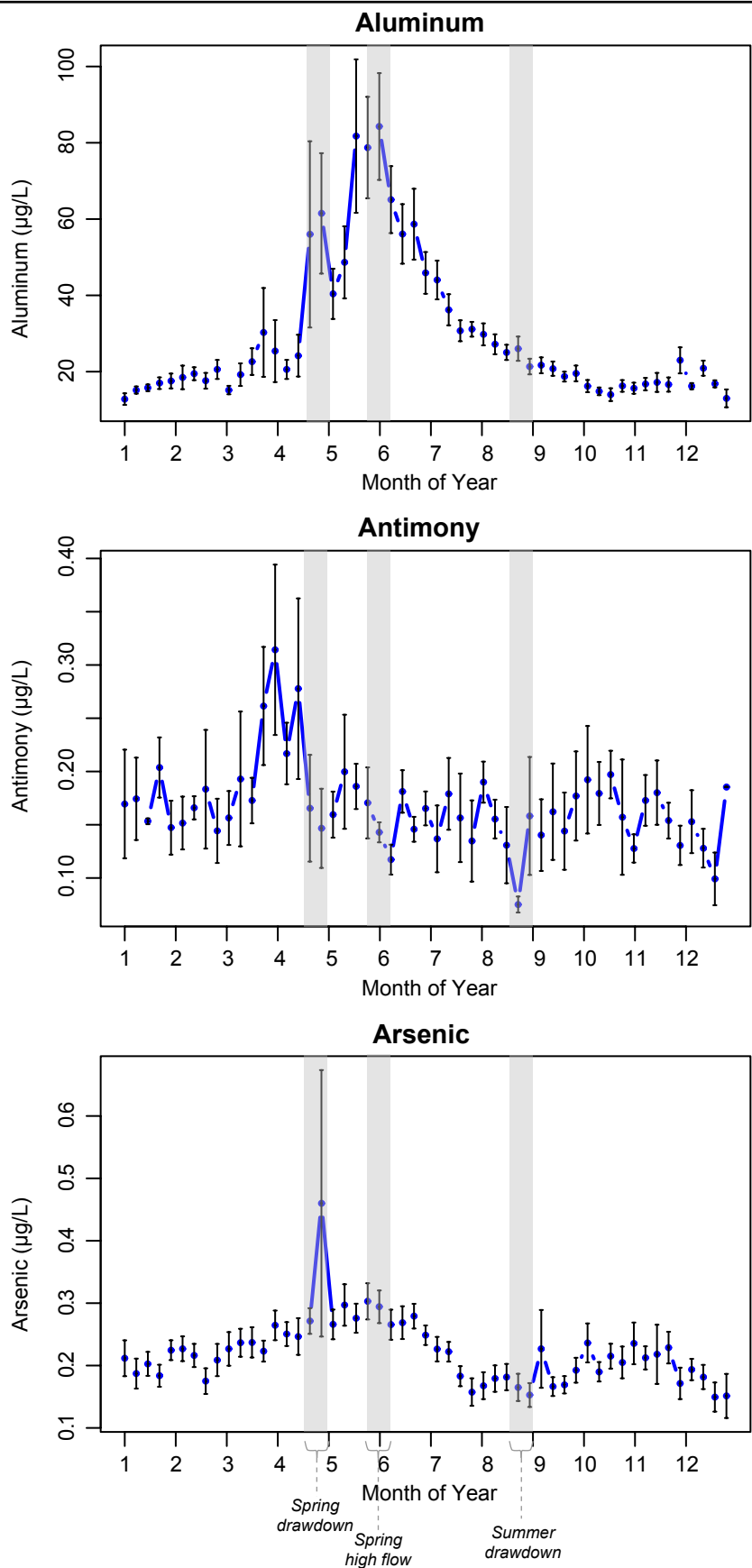


Figure A-14a. Weekly Mean Concentrations of Total Aluminum, Antimony, and Arsenic in the Columbia River at Waneta, B.C., from 1995 to 2007 (Mean ± 1 SE).

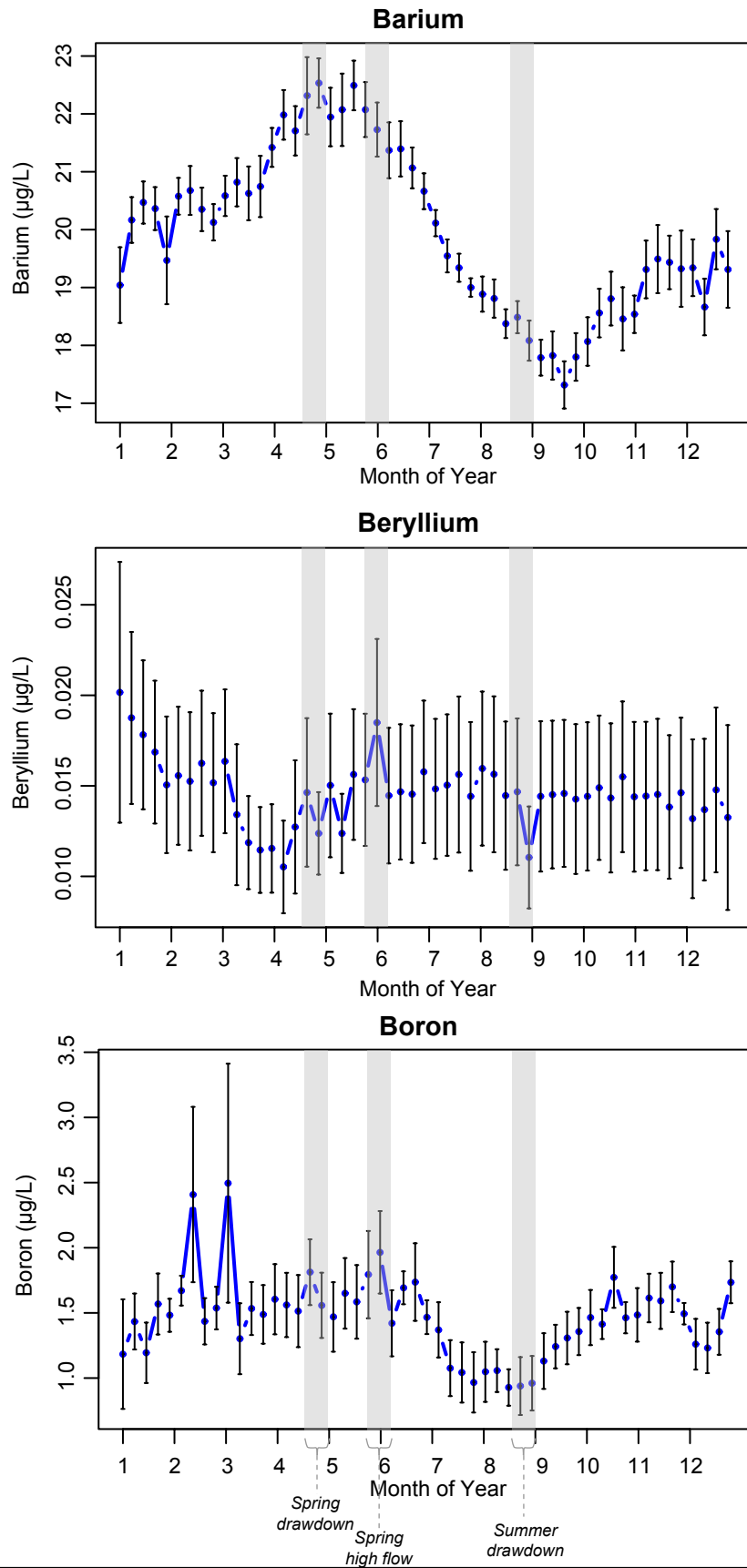


Figure A-14b. Weekly Mean Concentrations of Total Barium, Beryllium, and Boron in the Columbia River at Waneta, B.C., from 1995 to 2007 (Mean ± 1 SE).

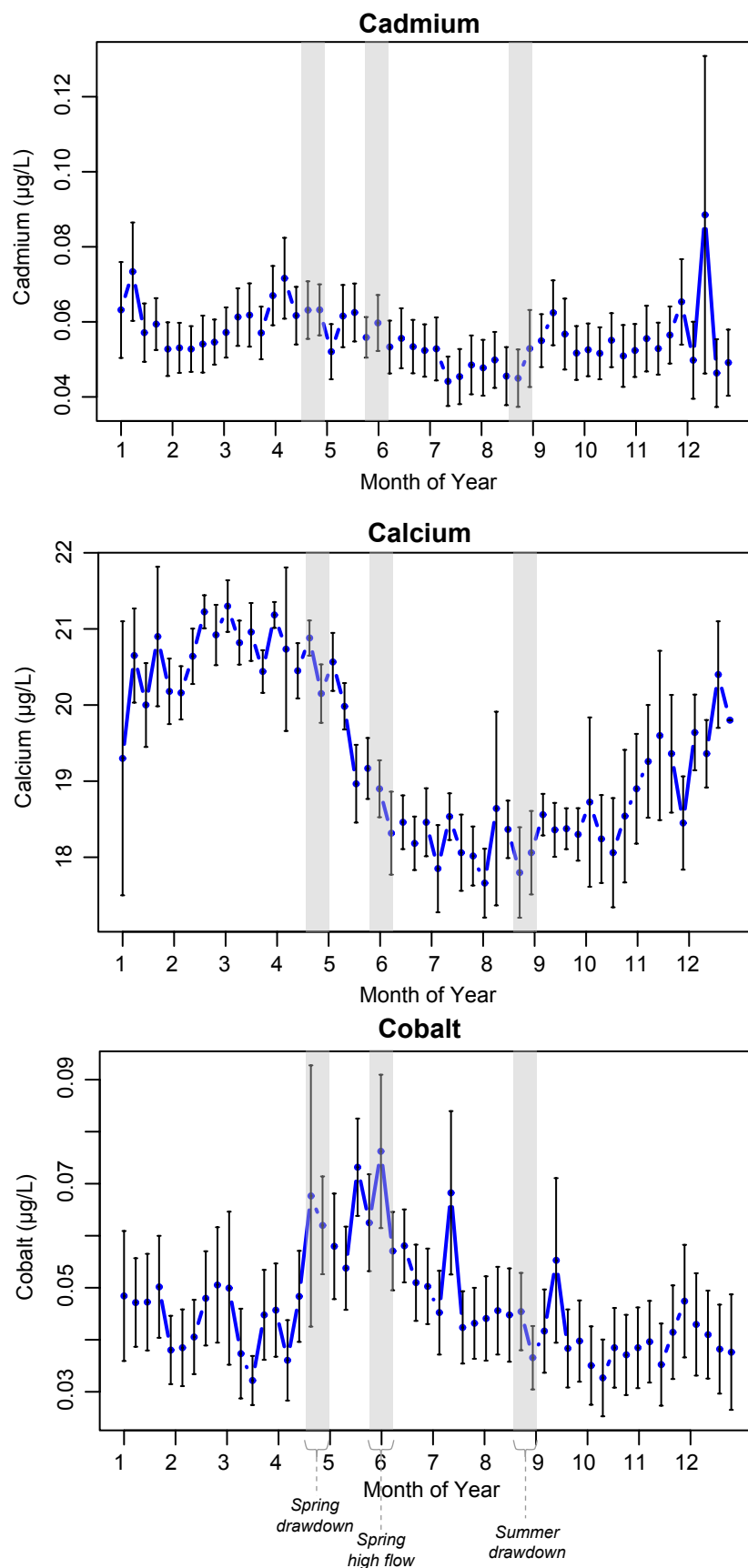


Figure A-14c. Weekly Mean Concentrations of Total Cadmium, Calcium, and Cobalt in the Columbia River at Waneta, B.C., from 1995 to 2007 (Mean \pm 1 SE).

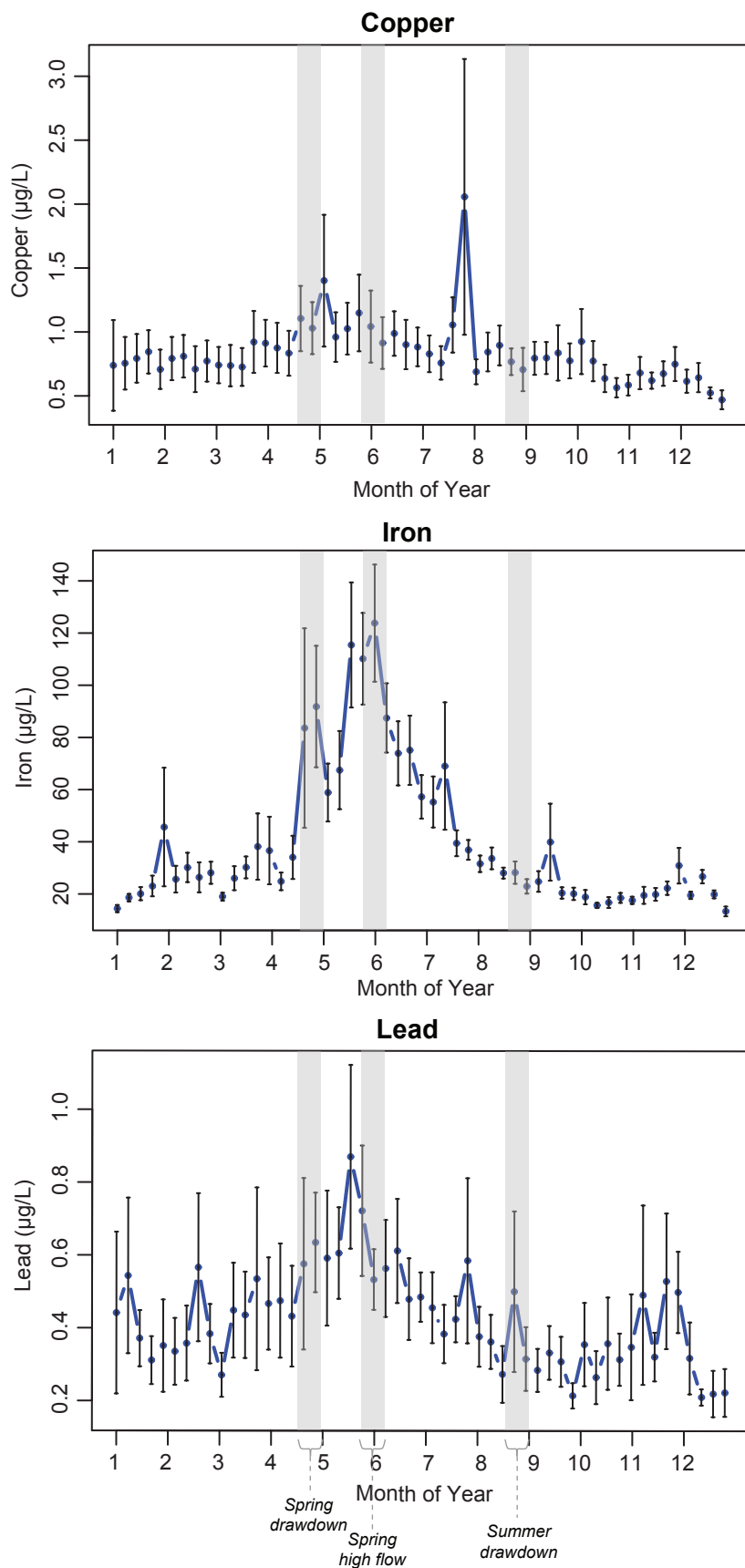


Figure A-14d. Weekly Mean Concentrations of Total Copper, Iron, and Lead in the Columbia River at Waneta, B.C., from 1995 to 2007 (Mean \pm 1 SE).

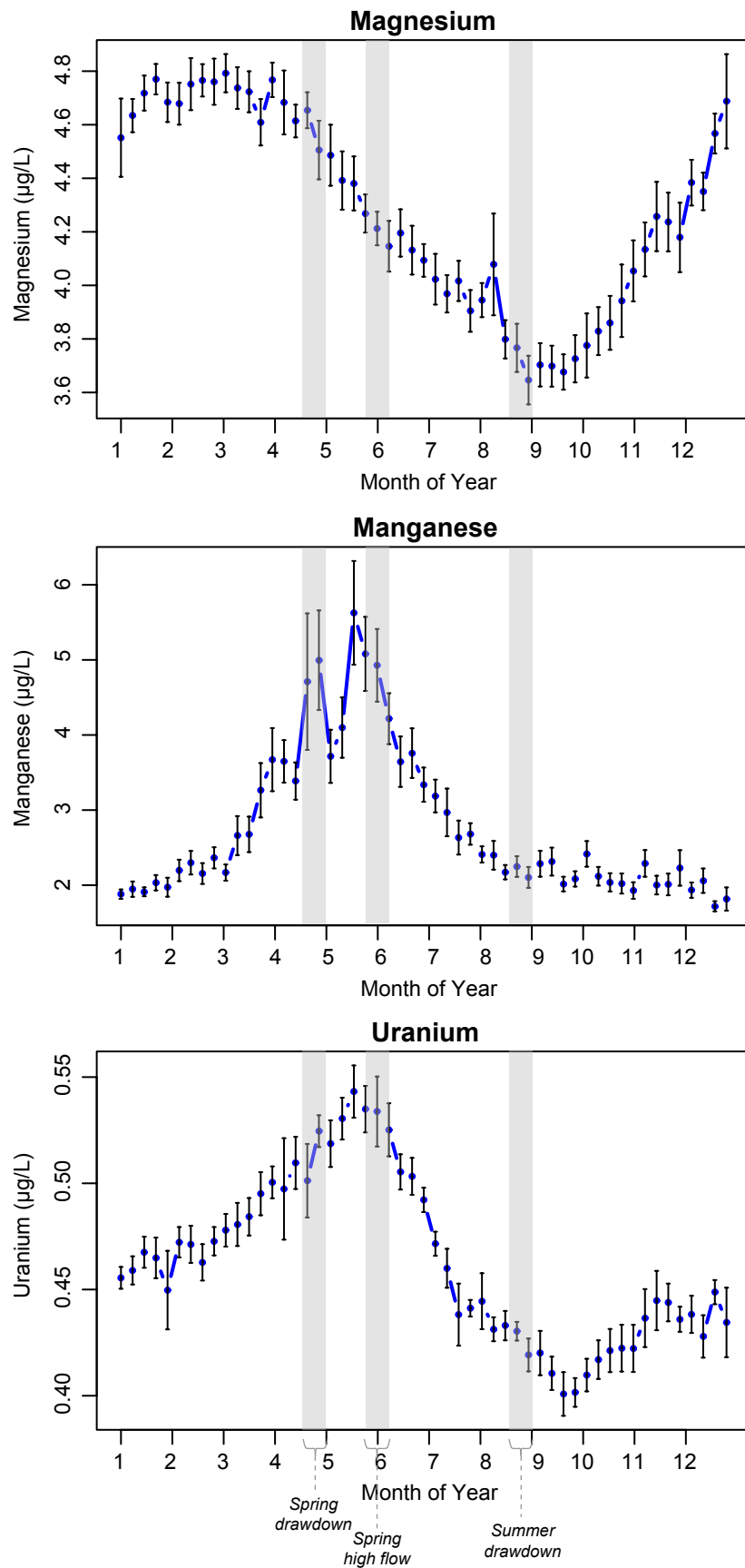


Figure A-14e. Weekly Mean Concentrations of Mean Magnesium, Manganese, and Uranium in the Columbia River at Waneta, B.C., from 1995 to 2007 (Mean \pm 1 SE).

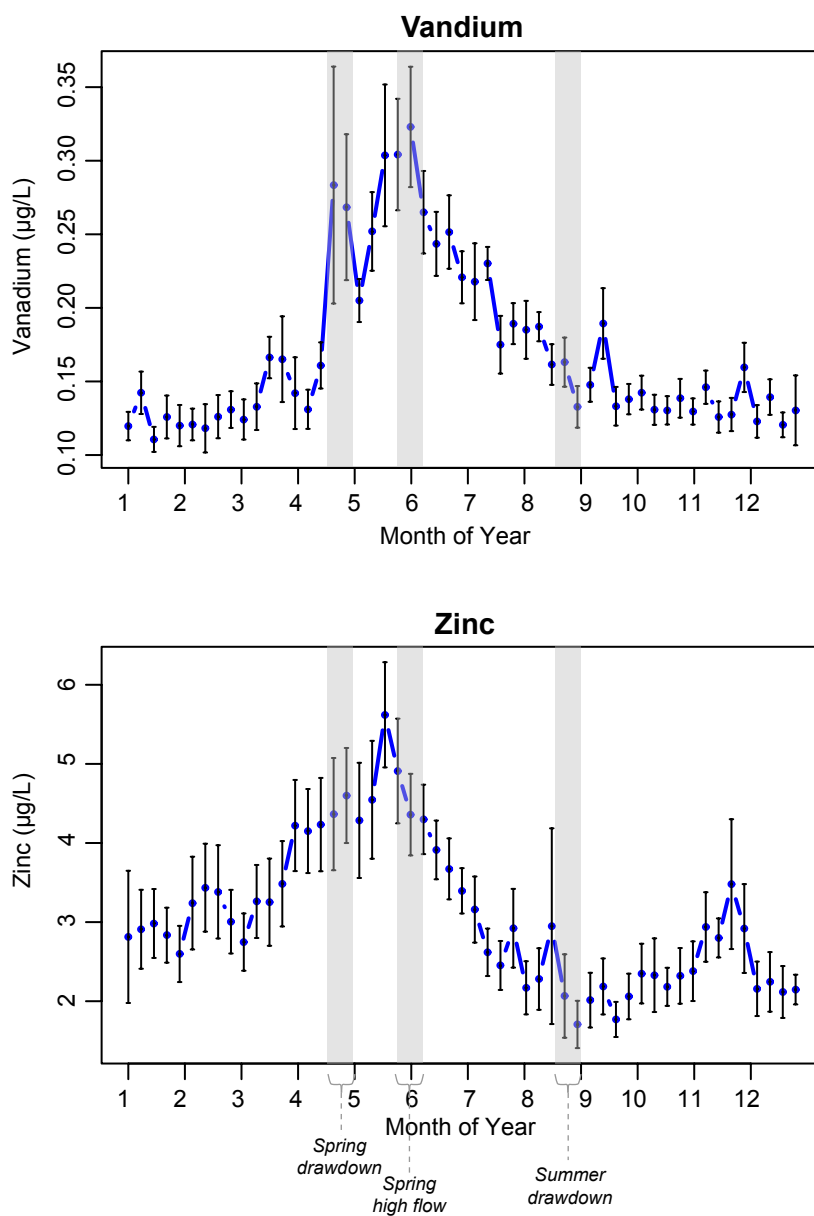


Figure A-14f. Weekly Mean Concentrations of Total Vanadium and Zinc in the Columbia River at Waneta, B.C., from 1995 to 2007 (Mean ± 1 SE).

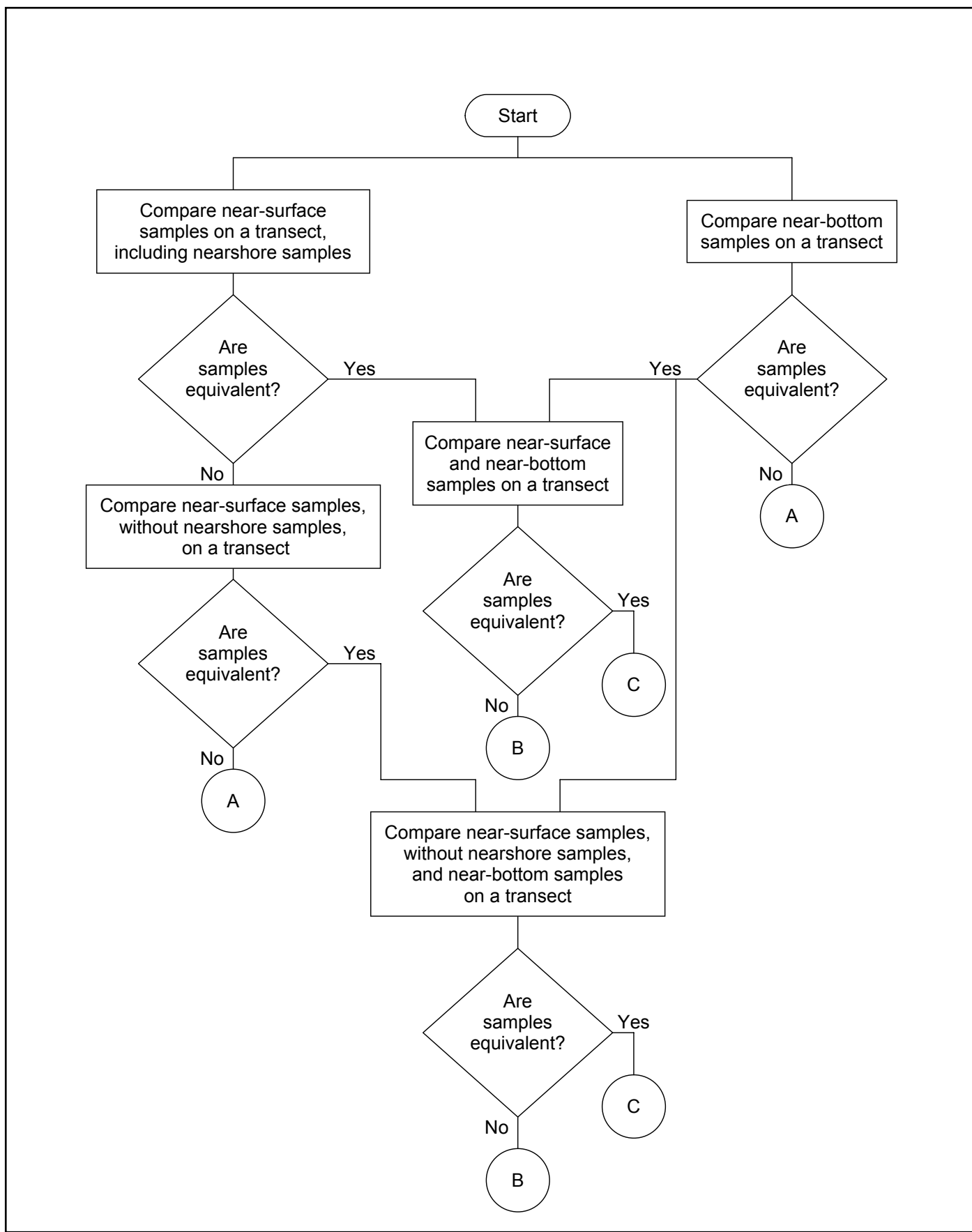


Figure A-15a. Flowchart for Pooling of Surface Water Samples.

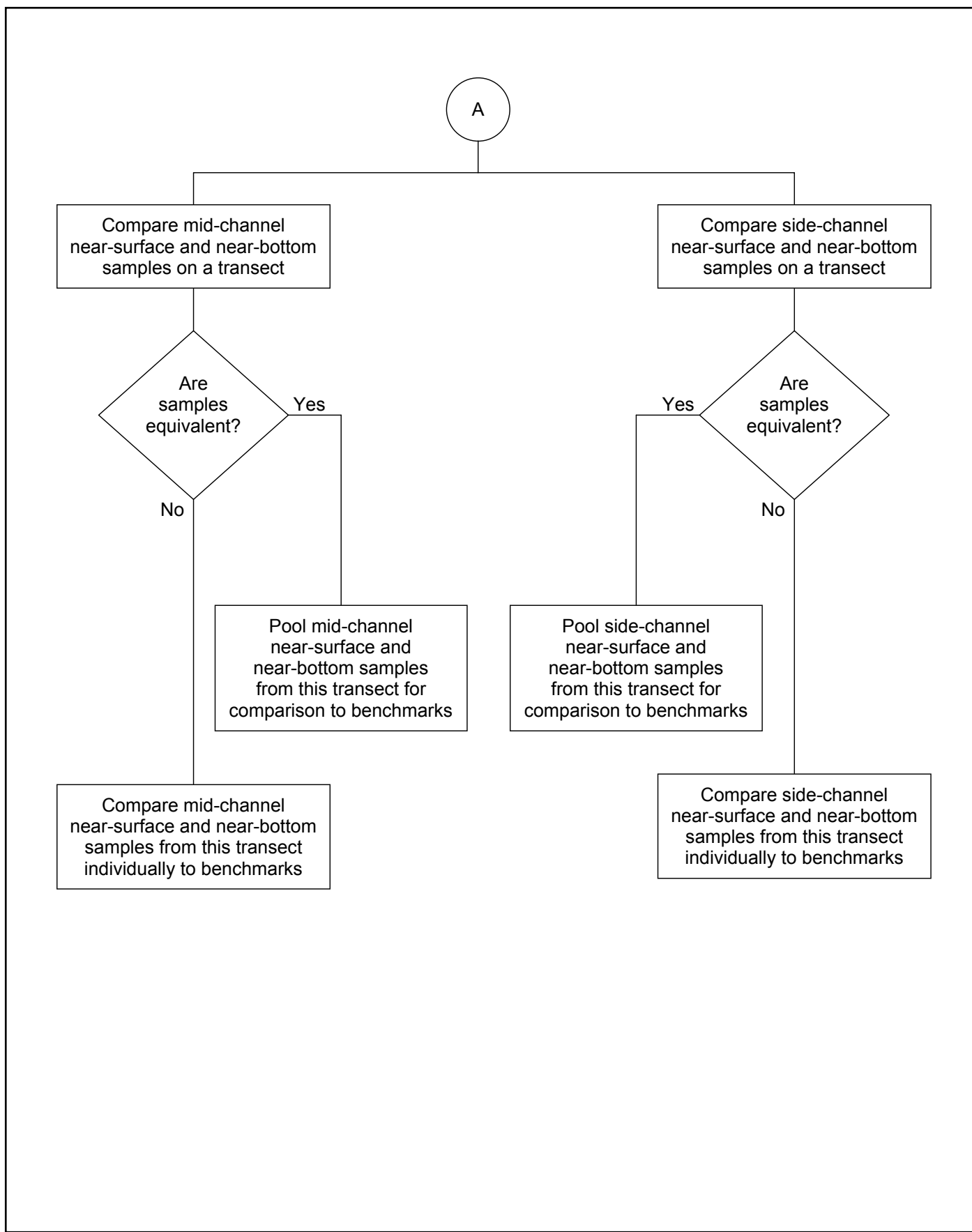


Figure A-15b. Flowchart for Pooling of Surface Water Samples.

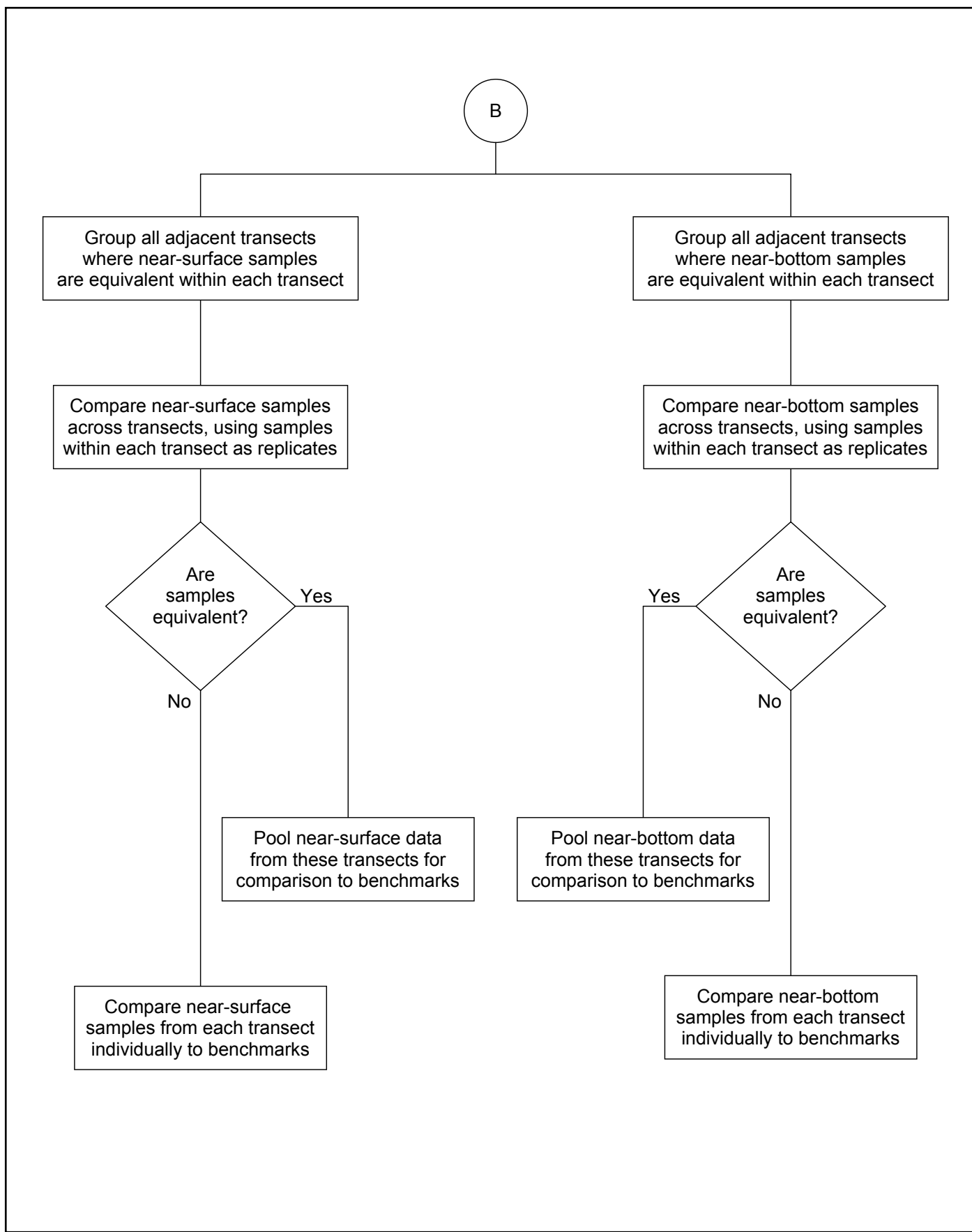


Figure A-15c. Flowchart for Pooling of Surface Water Samples.

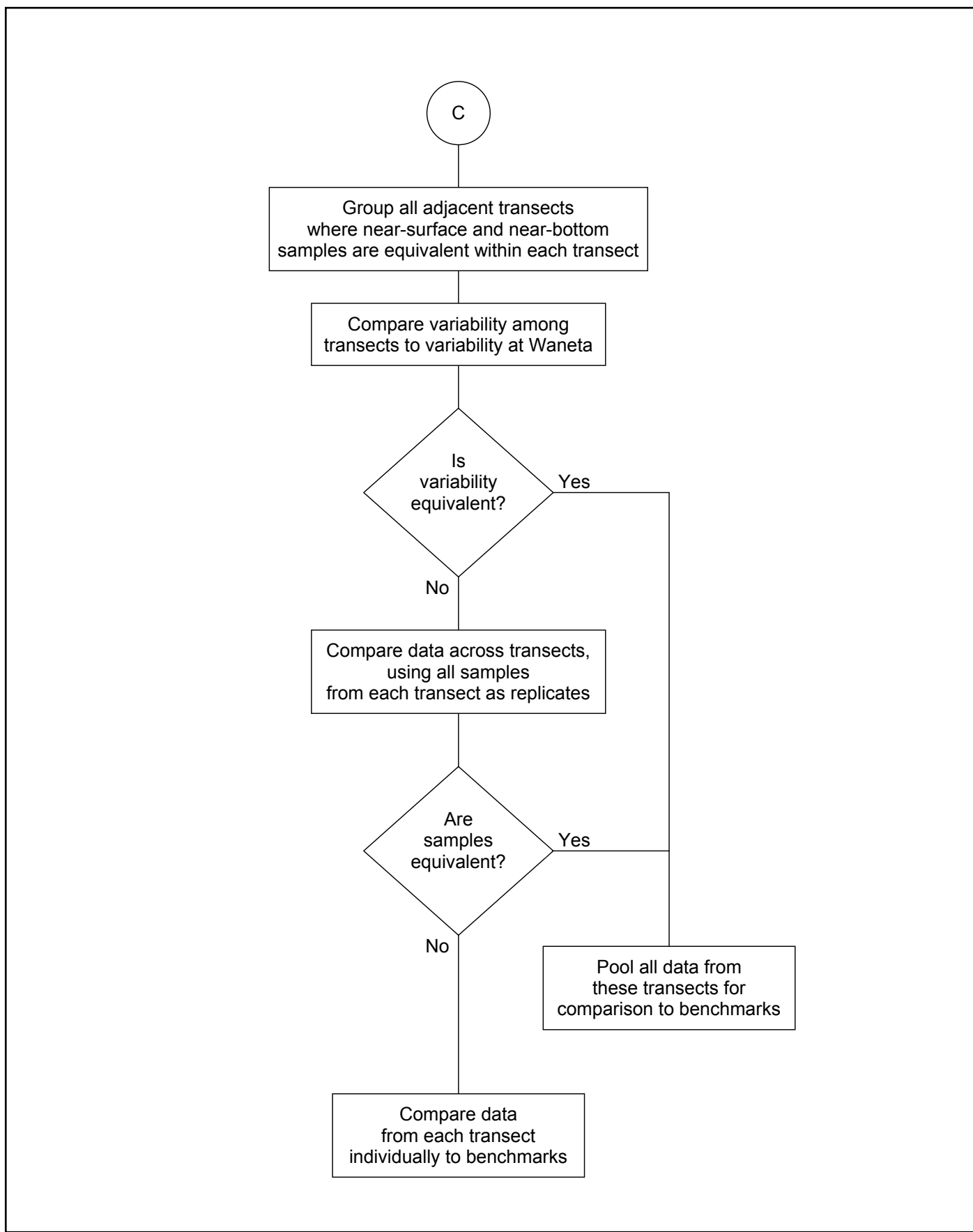


Figure A-15d. Flowchart for Pooling of Surface Water Samples.

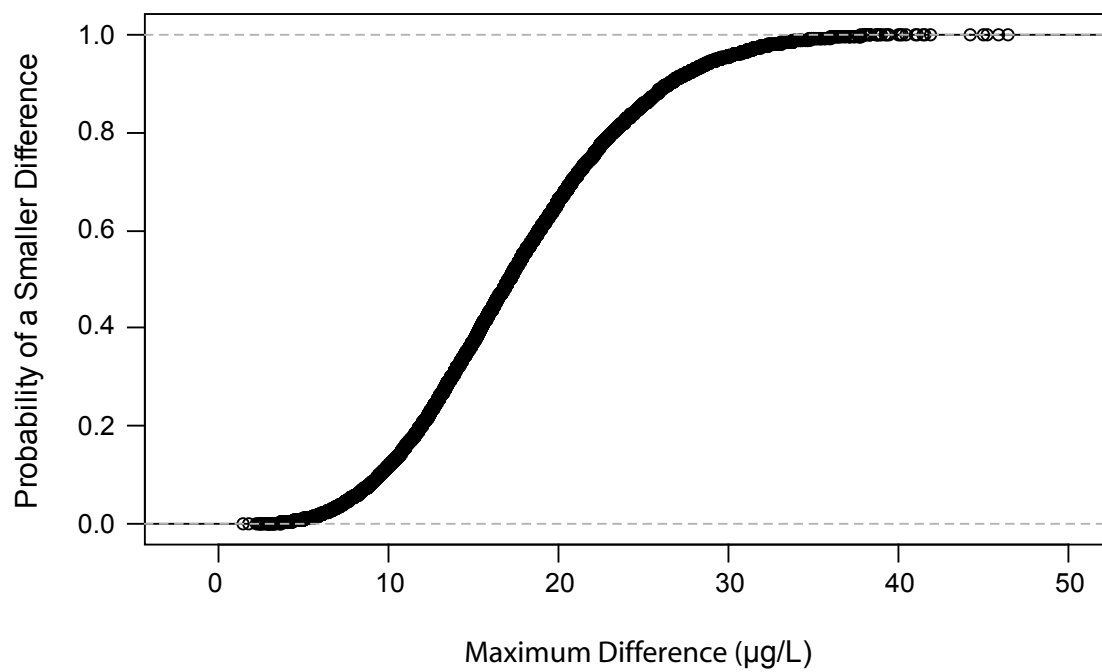


Figure A-16. Example Probability Distribution for the Maximum Difference Between Transect Samples.

Transect TC1

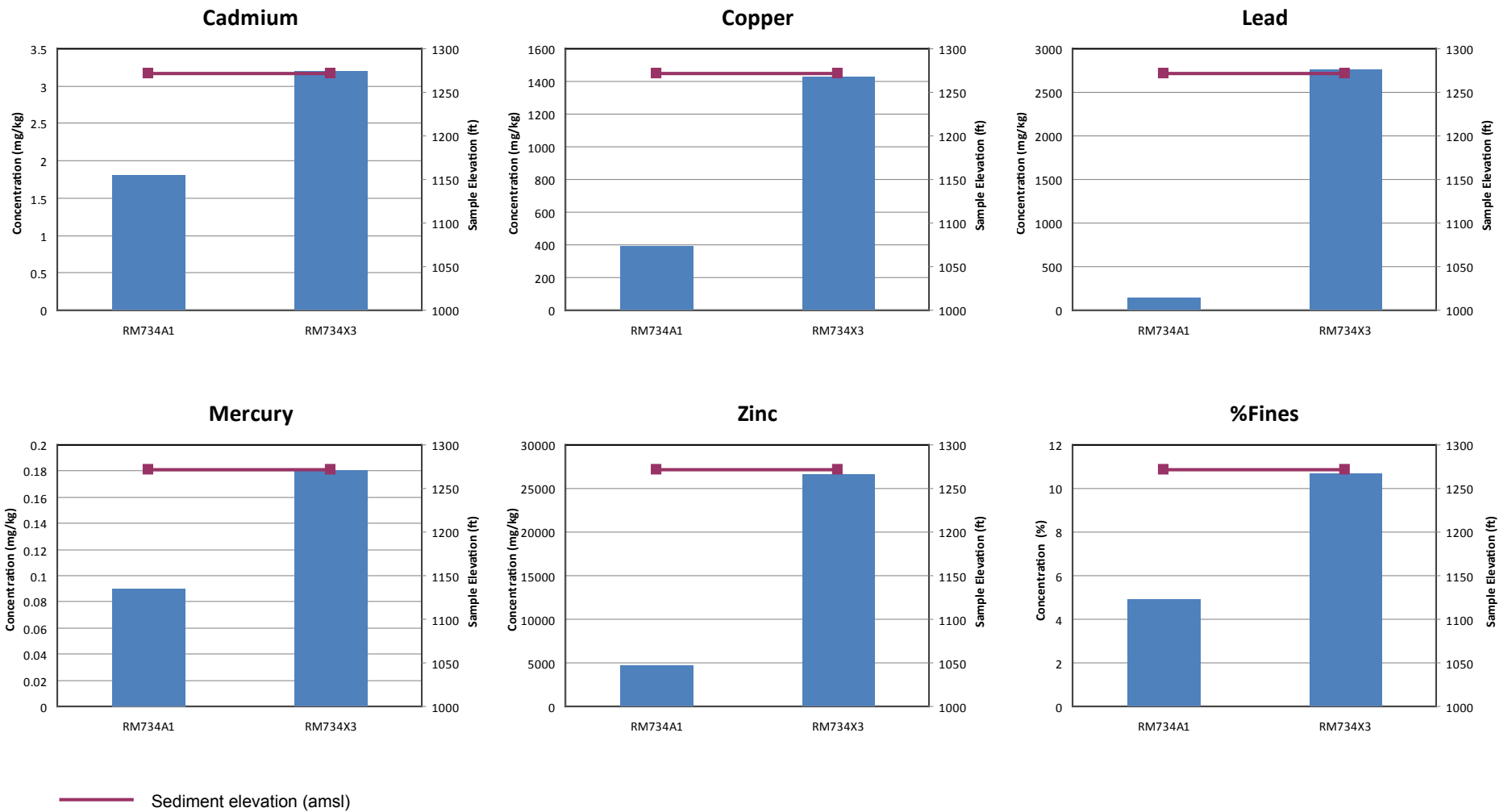


Figure B-1. Concentrations of Five Metals and Percent Fines (Silt and Clay) in Surface Sediment Samples Relative to Sediment Bed Elevation at USGS RM 734 (Northport).
Source: USEPA (2006e).

Transect TC2

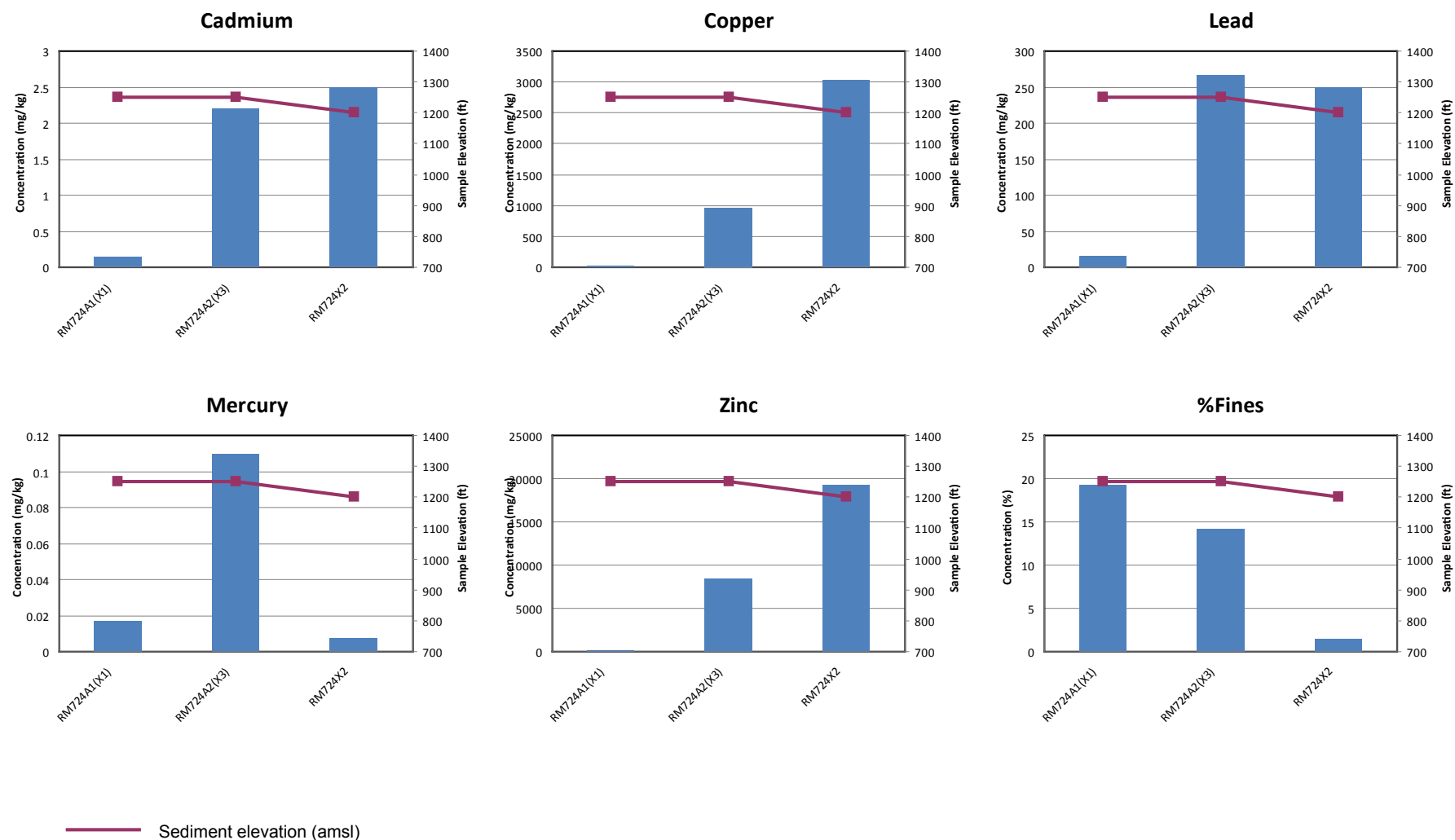


Figure B-2. Concentrations of Five Metals and Percent Fines (Silt and Clay) in Surface Sediment Samples Relative to Sediment Bed Elevation at USGS RM 724 (China Bend).
Source: USEPA (2006e).

Transect TC3

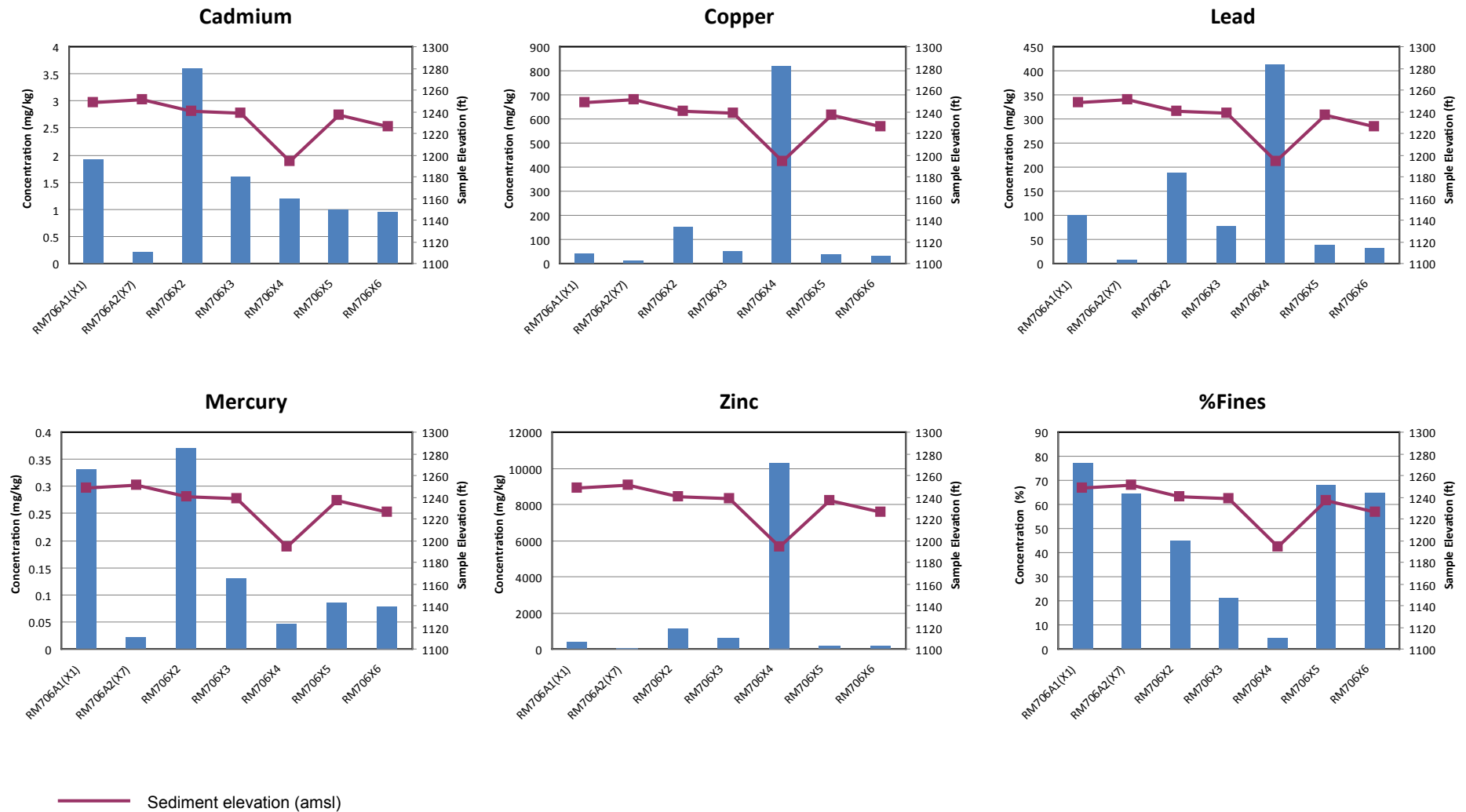


Figure B-3. Concentrations of Five Metals and Percent Fines (Silt and Clay) in Surface Sediment Samples Relative to Sediment Bed Elevation at USGS RM 704 (Marcus Flats).
Source: USEPA (2006e).

Transect TC4

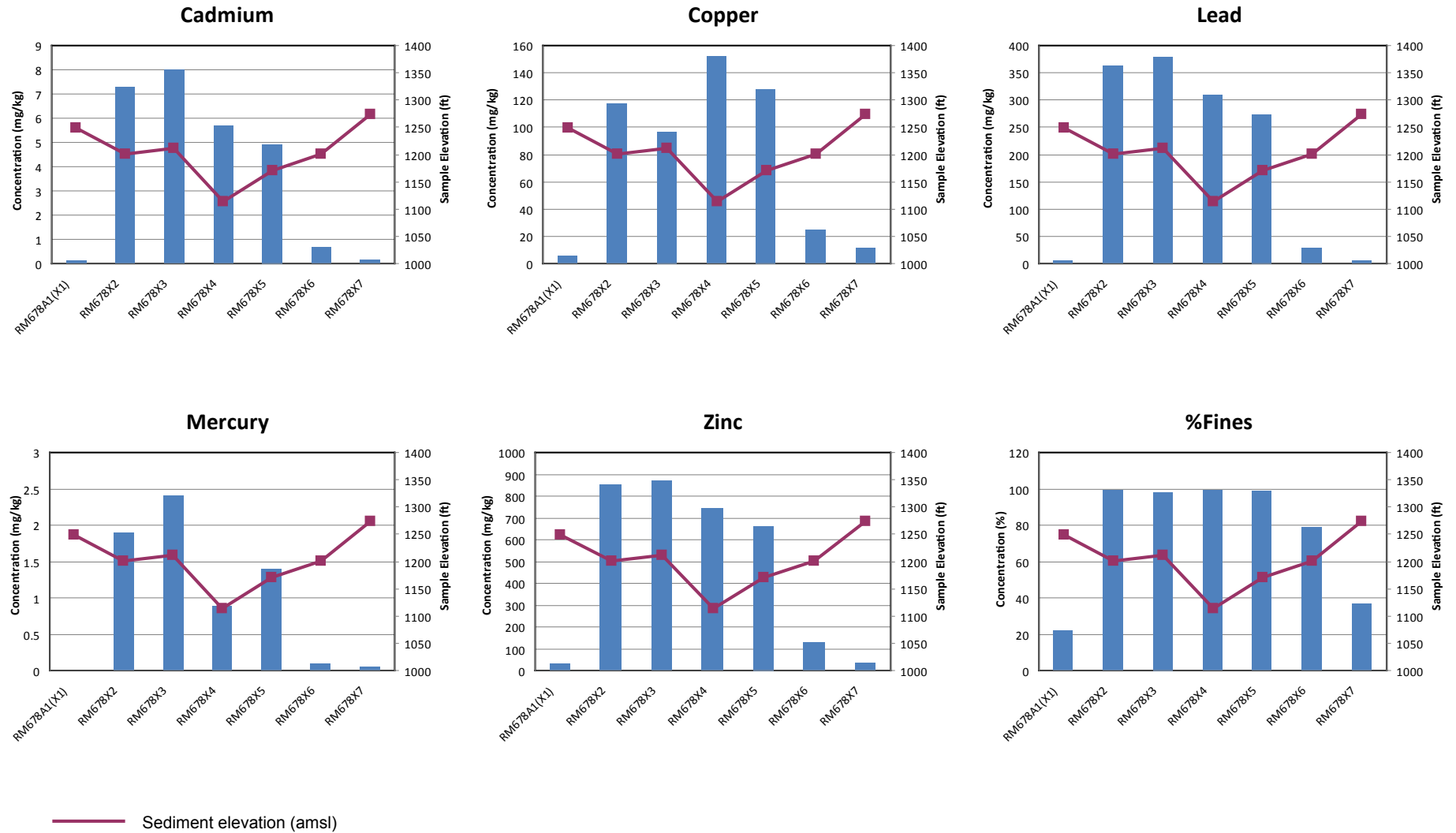


Figure B-4. Concentrations of Five Metals and Percent Fines (Silt and Clay) in Surface Sediment Samples Relative to Sediment Bed Elevation at USGS RM 678 (Upstream of Inchelium.)
Source: USEPA (2006e).

Transect TC5

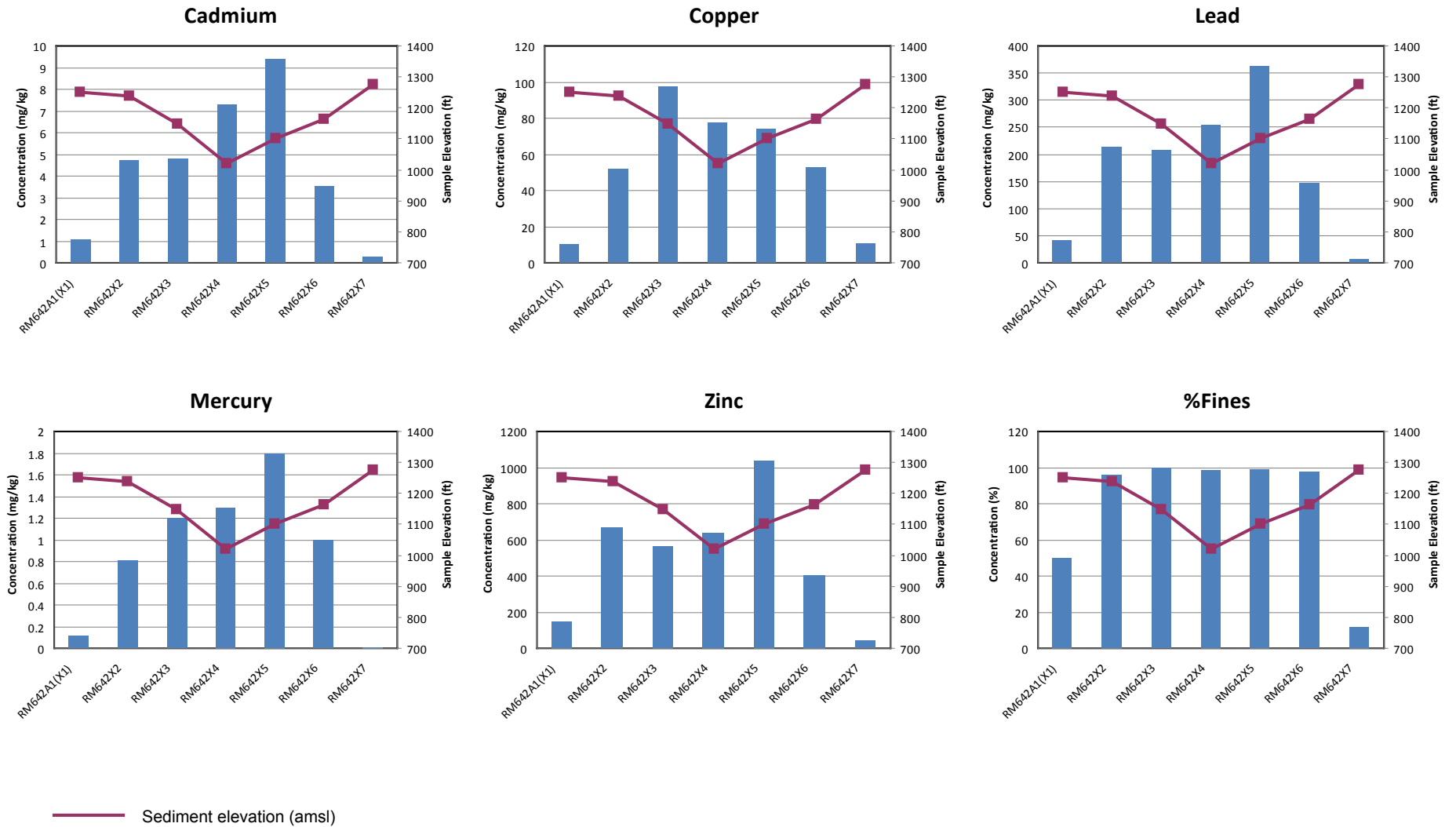


Figure B-5. Concentrations of Five Metals and Percent Fines (Silt and Clay) in Surface Sediment Samples Relative to Sediment Bed Elevation at USGS RM 642 (Upstream of Spokane River).
Source: USEPA (2006e).

Transect TC6

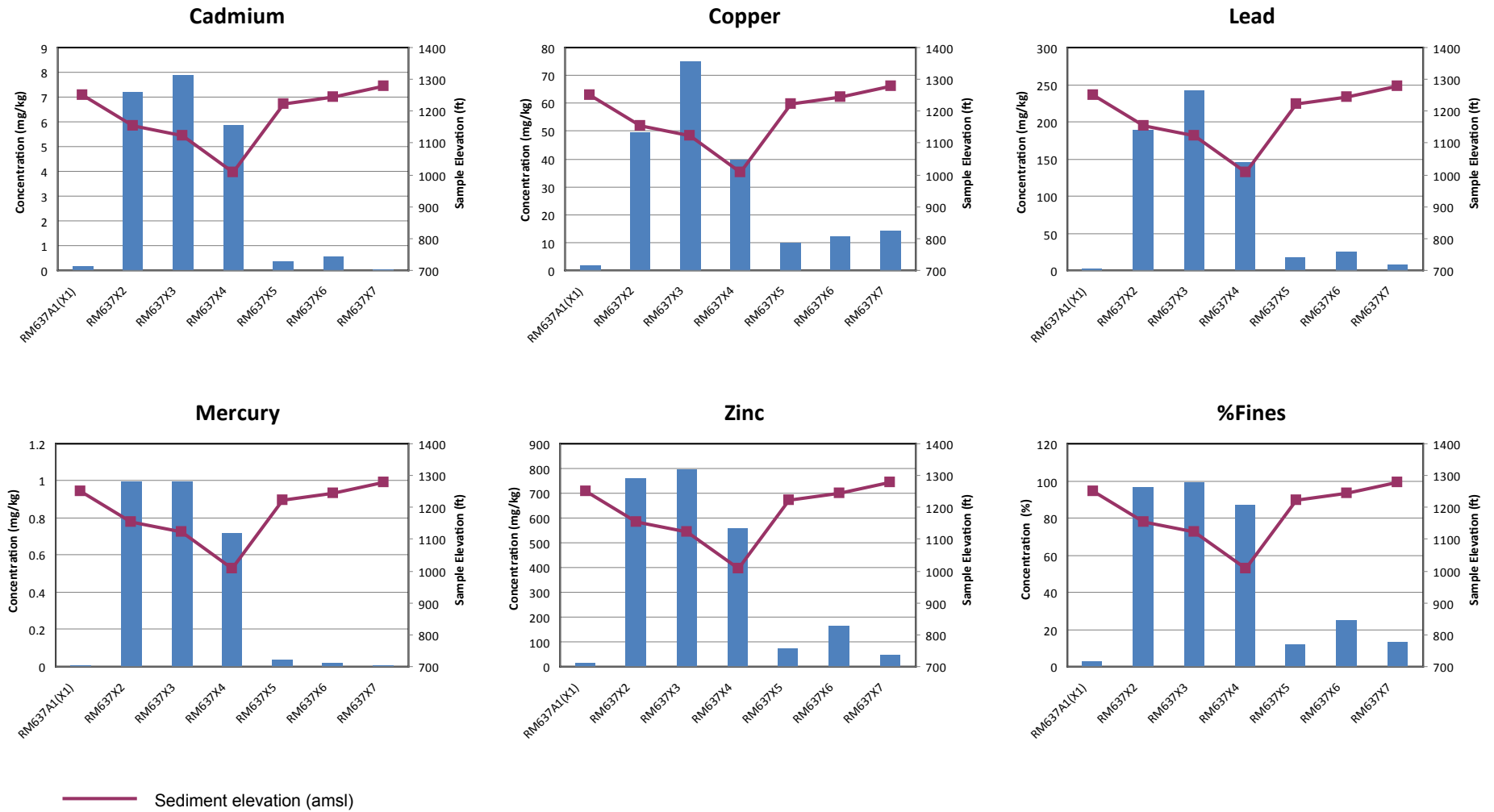


Figure B-6. Concentrations of Five Metals and Percent Fines (Silt and Clay) in Surface Sediment Samples Relative to Sediment Bed Elevation at USGS RM 637 (Downstream of Spokane River).
Source: USEPA (2006e).

Transect TC7

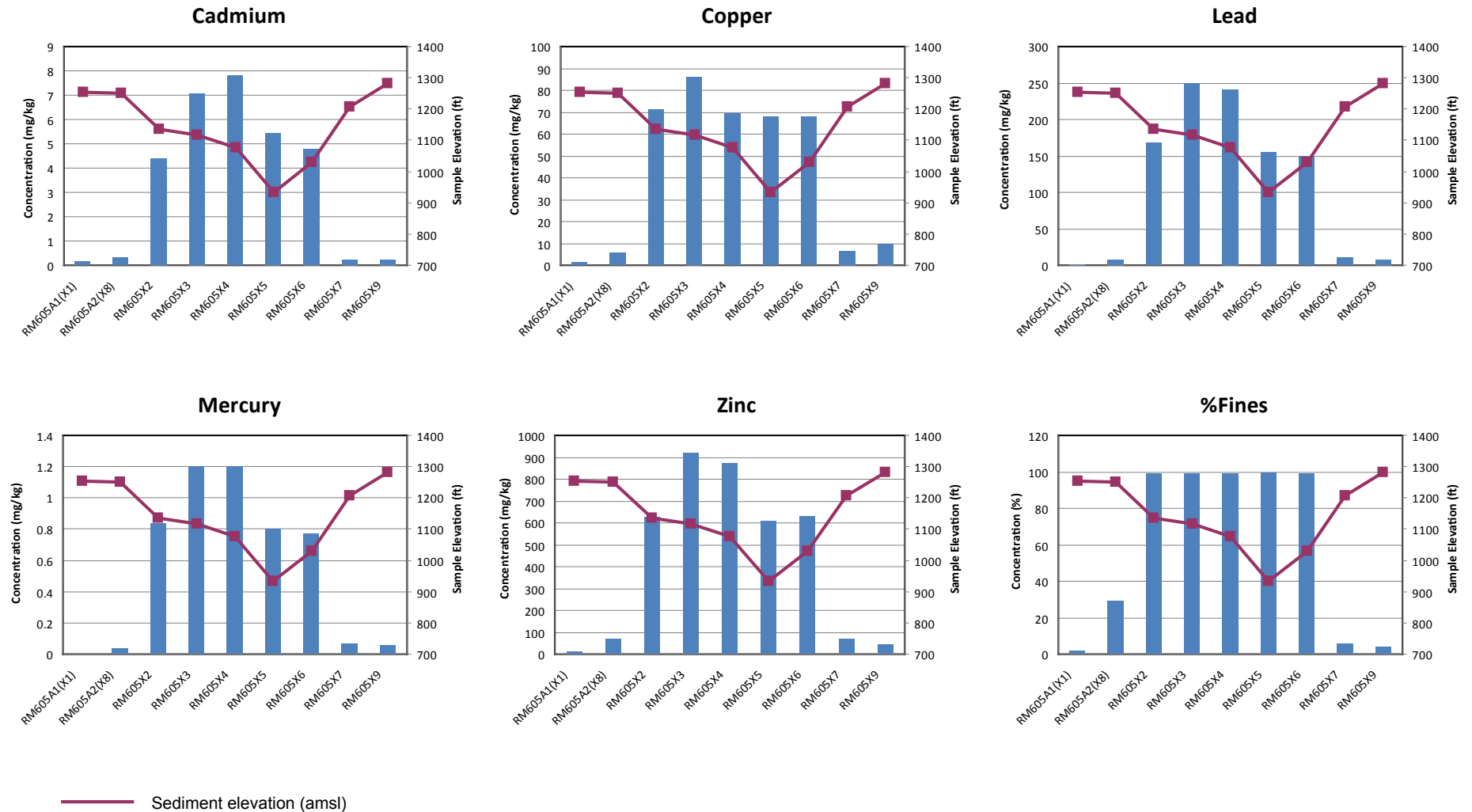
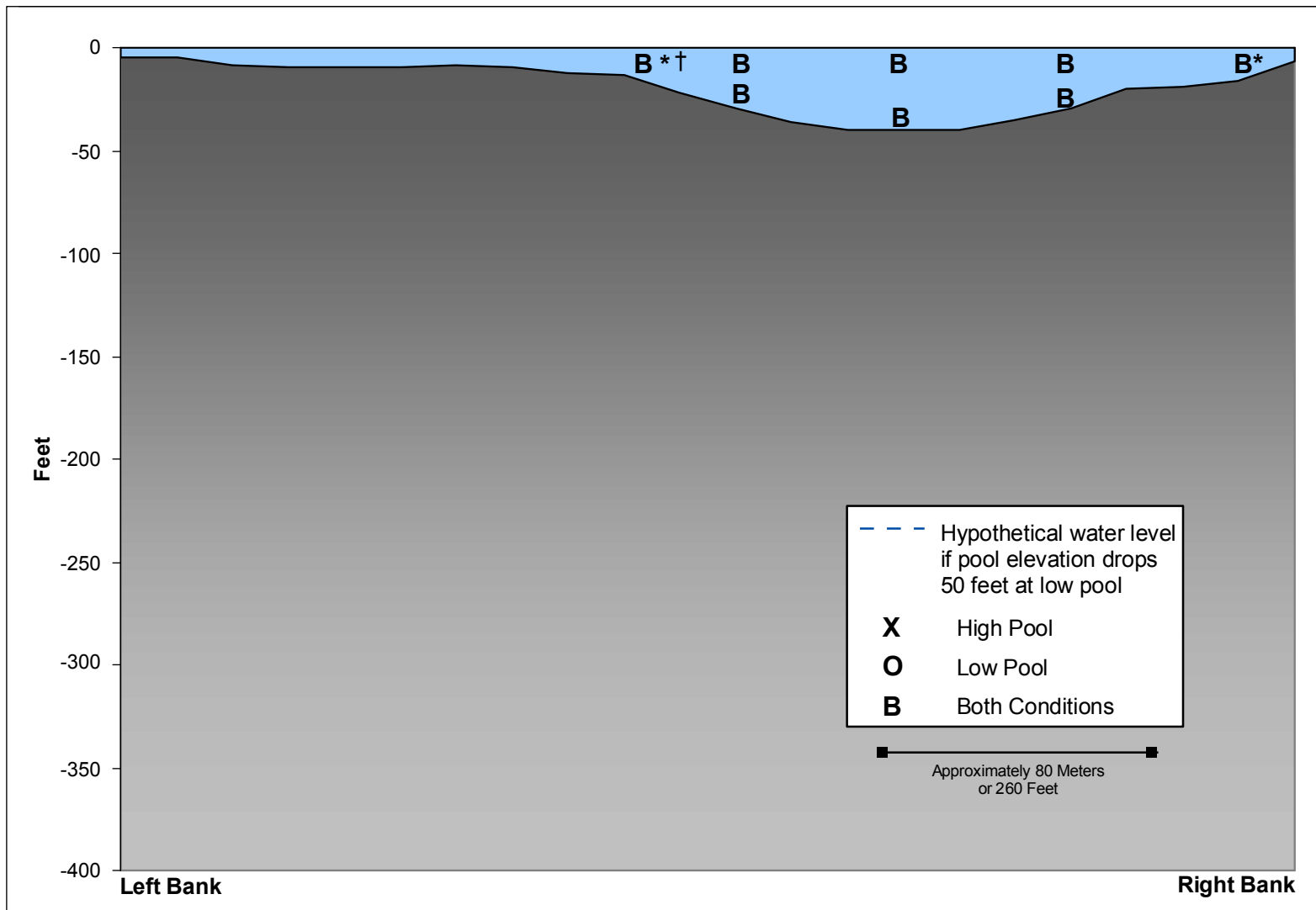


Figure B-7. Concentrations of Five Metals and Percent Fines (Silt and Clay) in Surface Sediment Samples Relative to Sediment Bed Elevation at USGS RM 605 (Plum Point).
Source: USEPA (2006e).

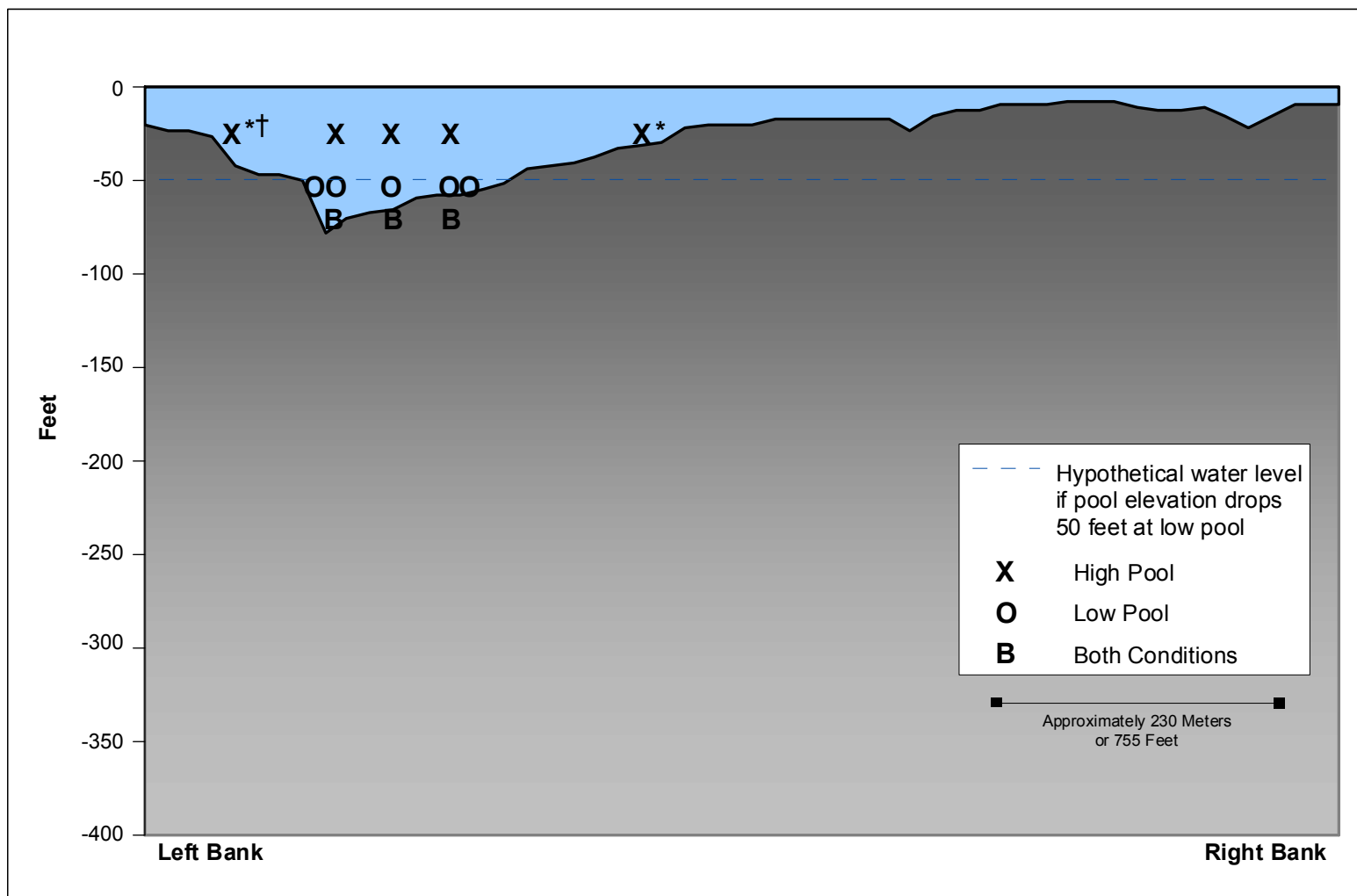


Notes: Orientation to left and right banks is based on looking down river.

* Sample locations at which disturbed-sediment surface water samples will be collected to support the human health risk assessment.

† One of the three disturbed-sediment surface water samples collected from this location will also be analyzed for the supplementary list of chemicals identified in the beach sediment study (i.e., organic compounds, radionuclides) (Teck 2009).

Figure B-8. Proposed Sampling Locations – Transect TC1 at River Mile 734: Northport.

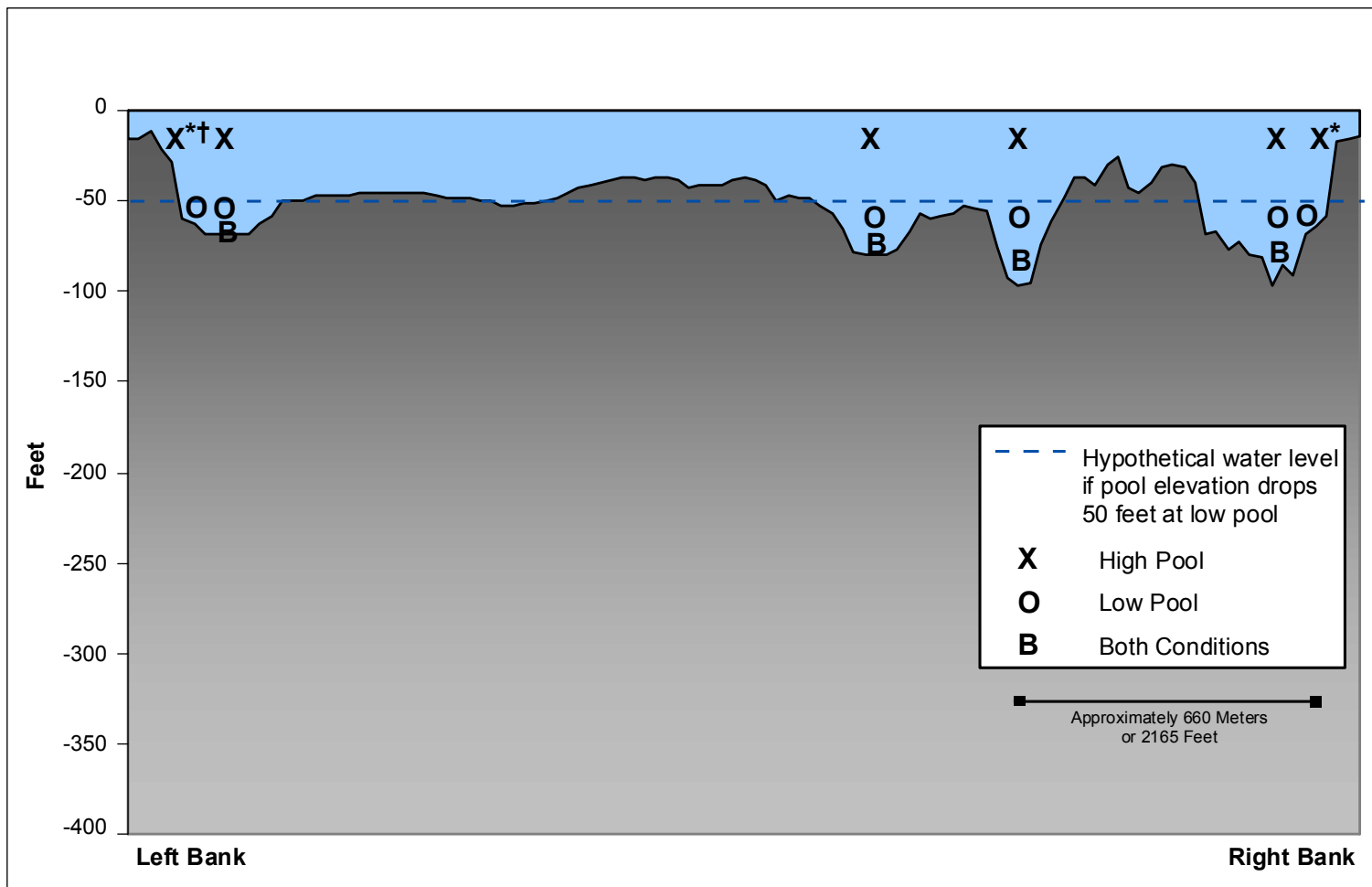


Notes: Orientation to left and right banks is based on looking down river.

* Sample locations at which disturbed-sediment surface water samples will be collected to support the human health risk assessment.

† One of the three disturbed-sediment surface water samples collected from this location will also be analyzed for the supplementary list of chemicals identified in the beach sediment study (i.e., organic compounds, radionuclides) (Teck 2009).

Figure B-9. Proposed Sampling Locations – Transect TC2 at River Mile 724: China Bend.

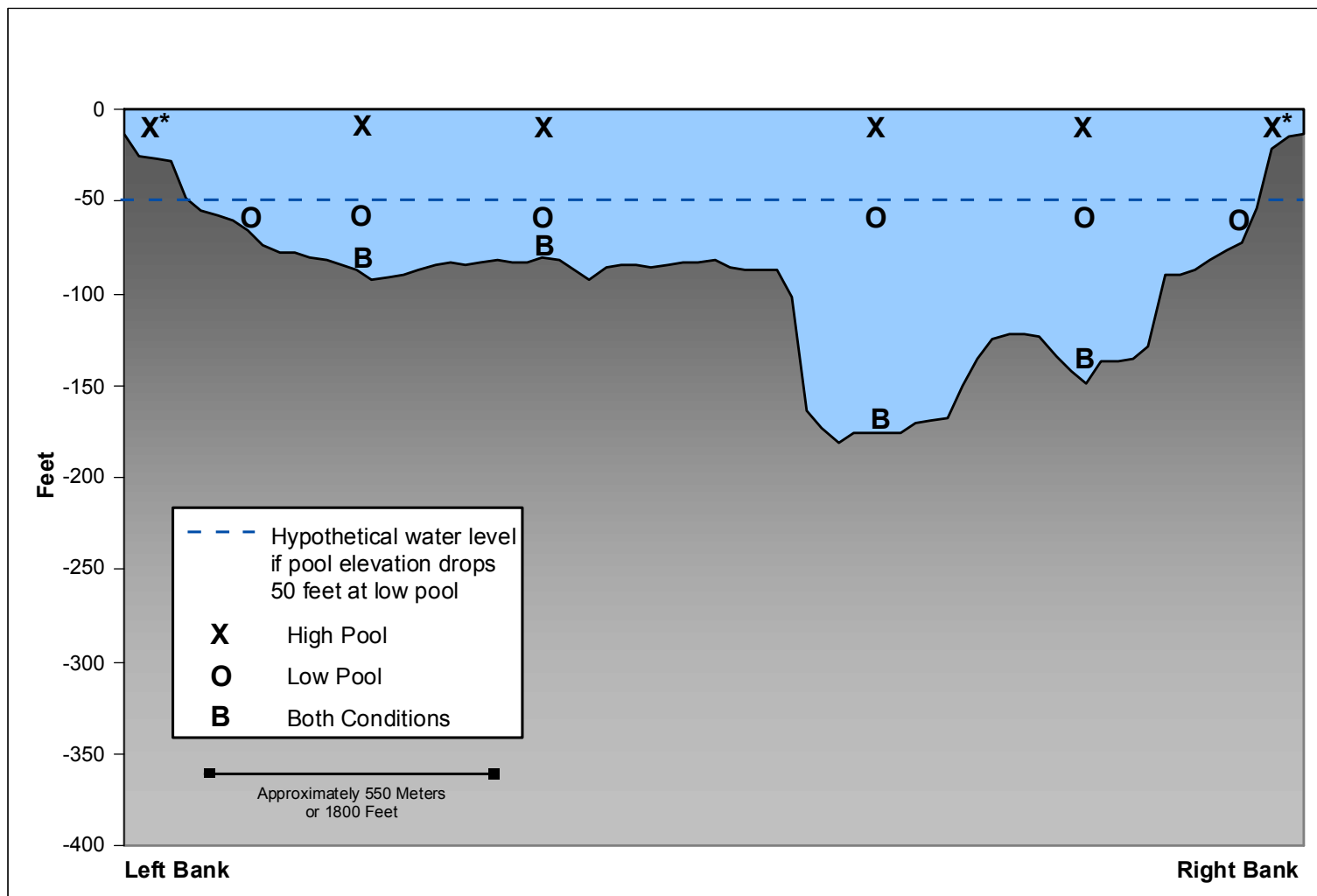


Notes: Orientation to left and right banks is based on looking down river.

* Sample locations at which disturbed-sediment surface water samples will be collected to support the human health risk assessment.

† One of the three disturbed-sediment surface water samples collected from this location will also be analyzed for the supplementary list of chemicals identified in the beach sediment study (i.e., organic compounds, radionuclides) (Teck 2009).

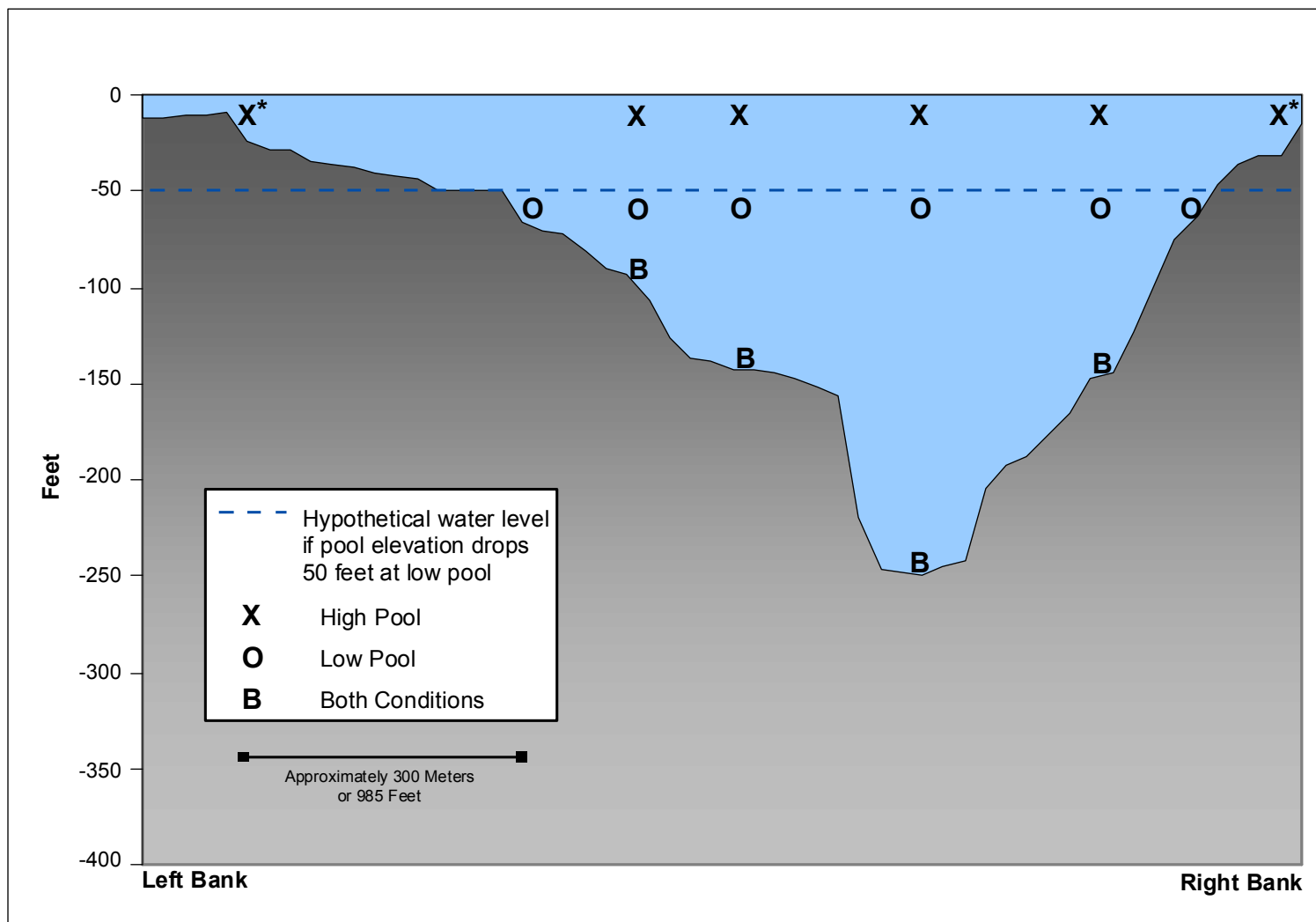
Figure B-10. Proposed Sampling Locations – Transect TC3 at River Mile 704: Marcus Flats.



Notes: Orientation to left and right banks is based on looking down river.

* Sample locations at which disturbed-sediment surface water samples will be collected to support the human health risk assessment.

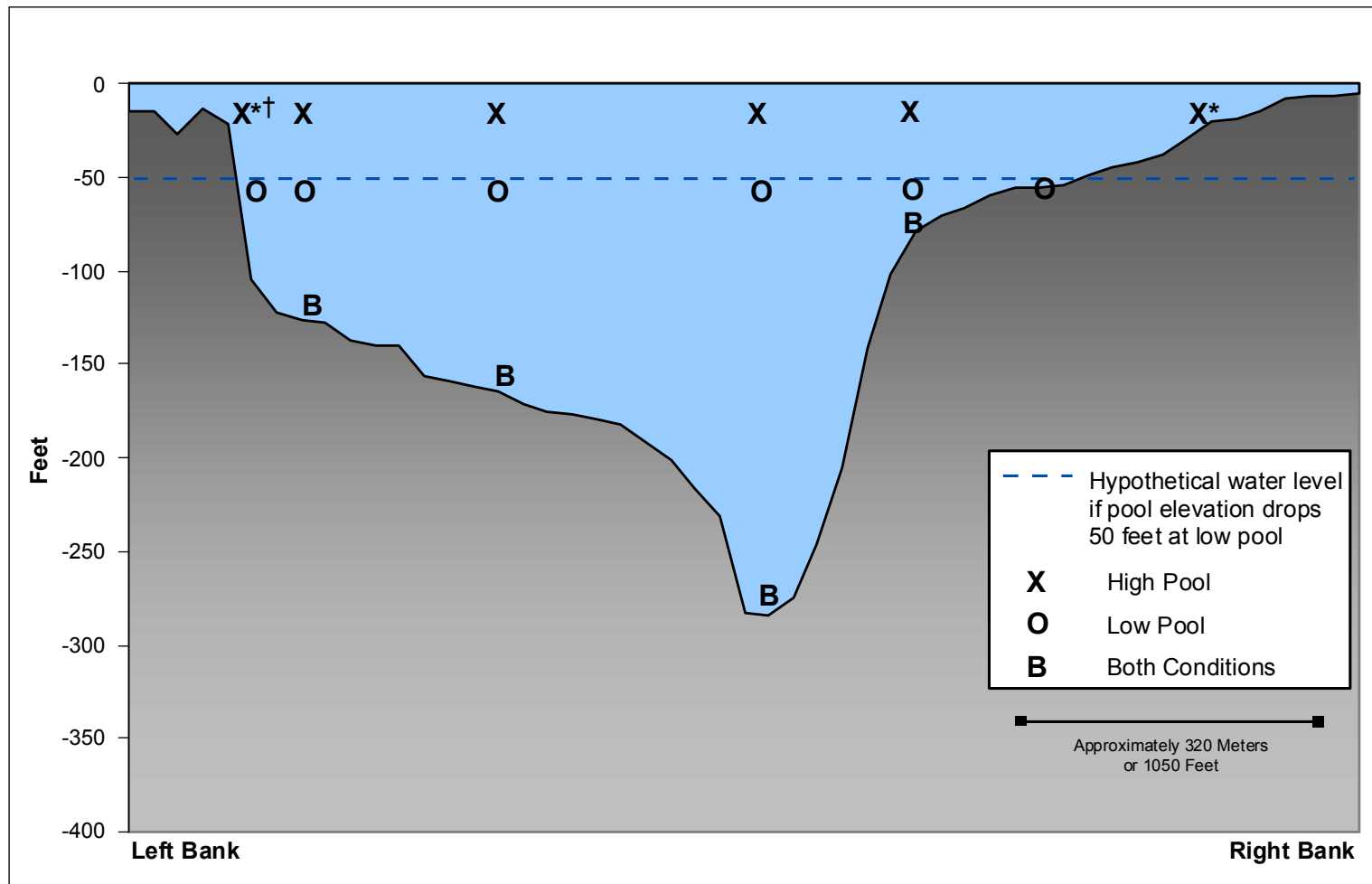
Figure B-11. Proposed Sampling Locations – Transect TC4 at River Mile 678: Inchelium.



Notes: Orientation to left and right banks is based on looking down river.

* Sample locations at which disturbed-sediment surface water samples will be collected to support the human health risk assessment.

Figure B-12. Proposed Sampling Locations – Transect TC5 at River Mile 642: Upstream of Spokane River Confluence.

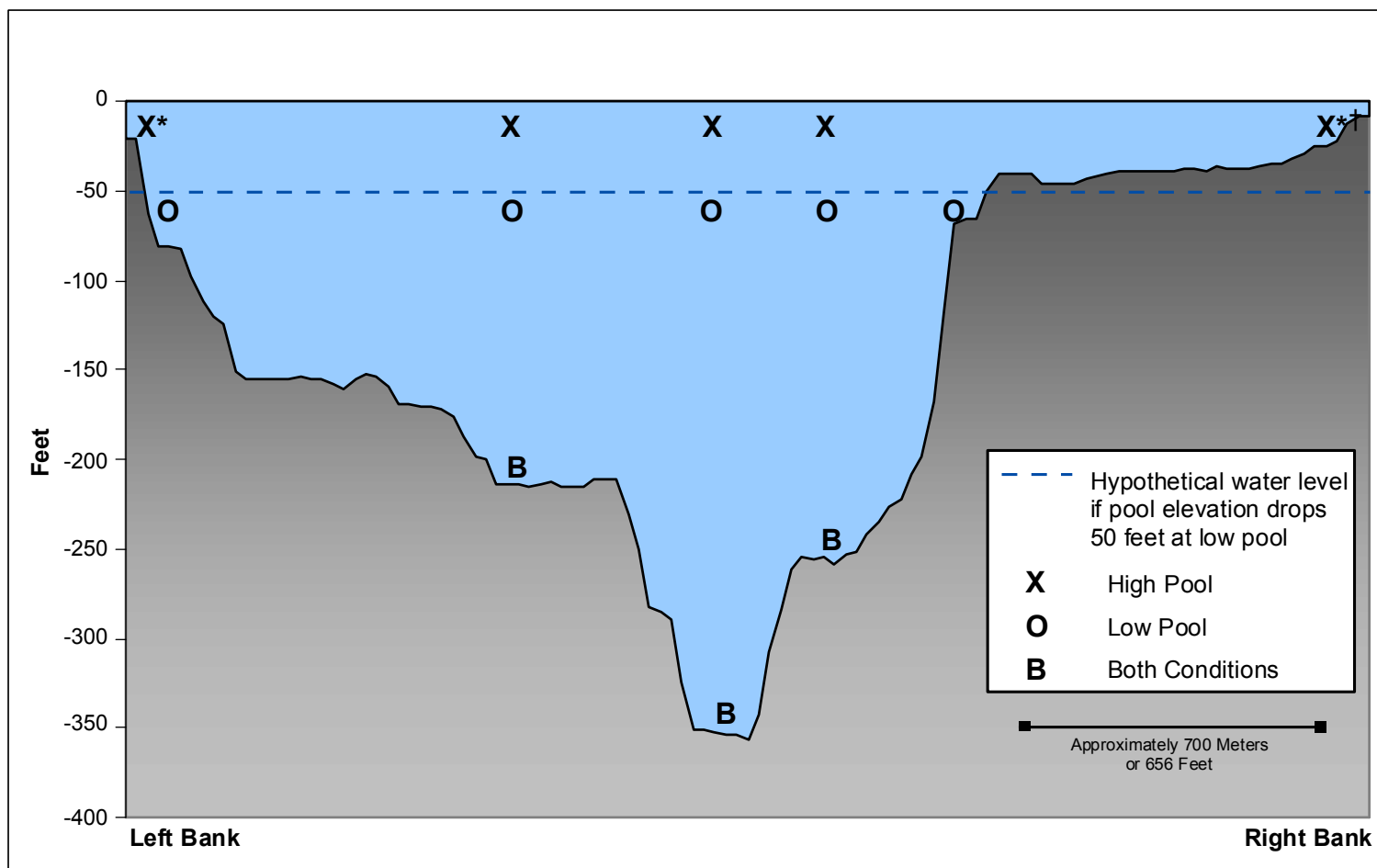


Notes: Orientation to left and right banks is based on looking down river.

* Sample locations at which disturbed-sediment surface water samples will be collected to support the human health risk assessment.

† One of the three disturbed-sediment surface water samples collected from this location will also be analyzed for the supplementary list of chemicals identified in the beach sediment study (i.e., organic compounds, radionuclides) (Teck 2009).

Figure B-13. Proposed Sampling Locations – Transect TC6 at River Mile 637: Seven Bays.

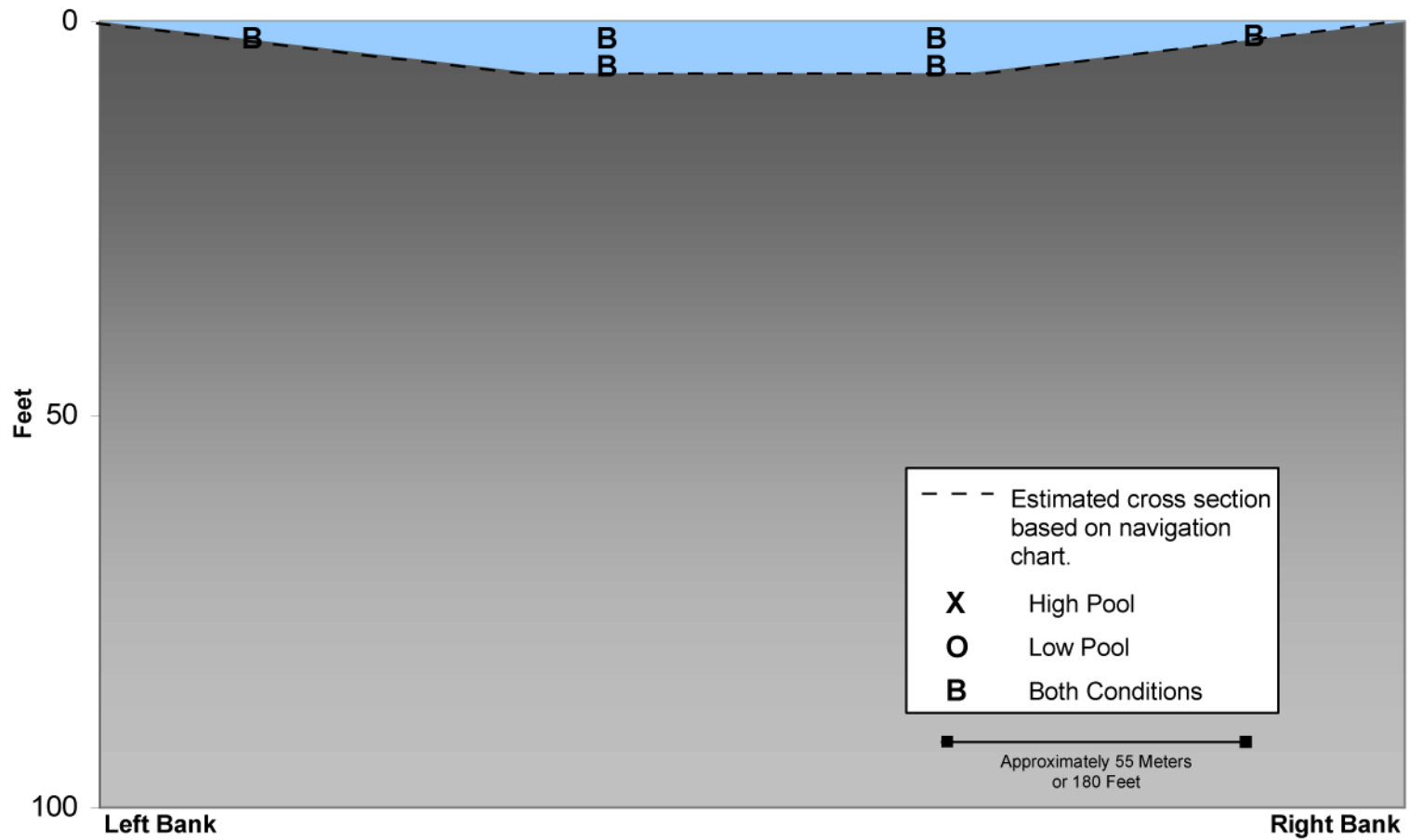


Notes: Orientation to left and right banks is based on looking down river.

* Sample locations at which disturbed-sediment surface water samples will be collected to support the human health risk assessment.

† One of the three disturbed-sediment surface water samples collected from this location will also be analyzed for the supplementary list of chemicals identified in the beach sediment study (i.e., organic compounds, radionuclides) (Teck 2009).

Figure B-14. Proposed Sampling Locations – Transect TC7 at River Mile 605: Plum Point.



Note: Orientation to left and right banks is based on looking down river.

Figure B-15. Proposed Sampling Locations – Transect CAN1 at USGS River Mile 762 (Birchbank).

TABLES

Table A-1. Surface Water Task Team Contact Information

Name	Task Role	Phone	Fax	Email
Teck American Incorporated				
Marko Adzic	Project Coordinator	(509) 892-2585	(509) 459-4400	marko.adzic@teck.com
Environmental Protection Agency				
Helen Bottcher	EPA Project Coordinator	(206) 553-6069	(206) 553-8509	Bottcher.Helen@epa.gov
Gina Grepo-Grove	EPA Quality Assurance (QA) Manager	(206) 553-1632	(206) 553-8509	Grepo-Grove.Gina@epa.gov
Consultant Team				
Dreas Nielsen, Integral	Consultant Team Coordinator	(206) 957-0311	(206) 230-9601	dnielsen@integral-corp.com
Betsy Day, Integral	Task Manager	(206) 957-0346	(206) 230-9601	bday@integral-corp.com
TBD	Field Supervisor	TBD	TBD	TBD
Scott Becker, Integral	Senior Technical Advisor	(206) 957-0349	(206) 230-9601	sbecker@integral-corp.com
Craig Hutchings, Integral	Task QA Coordinator, Chemical Laboratory Coordinator	(360) 705-3534	(306) 705-3669	chutchings@integral-corp.com
TBD	Task Safety Officer	TBD	TBD	TBD
Dreas Nielsen, Integral	Database Administrator	(206) 957-0311	(206) 230-9601	dnielsen@integral-corp.com
Laboratories				
Jeff Christian, Columbia Analytical Services	Laboratory Project Manager	(360) 501-3316	(360) 363-1068	jchristian@caslab.com
Julie Gish, Columbia Analytical Services	Laboratory QA Manager	(360) 501-3317	(360) 363-1068	jpgish@caslab.com
Linda McWhirter, SGS Environmental Services	Laboratory Project Manager	(910) 350-1903	(910) 350-1557	Linda.McWhirter@sgs.com
Jeannie Milholland, SGS Environmental Services	Laboratory QA Manager	(910) 350-1903	(910) 350-1557	jeannie.milholland@sgs.com
Jacquelyn Collins, Pace Analytical Services	Laboratory Project Manager	(724) 850-5612	(724) 850-5601	Jacquelyn.Collins@pacelabs.com
Randy Hill, Pace Analytical Services	Laboratory QA Manager	(724) 850-5620	(724) 850-5601	Randy.Hill@pacelabs.com
Patrick Garcia-Strickland, Frontier GeoSciences	Laboratory Project Manager	(206)-622-6960	(206) 622-6870	PatrickS@frontiergeosciences.com
Kristina Spadafora, Frontier GeoSciences	Laboratory QA Manager	(206)-622-6960	(206) 622-6870	kristinas@frontiergeosciences.com
Steven Pelphrey, Isotech	Laboratory Project Manager	(217) 398-3490	(217) 398-3493	steve@isotechlabs.com
Christy Legner, Isotech	Laboratory QA Manager	(217) 398-3490	(217) 398-3493	legner@isotechlabs.com

Notes:

TBD = to be determined

Table A-2. Metals and Metalloids Identified as COIs for the UCR RI/FS (USEPA 2008).

Chemical Group	Analyte(s)
Metals and Metalloids	Aluminum, Antimony, Arsenic, Barium, Beryllium, Bismuth, Boron, Cadmium, Calcium, Cerium, Cesium, Chromium, Cobalt, Copper, Dysprosium, Erbium, Europium, Fluoride, Gadolinium, Gallium, Germanium, Gold, Holmium, Indium, Iron, Lanthanum, Lead, Lithium, Lutetium, Magnesium, Manganese, Mercury, Molybdenum, Neodymium, Nickel, Niobium, Potassium, Praseodymium, Rubidium, Samarium, Scandium, Selenium, Silicon, Silver, Sodium, Strontium, Sulfur, Tantalum, Tellurium, Thorium, Thulium, Tin, Thallium, Titanium, Tungsten, Uranium, Vanadium, Ytterbium, Yttrium, Zinc, Zirconium

Notes:

COI = chemical of interest

Table A-3. Organic Compounds Identified as COIs for the UCR RI/FS (USEPA 2008).

Chemical Group	Analyte(s)
Semivolatile Organic Compounds (SVOCs)	1,1'-Biphenyl, 1,2,4-Trichlorobenzene, 1,2-Dichlorobenzene, 1,3-Dichlorobenzene, 1,4-Dichlorobenzene, 2,2'-oxybis(1-chloropropane), 2,4,5-Trichlorophenol, 2,4,6-Trichlorophenol, 2,4-Dichlorophenol, 2,4-Dimethylphenol, 2,4-Dinitrophenol, 2,4-Dinitrotoluene, 2,6-Dinitrotoluene, 2-Chloronaphthalene, 2-Chlorophenol, 2-Methylphenol (o-cresol), 2-Nitroaniline, 2-Nitrophenol, 3,3'-Dichlorobenzidine, 3-Nitroaniline, 4,6-Dinitro-2-methylphenol, 4-Bromophenyl-phenylether, 4-Chloro-3-methylphenol, 4-Chloroaniline, 4-Chlorophenyl-phenyl ether, 4-Methylphenol (p-cresol), 4-Nitroaniline, 4-Nitrophenol, Acetophenone, Benzaldehyde, Benzoic acid, Benzyl alcohol, Bis(2-chloroethoxy)methane, Bis(2-chloroethyl)ether, Bis(2-ethylhexyl)phthalate, Butyl benzyl phthalate, Caprolactam, Carbazole, Dibenzofuran, Diethyl phthalate, Dimethyl phthalate, Di-n-butyl phthalate, Di-n-octylphthalate, 1-Phenyl-ethanone, Hexachlorobenzene, Hexachlorocyclopentadiene, Hexachloroethane, Isophorone, Nitrobenzene, N-Nitrosodi-n-propylamine, N-Nitrosodiphenylamine, Pentachlorophenol, Perchlorocyclopentadiene, Phenol
Polycyclic Aromatic Hydrocarbons (PAHs)	High Molecular Weight PAHs: Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(ghi)perylene, Benzo(k)fluoranthene, Chrysene, Dibenzo(a,h)anthracene, Indeno[1,2,3-cd]pyrene Low Molecular Weight PAHs: Anthracene, 2-Methylnaphthalene, Acenaphthene, Acenaphthylene, Fluoranthene, Fluorene, Naphthalene, Phenanthrene, Pyrene
Pesticides	2,4'-DDD, 2,4'-DDE, 2,4'-DDT, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, Aldrin, alpha-BHC, alpha-Chlordane, Atrazine, beta-BHC, cis-Nonachlor, delta-BHC, Dieldrin, Endosulfan I, Endosulfan II, Endosulfan sulfate, Endrin, Endrin aldehyde, Endrin ketone, gamma-BHC (Lindane), gamma-Chlordane, Heptachlor, Heptachlor epoxide, Hexachlorobenzene, Hexachlorobutadiene, Methoxychlor, Oxychlordane, Toxaphene, trans-Nonachlor
Polychlorinated Biphenyls (PCBs)	Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, Aroclor 1260, PCB Congeners (209 forms)
Polybrominated Diphenylethers (PBDEs)	PBDE-47, PBDE-66, PBDE-71, PBDE-99, PBDE-100, PBDE-138, PBDE-153, PBDE-154, PBDE-183, PBDE-184, PBDE-191, PBDE-209
Polychlorinated Dibenzo-p-Dioxins (PCDDs)	1,2,3,4,6,7,8-Heptachlorodibenzodioxin, 1,2,3,4,7,8-Hexachlorodibenzodioxin, 1,2,3,6,7,8-Hexachlorodibenzodioxin, 1,2,3,7,8,9-Hexachlorodibenzodioxin, 1,2,3,7,8-Pentachlorodibenzodioxin, 2,3,7,8-Tetrachlorodibenzodioxin, Octachlorodibenzodioxin
Polychlorinated Dibenzofurans (PCDFs)	1,2,3,4,6,7,8-Heptachlorodibenzofuran, 1,2,3,4,7,8,9-Heptachlorodibenzofuran, 1,2,3,4,7,8-Hexachlorodibenzofuran, 1,2,3,6,7,8-Hexachlorodibenzofuran, 1,2,3,7,8,9-Hexachlorodibenzofuran, 1,2,3,7,8-Pentachlorodibenzofuran, 2,3,4,6,7,8-Hexachlorodibenzofuran, 2,3,4,7,8-Pentachlorodibenzofuran, 2,3,7,8-Tetrachlorodibenzofuran (TCDF), Octachlorodibenzofuran

Table A-4. Temporal Variability in Concentrations of Several Water Quality Parameters at Waneta, B.C. (2000-2006).

Metric	Mean ^a	Coefficient of Variation ^a , %
Barium µg/L	20	9
Potassium mg/L	0.62	9
Hardness mg/L CaCO ₃	64.7	8
Sodium mg/L	1.5	18
SiO ₂ mg/L	1.9	26

Source: Environment Canada (2009)

^a Statistics were calculated using all weekly data from 2000-2006.

Notes:

CaCO₃ = calcium carbonate

mg/L = milligrams per liter

µg/L = micrograms per liter

SiO₂ = silicon dioxide (silica)

Table A-5. Concentrations of Some Inorganic Constituents in Surface Waters Measured in Lake Roosevelt from Evans to Grand Coulee Dam and at Waneta, B.C.

Constituent	Mean \pm 1 SE in UCR	Mean \pm 1 SE at Waneta
Barium (μ g/L)	31 \pm 0.7	20 \pm 0.1
Hardness (mg/L)	62.8 \pm 0.97	64.7 \pm 0.3
Potassium (mg/L)	0.56 \pm 0.012	0.62 \pm 0.005
Sodium (mg/L)	1.9 \pm .03	1.5 \pm 0.025
SiO ₂ (mg/L)	2.55 \pm 0.06	1.85 \pm 0.04

Source: Scofield and Pavlik-Kunkel (2007), Environment Canada (2009)

Table A-6. Summary of Screening Results for Surface Water Collected in the UCR between 2000 and 2006.

Analyte	Screening SEV (µg/L)	Source of SEV	Measure	Surface Water Screening Results for Aquatic Life (µg/L)							
				N	# DT	FOD	Max Msd	Max Msd HQ	#Msd>SEV	Max DL	#DL>SEV
Nutrients											
Ammonia	2070	b,c,d,e	Dissolved	91	17	19%	0.02	0.00001	0	0.01	0
Cyanide	5.2	b,c,d,e	Dissolved	7	0	0%	-	-	-	0.018	0
Nitrite-Nitrate	no SEV		Dissolved	84	84	100%	0.137	-	-	n/a	-
Phosphorus	no SEV		Dissolved	93	52	56%	0.05	-	-	0.01	-
Metals/Metalloids											
Aluminum	87	b,d,e	Dissolved	5	2	40%	11.5	0.1	0	19	0
Antimony	no SEV		Dissolved	5	1	20%	0.46	-	-	1	-
Arsenic	150	b,d,e	Dissolved	35	27	77%	1	0.01	0	2	0
Arsenic	5	f	Total Recoverable	38	38	100%	0.86	0.2	0	n/a	n/a
Barium	no SEV		Dissolved	5	5	100%	37	-	-	n/a	-
Beryllium	no SEV		Dissolved	5	0	0%	-	-	-	1	-
Bismuth	no SEV		Dissolved	2	0	0%	-	-	-	0.2	-
Boron	no SEV		Dissolved	7	1	14%	8.5	-	-	16	-
Cadmium	0.19 ^a	b,d	Dissolved	31	15	48%	0.24	1.4	1	1	3
Cadmium	0.02	f	Total Recoverable	26	1	4%	0.24	12	1	1	25
Calcium	no SEV		Dissolved	9	9	100%	19.8	-	-	n/a	-
Cerium	no SEV		Dissolved	2	0	0%	-	-	-	0.05	-
Cesium	no SEV		Dissolved	2	0	0%	-	-	-	0.02	-
Chloride	230000	b,c,d,e	Dissolved	7	7	100%	0.99	0.004	-	n/a	n/a
Chromium	53 ^a	b,d,e	Dissolved	31	16	52%	0.56	0.01	0	5	0
Chromium	8.9	f	Total Recoverable	26	1	4%	0.83	0.1	0	0.5	0
Cobalt	no SEV		Dissolved	5	1	20%	0.11	-	-	1	-
Copper	6.4 ^a	b,d,e	Dissolved	31	27	87%	0.99	0.2	0	1	0
Copper	2 ^a	f	Total Recoverable	26	26	100%	4.58	1.4	1	n/a	n/a
Dysprosium	no SEV		Dissolved	2	0	0%	-	-	-	0.04	-
Erbium	no SEV		Dissolved	2	1	50%	0.03	-	-	0.025	-
Europium	no SEV		Dissolved	2	0	0%	-	-	-	0.025	-
Fluoride	no SEV		Dissolved	7	0	0%	-	-	-	0.1	-
Gadolinium	no SEV		Dissolved	2	0	0%	-	-	-	0.025	-
Gallium	no SEV		Dissolved	2	0	0%	-	-	-	0.05	-
Germanium	no SEV		Dissolved	2	0	0%	-	-	-	0.25	-
Gold	no SEV		Dissolved	0	-	-	-	-	-	-	-
Holmium	no SEV		Dissolved	2	0	0%	-	-	-	0.25	-
Indium	no SEV		Dissolved	0	-	-	-	-	-	-	-
Iron	1000	b,d,e	Dissolved	9	3	33%	10	0.01	0	250	0
Lanthanum	no SEV		Dissolved	2	0	0%	-	-	-	0.1	-
Lead	1.6 ^a	b,c,d,e	Dissolved	31	16	52%	0.07	0.04	0	1	0
Lead	2 ^a	f	Total Recoverable	26	26	100%	1.96	1.1	1	n/a	n/a

Table A-6. Summary of Screening Results for Surface Water Collected in the UCR between 2000 and 2006.

Analyte	Screening SEV (µg/L)	Source of SEV	Measure	Surface Water Screening Results for Aquatic Life (µg/L)						
				N	# DT	FOD	Max Msd	Max Msd HQ	#Msd>SEV	Max DL #DL>SEV
Lithium	no SEV		Dissolved	9	2	22%	2	-	-	4.5 -
Lutetium	no SEV		Dissolved	2	0	0%	-	-	-	0.5 -
Magnesium	no SEV		Dissolved	9	9	100%	4.71	-	-	n/a -
Manganese	no SEV		Dissolved	5	2	40%	1.9	-	-	5 -
Mercury	0.012	c,e	Total	26	4	15%	0.0022	0.2	0	0.004 0
Mercury	0.03	f	Total Recoverable	26	4	15%	0.0022	0.1	0	0.004 0
Molybdenum	no SEV		Dissolved	5	0	0%	-	-	-	2 -
Neodymium	no SEV		Dissolved	2	0	0%	-	-	-	0.05 -
Nickel	37 ^a	b,d,e	Dissolved	38	28	74%	1.63	0.05	0	1 0
Nickel	65 ^a	f	Total Recoverable	26	26	100%	0.95	0.03	0	n/a n/a
Niobium	no SEV		Dissolved	2	0	0%	-	-	-	1 -
Potassium	no SEV		Dissolved	9	9	100%	0.8	-	-	n/a -
Praseodymium	no SEV		Dissolved	2	0	0%	-	-	-	0.05 -
Rubidium	no SEV		Dissolved	2	2	100%	0.86	-	-	n/a -
Samarium	no SEV		Dissolved	2	0	0%	-	-	-	0.09 -
Scandium	no SEV		Dissolved	2	0	0%	-	-	-	3 -
Selenium	5	b,c,d,e	Dissolved	9	0	0%	-	-	-	5 2
Silicon (Silica)	no SEV		Dissolved	9	9	100%	6.81	-	-	n/a -
Silver	1.6 ^{a,g}	b,d	Dissolved	31	1	3%	0.066	0.04	0	15 2
Silver	0.1	f	Total Recoverable	26	0	0%	-	-	-	0.1 26
Sodium	no SEV		Dissolved	9	9	100%	2.19	-	-	n/a -
Strontium	no SEV		Dissolved	9	9	100%	101	-	-	n/a -
Sulfur (Sulfate)	no SEV		Dissolved	9	9	100%	33	-	-	n/a -
Tantalum	no SEV		Dissolved	2	0	0%	-	-	-	0.1 -
Tellurium	no SEV		Dissolved	0	-	-	-	-	-	- -
Terbium	no SEV		Dissolved	2	0	0%	-	-	-	0.1 -
Thallium	no SEV		Dissolved	2	0	0%	-	-	-	0.2 -
Thorium	no SEV		Dissolved	2	0	0%	-	-	-	1 -
Thulium	no SEV		Dissolved	2	0	0%	-	-	-	0.045 -
Tin	no SEV		Dissolved	0	-	-	-	-	-	- -
Titanium	no SEV		Dissolved	2	0	0%	-	-	-	2.5 -
Tungsten	no SEV		Dissolved	2	0	0%	-	-	-	0.5 -
Uranium	no SEV		Dissolved	5	0	0%	-	-	-	1 -
Vanadium	no SEV		Dissolved	9	0	0%	-	-	-	10 -
Ytterbium	no SEV		Dissolved	2	0	0%	-	-	-	0.025 -
Yttrium	no SEV		Dissolved	2	0	0%	-	-	-	0.05 -
Zinc	74 ^a	c,e	Dissolved	31	25	81%	7.4	0.1	0	4.7 0
Zinc	30	f	Total Recoverable	26	4	15%	45	1.5	1	5 0
Zirconium	no SEV		Dissolved	2	0	0%	-	-	-	1 -

Table A-6. Summary of Screening Results for Surface Water Collected in the UCR between 2000 and 2006.

Analyte	Screening SEV (µg/L)	Source of SEV	Measure	Surface Water Screening Results for Aquatic Life (µg/L)							
				N	# DT	FOD	Max Msd	Max Msd HQ	#Msd>SEV	Max DL	#DL>SEV
Dioxins/Furans											
1,2,3,4,6,7,8-HpCDD	no SEV		Dissolved	0	-	-	-	-	-	-	-
1,2,3,4,6,7,8-HpCDF	no SEV		Dissolved	0	-	-	-	-	-	-	-
1,2,3,4,7,8,9-HpCDF	no SEV		Dissolved	0	-	-	-	-	-	-	-
1,2,3,4,7,8-HxCDD	no SEV		Dissolved	0	-	-	-	-	-	-	-
1,2,3,4,7,8-HxCDF	no SEV		Dissolved	0	-	-	-	-	-	-	-
1,2,3,6,7,8-HxCDD	no SEV		Dissolved	0	-	-	-	-	-	-	-
1,2,3,6,7,8-HxCDF	no SEV		Dissolved	0	-	-	-	-	-	-	-
1,2,3,7,8,9-HxCDD	no SEV		Dissolved	0	-	-	-	-	-	-	-
1,2,3,7,8,9-HxCDF	no SEV		Dissolved	0	-	-	-	-	-	-	-
1,2,3,7,8-PCDF	no SEV		Dissolved	0	-	-	-	-	-	-	-
1,2,3,7,8-PCDD	no SEV		Dissolved	0	-	-	-	-	-	-	-
2,3,4,6,7,8-HxCDF	no SEV		Dissolved	0	-	-	-	-	-	-	-
2,3,4,7,8-PCDF	no SEV		Dissolved	0	-	-	-	-	-	-	-
2,3,7,8-TCDD	no SEV		Dissolved	0	-	-	-	-	-	-	-
2,3,7,8-TCDF	no SEV		Dissolved	0	-	-	-	-	-	-	-
Octachlorodibenzodioxin	no SEV		Dissolved	0	-	-	-	-	-	-	-
Octachlorodibenzofuran	no SEV		Dissolved	0	-	-	-	-	-	-	-
PAHs											
2-Methylnaphthalene	no SEV		Dissolved	0	-	-	-	-	-	-	-
Acenaphthene	no SEV		Dissolved	0	-	-	-	-	-	-	-
Acenaphthylene	no SEV		Dissolved	0	-	-	-	-	-	-	-
Anthracene	no SEV		Dissolved	0	-	-	-	-	-	-	-
Benzo(a)anthracene	no SEV		Dissolved	0	-	-	-	-	-	-	-
Benzo(a)pyrene	no SEV		Dissolved	0	-	-	-	-	-	-	-
Benzo(b)fluoranthene	no SEV		Dissolved	0	-	-	-	-	-	-	-
Benzo(ghi)perylene	no SEV		Dissolved	0	-	-	-	-	-	-	-
Benzo(k)fluoranthene	no SEV		Dissolved	0	-	-	-	-	-	-	-
Chrysene	no SEV		Dissolved	0	-	-	-	-	-	-	-
Dibenzo(a,h)anthracene	no SEV		Dissolved	0	-	-	-	-	-	-	-
Fluoranthene	no SEV		Dissolved	0	-	-	-	-	-	-	-
Fluorene	no SEV		Dissolved	0	-	-	-	-	-	-	-
Indeno[1,2,3-cd]pyrene	no SEV		Dissolved	0	-	-	-	-	-	-	-
Naphthalene	no SEV		Dissolved	0	-	-	-	-	-	-	-
Phenanthrene	no SEV		Dissolved	0	-	-	-	-	-	-	-
Pyrene	no SEV		Dissolved	0	-	-	-	-	-	-	-
Total PAHs	no SEV		Dissolved	0	-	-	-	-	-	-	-
PCBs											
Aroclor 1016	no SEV		Dissolved	0	-	-	-	-	-	-	-
Aroclor 1221	no SEV		Dissolved	0	-	-	-	-	-	-	-

Table A-6. Summary of Screening Results for Surface Water Collected in the UCR between 2000 and 2006.

Analyte	Screening SEV (µg/L)	Source of SEV	Measure	Surface Water Screening Results for Aquatic Life (µg/L)								
				N	# DT	FOD	Max Msd	Max Msd HQ	#Msd>SEV	Max DL	#DL>SEV	
Aroclor 1232	no SEV	b,c,d,e	Dissolved	0	-	-	-	-	-	-	-	
Aroclor 1242	no SEV		Dissolved	0	-	-	-	-	-	-	-	
Aroclor 1248	no SEV		Dissolved	0	-	-	-	-	-	-	-	
Aroclor 1254	no SEV		Dissolved	0	-	-	-	-	-	-	-	
Aroclor 1260	no SEV		Dissolved	0	-	-	-	-	-	-	-	
Total PCBs	0.014		Dissolved	0	-	-	-	-	-	-	-	
PBDEs												
Total PBDEs	no SEV		Dissolved	0	-	-	-	-	-	-	-	
Pesticides												
2,4'-DDD	no SEV	b,c,d,e	Dissolved	0	-	-	-	-	-	-	-	
2,4'-DDE	no SEV		Dissolved	0	-	-	-	-	-	-	-	
2,4'-DDT	no SEV		Dissolved	0	-	-	-	-	-	-	-	
4,4'-DDD	no SEV		Dissolved	0	-	-	-	-	-	-	-	
4,4'-DDE	no SEV		Dissolved	7	2	29%	0.002	-	-	0.006	-	
4,4'-DDT	no SEV		Dissolved	0	-	-	-	-	-	-	-	
Total DDx	0.001		Dissolved	0	-	-	-	-	-	-	-	
Alachlor	no SEV	c,e	Dissolved	7	0	0%	-	-	-	0.002	-	
Aldrin	0.0019		Dissolved	0	-	-	-	-	-	-	-	
Atrazine	no SEV		Dissolved	7	0	0%	-	-	-	0.008	-	
alpha-BHC	no SEV	c,e	Dissolved	7	0	0%	-	-	-	0.005	-	
beta-BHC	no SEV		Dissolved	0	-	-	-	-	-	-	-	
gamma-BHC (Lindane)	0.08		Dissolved	7	0	0%	-	-	-	0.004	0	
alpha-Chlordane	0.0043		Dissolved	0	-	-	-	-	-	-	-	
gamma-Chlordane	no SEV		Dissolved	0	-	-	-	-	-	-	-	
cis-Nonachlor	no SEV		Dissolved	0	-	-	-	-	-	-	-	
trans-Nonachlor	no SEV	b,c,d,e	Dissolved	0	-	-	-	-	-	-	-	
Oxychlordane	no SEV		Dissolved	0	-	-	-	-	-	-	-	
Total Chlordane	no SEV		Dissolved	0	-	-	-	-	-	-	-	
Dieldrin	0.0019		c,e	Dissolved	7	0	0%	-	-	-	0.005	1
Endosulfan I	0.056		b,c,d,e	Dissolved	0	-	-	-	-	-	-	-
Endosulfan II	0.056		b,c,d,e	Dissolved	0	-	-	-	-	-	-	-
Endrin	0.0023	c,e	Dissolved	0	-	-	-	-	-	-	-	
Endrin aldehyde	no SEV	b,c,d,e	Dissolved	0	-	-	-	-	-	-	-	
Endrin ketone	no SEV		Dissolved	0	-	-	-	-	-	-	-	
Endosulfan sulfate	no SEV		Dissolved	0	-	-	-	-	-	-	-	
Heptachlor	0.0038		Dissolved	0	-	-	-	-	-	-	-	
Heptachlor epoxide	0.0038		Dissolved	0	-	-	-	-	-	-	-	
Hexachlorobenzene	no SEV		Dissolved	0	-	-	-	-	-	-	-	
Hexachlorobutadiene	no SEV		Dissolved	0	-	-	-	-	-	-	-	

Table A-6. Summary of Screening Results for Surface Water Collected in the UCR between 2000 and 2006.

Analyte	Screening SEV (µg/L)	Source of SEV	Measure	Surface Water Screening Results for Aquatic Life (µg/L)							
				N	# DT	FOD	Max Msd	Max Msd HQ	#Msd>SEV	Max DL	#DL>SEV
Methoxychlor	0.03	b,d,e	Dissolved	0	-	-	-	-	-	-	-
Toxaphene	0.0002	b,c,d,e	Dissolved	0	-	-	-	-	-	-	-
SVOCs											
1,1'-Biphenyl	no SEV		Dissolved	0	-	-	-	-	-	-	-
1,2,4-Trichlorobenzene	no SEV		Dissolved	0	-	-	-	-	-	-	-
1,2-Dichlorobenzene	no SEV		Dissolved	0	-	-	-	-	-	-	-
1,3-Dichlorobenzene	no SEV		Dissolved	0	-	-	-	-	-	-	-
1,4-Dichlorobenzene	no SEV		Dissolved	0	-	-	-	-	-	-	-
2,2'-Oxybis(1-chloropropane)	no SEV		Dissolved	0	-	-	-	-	-	-	-
2,4,5-Trichlorophenol	no SEV		Dissolved	0	-	-	-	-	-	-	-
2,4,6-Trichlorophenol	no SEV		Dissolved	0	-	-	-	-	-	-	-
2,4-Dichlorophenol	no SEV		Dissolved	0	-	-	-	-	-	-	-
2,4-Dimethylphenol	no SEV		Dissolved	0	-	-	-	-	-	-	-
2,4-Dinitrophenol	no SEV		Dissolved	0	-	-	-	-	-	-	-
2,4-Dinitrotoluene	no SEV		Dissolved	0	-	-	-	-	-	-	-
2,6-Dinitrotoluene	no SEV		Dissolved	0	-	-	-	-	-	-	-
2-Chloronaphthalene	no SEV		Dissolved	0	-	-	-	-	-	-	-
2-Chlorophenol	no SEV		Dissolved	0	-	-	-	-	-	-	-
2-Methylphenol (o-cresol)	no SEV		Dissolved	0	-	-	-	-	-	-	-
2-Nitroaniline	no SEV		Dissolved	0	-	-	-	-	-	-	-
2-Nitrophenol	no SEV		Dissolved	0	-	-	-	-	-	-	-
3,3'-Dichlorobenzidine	no SEV		Dissolved	0	-	-	-	-	-	-	-
3-Nitroaniline	no SEV		Dissolved	0	-	-	-	-	-	-	-
4,6-Dinitro-2-methylphenol	no SEV		Dissolved	0	-	-	-	-	-	-	-
4-Bromophenyl-phenylether	no SEV		Dissolved	0	-	-	-	-	-	-	-
4-Chloro-3-methylphenol	no SEV		Dissolved	0	-	-	-	-	-	-	-
4-Chloroaniline	no SEV		Dissolved	0	-	-	-	-	-	-	-
4-Chlorophenyl-phenyl ether	no SEV		Dissolved	0	-	-	-	-	-	-	-
4-Methylphenol (p-cresol)	no SEV		Dissolved	0	-	-	-	-	-	-	-
4-Nitroaniline	no SEV		Dissolved	0	-	-	-	-	-	-	-
4-Nitrophenol	no SEV		Dissolved	0	-	-	-	-	-	-	-
Acetophenone	no SEV		Dissolved	0	-	-	-	-	-	-	-
Benzaldehyde	no SEV		Dissolved	0	-	-	-	-	-	-	-
Benzoic acid	no SEV		Dissolved	0	-	-	-	-	-	-	-
Benzyl alcohol	no SEV		Dissolved	0	-	-	-	-	-	-	-
Bis(2-chloroethoxy)methane	no SEV		Dissolved	0	-	-	-	-	-	-	-
Bis(2-chloroethyl)ether	no SEV		Dissolved	0	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	no SEV		Dissolved	0	-	-	-	-	-	-	-
Butyl benzyl phthalate	no SEV		Dissolved	0	-	-	-	-	-	-	-
Caprolactam	no SEV		Dissolved	0	-	-	-	-	-	-	-

Table A-6. Summary of Screening Results for Surface Water Collected in the UCR between 2000 and 2006.

Analyte	Screening SEV (µg/L)	Source of SEV	Measure	Surface Water Screening Results for Aquatic Life (µg/L)							
				N	# DT	FOD	Max Msd	Max Msd HQ	#Msd>SEV	Max DL	#DL>SEV
Dibenzofuran	no SEV	c,e	Dissolved	0	-	-	-	-	-	-	-
Diethyl phthalate	no SEV		Dissolved	0	-	-	-	-	-	-	-
Dimethyl phthalate	no SEV		Dissolved	0	-	-	-	-	-	-	-
Di-n-butyl phthalate	no SEV		Dissolved	0	-	-	-	-	-	-	-
Di-n-octylphthalate	no SEV		Dissolved	0	-	-	-	-	-	-	-
Hexachlorocyclopentadiene	no SEV		Dissolved	0	-	-	-	-	-	-	-
Hexachloroethane	no SEV		Dissolved	0	-	-	-	-	-	-	-
Isophorone	no SEV		Dissolved	0	-	-	-	-	-	-	-
Nitrobenzene	no SEV		Dissolved	0	-	-	-	-	-	-	-
N-Nitrosodi-n-propylamine	no SEV		Dissolved	0	-	-	-	-	-	-	-
N-Nitrosodiphenylamine	no SEV		Dissolved	0	-	-	-	-	-	-	-
Pentachlorophenol	17.5		Dissolved	0	-	-	-	-	-	-	-
Phenol	no SEV		Dissolved	0	-	-	-	-	-	-	-

Notes:

Shaded values are greater than or equal to the SEV.

DT = number of detected samples.

#DL>SEV = number of detection limits from non-detected samples greater than the SEV.

#Msd>SEV = number of measured samples greater than the SEV.

FOD = frequency of detection

Max DL = maximum detection limit

Max Msd = maximum measured concentration

Max Msd HQ = ratio of the maximum measured value to the screening SEV

N = sample size

n/a = not applicable since all concentrations were detected (FOD = 100%)

SEV = screening ecological value

^a For hardness dependent screening SEVs, the hardness value used for the screening evaluation was the sample-specific value or, when a sample-specific value was not available, the arithmetic mean of hardness measurements (66.89 ± 4.5 mg/L CaCO_3) collected between 2000 and 2006 in conjunction with the Ecology water quality monitoring was used (the raw data will be presented in the SLERA). The value shown in the SEV column represents the SEV adjusted to a hardness of 66.89 CaCO_3 .

^b USEPA. 2006. National Recommended Water Quality Criteria. Office of Water. U.S. Environmental Protection Agency, Washington, DC. Available online at: <http://www.epa.gov/waterscience/criteria/wqcriteria.html>

^c Ecology. 2006. Water Quality Standards for Surface Waters of the State of Washington, Chapter 173 201A. Amended November 20, 2006. Publication No. 06 10 091. Washington State Department of Ecology, Olympia, WA.

^d Confederated Colville Tribes. 2004. Water Quality Standards. Title 4 Natural Resources and Environment, CH. 8 9. Available at: <http://www.narf.org/nill/Codes/colvillecode/cc4ch8to9.htm>.

^e STI (Spokane Tribe of Indians). 2003. Surface Water Quality Standards. March 7, 2003. Resolution 2003 259.

^f CCME. 2007. Guidelines for the Protection of Aquatic Life. Canadian Council of Ministers of the Environment. Environment Canada. Available at: <http://www.waterquality.ec.gc.ca/EN/navigation/3297/3301/3307.htm>

^g Value represents acute criterion for silver because no chronic criterion is available

Table A-7. Recommended Laboratory Methods for Surface Water Samples

Analytes	Laboratory	Sample Preparation		Quantitative Analysis	
		Protocol	Procedure	Protocol	Procedure
Conventional Parameters	CAS				
Alkalinity as CaCO ₃		--	--	SM 2320B	Titrimetric
DOC		SM 5310C	Filtration, chemical oxidation	SM 5310C	Infrared detector
Hardness as CaCO ₃		--	--	SM 2340C	Calculation
TDS/TSS		--	--	SM 2540	Gravimetric
TOC		SM 5310C	Filtration, chemical oxidation	SM 5310C	Infrared detector
pH		EPA 150.1/SM 4500 H ⁺ B	--	EPA 150.1/SM 4500 H ⁺ B	Electrometric
Silicon dioxide (silica) (dissolved)		EPA 370.1	Filtration	EPA 370.1	Colorimetric
Major Ions	CAS				
Calcium, magnesium, potassium, sodium		EPA 3005	Acid digestion	EPA 6010B	ICP/AES
Chloride, fluoride, sulfate		--	--	EPA 300.0	Ion chromatography
Nutrients	CAS				
Ammonia		SM 4500-NH3 G	Buffered to pH 9.5	SM 4500-NH3 G	Colorimetric
Nitrate-nitrite		--	--	EPA 300.0	Ion chromatography
Total phosphorus		EPA 365.3	Persulfate digestion	EPA 365.3	Colorimetric
Common Metals and Metalloids ^a					
Aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, manganese, nickel, selenium, silver, thallium, vanadium, zinc	CAS	EPA 3005	Acid digestion	EPA 6020	ICP/MS
Iron	CAS	EPA 3005	Acid digestion	EPA 6010B	ICP/AES
Mercury	CAS	EPA 1631E	BrCl oxidation	EPA 1631E	AFS
Arsenic ^c	FGS	EPA 1632	Acid digestion	EPA 1632	AAS
Other Metals and Metalloids ^a	CAS				
Bismuth, boron, cerium, cesium, dysprosium, erbium, europium, gadolinium, gallium, germanium, gold, holmium, indium, lanthanum, lithium, lutetium, molybdenum, neodymium, niobium, praseodymium, rubidium, samarium, scandium, silicon (silica), tantalum, tellurium, terbium, thorium, thulium, tin, tungsten, uranium, ytterbium, yttrium		EPA 3005	Acid digestion	EPA 6020	ICP/MS
Strontium, titanium		EPA 3005	Acid digestion	EPA 6010B	ICP/AES
Stable Isotopes	Isotech				
Deuterium		Indiana Zinc Method	Addition of sample water to zinc turnings	Indiana Zinc Method	Mass spectrometry
Oxygen-18		CO ₂ Equilibration Method	Addition of sample water to CO ₂	CO ₂ Equilibration Method	Mass spectrometry
Pesticides	CAS	EPA 3510C / 3520C EPA 3640A EPA 3620C	Separatory funnel or continuous liquid-liquid extraction Gel permeation chromatography ^b Florisil [®] cleanup ^b Additional cleanup as needed	EPA 8081B	GC/ECD
SVOCs	CAS	EPA 3510C / 3520C	Separatory funnel or continuous liquid-liquid extraction	EPA 8270D	GC/MS

Table A-7. Recommended Laboratory Methods for Surface Water Samples

Analytes	Laboratory	Sample Preparation		Quantitative Analysis	
		Protocol	Procedure	Protocol	Procedure
PAHs	CAS	EPA 3510C / 3520C	Separatory funnel or continuous liquid-liquid extraction	EPA 8270D-SIM	GC/MS-SIM
PCB Congeners	SGS	EPA 1668A	Soxhlet extraction Gel permeation chromatography ^b Layered Acid/Base/SiO ₃ column ^b Florisil [®] cleanup ^b Additional cleanup as needed	EPA 1668A	HRGC/HRMS
PBDEs	SGS	EPA 3520C	Separatory funnel or continuous liquid-liquid extraction Gel permeation chromatography ^b Florisil [®] cleanup Layered Acid/Base/SiO ₃ column ^b Alumina cleanup ^b	EPA 1614	HRGC/HRMS
Radionuclides	Pace				
Ra-226		EPA 903.1	BaSO ₄ precipitation	EPA 903.1	Alpha spectrometry
U-238		EPA 908.0	Acid digestion, Fe(OH) ₃ precipitation	EPA 908.0	Alpha spectrometry

Notes:

AAS = atomic absorption spectrometry

AFS = atomic fluorescence spectroscopy

CVAAS = cold vapor atomic absorption spectrometry

DOC = dissolved organic carbon

EPA = U.S. Environmental Protection Agency

GC/ECD = gas chromatography/electron capture detection

GC/MS = gas chromatography/mass spectrometry

HRGC/HRMS = high resolution gas chromatography/high resolution mass spectrometry

ICP/AES = inductively coupled plasma/atomic emission spectrometry

ICP/MS = inductively coupled plasma/mass spectrometry

PAH = polycyclic aromatic hydrocarbon

PBDE = polybrominated diphenyl ether

PCB = polychlorinated biphenyl

SM = Standard Methods for the Examination of Water and Wastewater

SVOC = semivolatile organic compound

TBD = to be determined

TDS = total dissolved solids

TOC = total organic carbon

TSS = total suspended solids

^a Surface water samples will be collected and analyzed for total and dissolved metals and metalloids.

^b Cleanup procedures are to be performed as needed.

^c Samples analyzed by 6020 at CAS with not-detects for arsenic would be analyzed by Frontier (FGS) to achieve detection limits.

Table A-8. Data Quality Objectives for Surface Water Study

Problem Statement	Identify the Decision	Identify Inputs to the Decision	Define the Boundaries of the Study	Identify the Analytic Approach	Specify Performance or Acceptance Criteria	Develop the Plan for Obtaining Data
<p>The UCR RI/FS was initiated due to concerns regarding historical discharges into the Columbia River, including granulated slag and liquid effluent, from the Teck Cominco Metals Limited (TCM) smelter near Trail, B.C. Other potential sources of chemicals of interest (COIs) are identified in the preliminary conceptual site model (CSM) for the Site.</p> <p>The preliminary CSM identifies surface water as an exposure medium for ecological receptors and people.</p> <p>Available surface water data are limited spatially and with respect to COIs with metals data being predominant due to the types of sources. Conservative screening ecotoxicity values (SEVs) are seldom exceeded by detected metal concentrations, and concentrations do not exhibit large temporal variability. However, additional surface water data are needed to determine potential risk to ecological receptors and people within the Site.</p>	<p>The preliminary CSM provides a general framework for considering the relationship between the major exposure media and exposure pathways to ecological receptors and people. The key questions related to potential exposures and related risks are:</p> <p>Key Questions:</p> <ol style="list-style-type: none">1. Do COI concentrations exceed state, federal, or Tribal water quality benchmarks?2. Do COIs in surface water pose an unacceptable risk to aquatic life and wildlife through direct contact, ingestion, or respiration?3. Do COIs in surface water pose an unacceptable risk to human health through dermal contact and ingestion?4. Do COIs in surface water pose an unacceptable risk to aquatic life and wildlife through food chain transfer?5. Do COIs in surface water pose an unacceptable risk to human health through food chain transfer?	<p>Major Types of Data:</p> <ul style="list-style-type: none">• Analytical data for total and dissolved EPA Target Analyte List (TAL) metals/metalloids<ul style="list-style-type: none">– at all locations– at seasonal extremes in water flow conditions<ul style="list-style-type: none">• Analytical data for other total and dissolved metals at some locations during each sampling event• Analytical data for organic COIs<ul style="list-style-type: none">– at select locations– at extreme flow and water level conditions• Federal, state, and Tribal water quality benchmarks• Conventional data relevant to interpretation of metals data• Nutrient and major ion data relevant to understanding water homogeneity and bioavailability• Field water quality parameters relevant to interpretation of all surface water data <p>Target Analytes and Field Measurements:</p> <ul style="list-style-type: none">• Total recoverable and dissolved EPA TAL metals and metalloids, molybdenum, and uranium in all samples• Total recoverable and dissolved other metals in select water samples: bismuth, boron, cerium, cesium, dysprosium, erbium, europium, gadolinium, gallium, germanium, gold, holmium, indium, lanthanum, lithium, lutetium, neodymium, niobium, praseodymium, rubidium, samarium, scandium, strontium, tantalum, tellurium, terbium, thorium, thulium, tin, tungsten, titanium, ytterbium, yttrium, zirconium• Organic compounds in select water samples: pesticides, SVOCs, PAHs, PCBs, PBDEs• Total suspended solids in all samples• Other conventional parameters in most samples: alkalinity, hardness (as CaCO₃), total suspended solids, total dissolved solids, total	<p>Temporal – defining the range of hydrologic conditions:</p> <ul style="list-style-type: none">• Fall low flow (stable pool, small drawdown)• Descending limb of hydrograph, prior to lake infilling (decreasing pool)• Ascending limb of the hydrograph (increasing pool) <p>Longitudinal:</p> <ul style="list-style-type: none">• UCR: Samples will be collected between U.S.-Canadian border and Grand Coulee Dam (includes Lake Roosevelt)• Canada: Samples will be collected at Birchbank, B.C. and Waneta, B.C. to provide data to help interpret Site data. The time series of grab samples to be collected at Waneta are intended to help distinguish potential temporal variation upstream of the Site from spatial variation within the Site during the time period sampled.	<p>Decision Frameworks:</p> <p>Surface water data will initially be compared to SEVs. Non-bioaccumulative COIs that are below SEVs will be removed from the COI list. COIs remaining on the list (including bioaccumulative COIs) or lacking SEVs will be evaluated in a more detailed risk assessment to determine potential adverse risk to ecological receptors (via contact, ingestion, respiration, or bioaccumulation) or human health (via contact or ingestion). In the event one or more COIs are associated with predictions of unacceptable risk, then future actions will be considered.</p>	<p>Field:</p> <ul style="list-style-type: none">• Field quality assurance/ quality control (QA/QC) will be sufficient to characterize sampling variability• EPA clean-hands sample handling techniques will be used. <p>Laboratory:</p> <ul style="list-style-type: none">• Method reporting limits are below federal, state, or Tribal benchmarks for protection of human health and the environment• Analytical concentration goals will be one-fifth of the lowest screening benchmark• For COIs without screening benchmarks, analytical concentration goal is reporting limit from Paulson et al. (2006) or laboratory's method reporting limits, whichever is lower• Lab QA/QC will meet method requirements <p>Data Evaluation:</p> <p>Questions posed in Step 2 will be addressed through statistical evaluations. Measurement variability will be ascertained using field replicates and by evaluating variability along and across transects. Data will be pooled within transects, and across depths and transects, as appropriate, following statistical tests of equivalence.</p> <ol style="list-style-type: none">1. Are the levels of COIs in surface water from the UCR Site greater than benchmarks for the survival, growth, or reproduction of fish?<ul style="list-style-type: none">• Site data will be compared to benchmarks using one-sample <i>t</i>-tests (or nonparametric equivalents) with a one-sided null hypothesis. Data will be transformed as necessary, and power calculated.2. Do COI concentrations in surface water pose unacceptable risk to aquatic life and wildlife through direct contact or ingestion?<ul style="list-style-type: none">• Both point-to-point comparisons and one-sample <i>t</i>-tests will be used. Upper 95 percent confidence limits on Site data and power calculations will be used to assist interpretation of the comparison results.3. Do COI concentrations in surface water pose unacceptable risk to human health through dermal contact and ingestion?<ul style="list-style-type: none">• EPA is performing the human health risk assessment and will develop the data evaluation approach.	<ol style="list-style-type: none">1. Transect Locations in the UCR<ul style="list-style-type: none">• TC9 (RM 744)- At the border• TC1(RM733)–Downstream of Northport where historical surface water data have been collected• TC2 (RM724)–China Bend• TC3 (RM 707)–Marcus Flats where granulated slag deposits occur• TC4 (RM 678)–Upstream of Inchelium where cadmium and mercury are elevated in sediment• TC5 (RM 642)–Upstream of Spokane River• TC6 (RM 633)–Below Spokane River• TC7 (RM 605)–Plum Point<p>Transect Sampling Design</p><ul style="list-style-type: none">• Depending on transect width and underwater topography, 10 to 12 samples/transect<ul style="list-style-type: none">– Two near-shore undisturbed samples– Six near-shore samples where sediments have been disturbed– Two to four offshore near-surface samples– Two to four offshore near-bottom samples• Frequency of Sampling<ul style="list-style-type: none">– Three surveys to capture conditions during the ascending limb of the hydrograph, the descending limb of the hydrograph, and low flow conditions• Analytes<ul style="list-style-type: none">– Total recoverable and dissolved TAL metals/metalloids, molybdenum, and uranium; and conventional parameters for all samples– Other metals along the Northport (TC1), Marcus Flats (TC3), Inchelium (TC4), and below the Spokane River (TC6) transects.– Organics in three or four samples per transect per survey (one near-surface and one near-bottom sample at the thalweg or mid-channel station, one undisturbed, near-shore sample, and, at stations proximate to beach sediment sampling locations, one disturbed sediment nearshore sample [transects TC1, TC2, TC3, TC6, TC7])– Radionuclides in one disturbed sediment surface water sample at surface water stations proximate to beach sampling locations (TC1, TC2, TC3, TC6, TC7)– Continuous measurement of field parameters (e.g., temperature, dissolved oxygen, conductivity) at all stations<ol style="list-style-type: none">2. Individual Sampling Location in the UCR<ul style="list-style-type: none">• TC8 (RM742)–Black Sand Beach<ul style="list-style-type: none">– Three surveys to capture conditions during the ascending limb of the hydrograph, the descending limb of the hydrograph, and low

Table A-8. Data Quality Objectives for Surface Water Study

Problem Statement	Identify the Decision	Identify Inputs to the Decision	Define the Boundaries of the Study	Identify the Analytic Approach	Specify Performance or Acceptance Criteria	Develop the Plan for Obtaining Data
		<p>organic carbon, dissolved organic carbon, pH, silica (as dissolved SiO₂)</p> <ul style="list-style-type: none">Nutrients and major ions in most samples: ammonia, nitrate, nitrite, total phosphorus, potassium, sodium, calcium, magnesium, fluoride, chloride, sulfateField measurements at all stations: water temperature, pH, dissolved oxygen, conductivity, turbidity, oxidation-reduction potential			<p>4. Do COI concentrations in surface water pose an unacceptable risk to aquatic life or wildlife in the absence of bioaccumulated chemicals in their food?</p> <ul style="list-style-type: none">To assess the risk from bioaccumulative COIs in surface water, and only if the hazard quotient for a COI and receptor is greater than 1.0, a wildlife exposure model will be applied in a Monte-Carlo fashion to evaluate the incremental risk of the COI concentration in surface water (i.e., with and without the surface water pathway). The incremental risk due to the COI concentration in surface water must be statistically significantly different from zero, based on a two-sample one-sided <i>t</i>-test (or nonparametric equivalent) of the risk distributions with and without the surface water pathway, at an experiment wise false positive error rate of no more than 5 percent. <p>5. Do COIs in surface water pose an unacceptable risk to human health through food chain transfer?</p> <ul style="list-style-type: none">EPA is performing the human health risk assessment and will develop the data evaluation approach	<p>flow conditions</p> <ul style="list-style-type: none">Three near-shore samples where sediments have been disturbedTAL metals and metalloids, molybdenum, and uranium; total suspended solids; and field parameters; organic compounds and radionuclides in one of the three samples <p>3. Samples in Canada</p> <ul style="list-style-type: none">Transect and Station Locations<ul style="list-style-type: none">CAN1 (RM 762)–Transect at Birchbank, B.C.CAN2 (RM 645)–Station at Waneta, B.C.One transect containing two sampling locations will be sampled at Birchbank, B.C. (CAN1) during each UCR survey. Near-surface and near-bottom samples will be collected and analyzed for EPA total and dissolved TAL metals and metalloids, molybdenum, and uranium; other metals; organic compounds; conventional parameters; nutrients; and major ions. Field parameters will be collected.One station will be sampled from shore at Waneta, B.C., for several weeks prior to the initiation of each UCR survey. The duration of weekly sampling will correspond to the average hydraulic residence time of water in the UCR during the UCR survey. The nearshore sample will be analyzed for total and dissolved EPA TAL metals, molybdenum, and uranium; conventional parameters; nutrients; and major ions. Field parameters will be collected. <p>4. Sampling Methods</p> <ul style="list-style-type: none">Water bottles (e.g., Go-Flow or Niskin bottles)Peristaltic pump with Teflon tubing <p>5. Analytical Methods</p> <ul style="list-style-type: none">EPA-approved methods for metals/metalloids, organics, conventionalsAnalytical concentration goals will be one-fifth of lowest screening benchmark

Table A-9. Comparison of Near-Surface and Near-Bottom Samples on a Transect

		Near-surface		
		Pool 5 samples	Pool 3 samples	No pooling
Near-bottom	Pool 3 samples	Evaluate pooling of 5 near-surface and 3 near-bottom samples using a two-sample <i>t</i> -test	Evaluate pooling of 2 near-surface and 3 near-bottom samples using a two-sample <i>t</i> -test	Evaluate pooling of near-surface and near-bottom samples from the left bank, channel center, and right-bank channels separately, using a Monte Carlo permutation procedure
	No pooling	Evaluate pooling of near-surface and near-bottom samples from the left bank, channel center, and right-bank channels separately, using a Monte Carlo permutation procedure	Evaluate pooling of near-surface and near-bottom samples from the left bank, channel center, and right-bank channels separately, using a Monte Carlo permutation procedure	Evaluate pooling of near-surface and near-bottom samples from the left bank, channel center, and right-bank channels separately, using a Monte Carlo permutation procedure

Table A-10. Evaluation of Transects by Depth

		Transect 1				
		Near-surface and near-bottom pooled together	Near-surface pooled and near-bottom pooled, but depths not pooled together	Near-surface pooled but near-bottom not pooled	Near-surface not pooled but near-bottom pooled	Neither near-surface nor near-bottom pooled
Transect 2	Near-surface and near-bottom pooled together	All samples from both transects	Near-surface samples from both transects, and, separately, near-bottom samples from both transects	Near-surface samples from both transects	Near-bottom samples from both transects	No comparison or pooling of depth horizons across transects
	Near-surface pooled and near-bottom pooled, but depths not pooled together	Near-surface samples from both transects, and, separately, near-bottom samples from both transects	Near-surface samples from both transects, and, separately, near-bottom samples from both transects	Near-surface samples from both transects	Near-bottom samples from both transects	No comparison or pooling of depth horizons across transects
	Near-surface pooled but near-bottom not pooled	Near-surface samples from both transects	Near-surface samples from both transects	Near-surface samples from both transects	Near-bottom samples from both transects	No comparison or pooling of depth horizons across transects
	Near-surface not pooled but near-bottom pooled	Near-bottom samples from both transects	Near-bottom samples from both transects	Near-bottom samples from both transects	Near-bottom samples from both transects	No comparison or pooling of depth horizons across transects
	Neither near-surface nor near-bottom pooled	No comparison or pooling of depth horizons across transects	No comparison or pooling of depth horizons across transects	No comparison or pooling of depth horizons across transects	No comparison or pooling of depth horizons across transects	No comparison or pooling of depth horizons across transects

Table A-11. Dissolved Metal Concentrations at Northport, 2002-2007, and Power Levels Associated with Comparisons of Concentrations to Water Quality Criteria (CCC).

Analyte	Season	Number of Samples	Concentration (µg/L)	Standard Deviation	CCC ^a (µg/L)	Power Level per Given Sample Size						
						2	3	4	5	6	7	8
Arsenic	Fall	14	0.39	0.069	150	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Arsenic	Spring	15	0.48	0.077		1.0	1.0	1.0	1.0	1.0	1.0	1.0
Cadmium	Fall	14	0.034	0.061	0.25	0.6	1.0	1.0	1.0	1.0	1.0	1.0
Cadmium	Spring	15	0.025	0.014		1.0	1.0	1.0	1.0	1.0	1.0	1.0
Copper	Fall	14	0.49	0.063	9.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Copper	Spring	15	0.59	0.23		1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lead	Fall	14	0.02	0.012	2.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lead	Spring	15	0.037	0.028		1.0	1.0	1.0	1.0	1.0	1.0	1.0
Nickel	Fall	14	0.62	0.14	52	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Nickel	Spring	15	0.54	0.12		1.0	1.0	1.0	1.0	1.0	1.0	1.0
Zinc	Fall	14	2.2	0.89	120	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Zinc	Spring	15	4	3.9		1.0	1.0	1.0	1.0	1.0	1.0	1.0

Note:

Criteria for all these metals except for arsenic are hardness dependent; a value of 100 mg/L hardness was used to calculate these values.

^a CCC= Freshwater Chronic Water Quality Criteria from USEPA (2005), National Recommended Water Quality Criteria.

<http://www.epa.gov/waterscience/criteria/wqctable/#E>. Accessed June 26, 2009.

Table A-12. Rationale for Transect and Station Placement

						Station Rationale					
Transect	Name	RM	Transect/Station Rationale	Station ID ^a	Station Description	Assess Exposure to Plankton	Assess Exposure to Nearshore Fish	Assess Exposure to Pelagic Fish	Assess Exposure to Demersal Fish	Assess Exposure to Aquatic-Dependent Wildlife	Human Health Risk Assessment
Site Transects/Stations											
TC9	International border	745	Riverine reach; northernmost portion of Site and closest to Trail facility; expand existing surface water data set.	TC9-NS-L	Near-surface single point sample; left	•		•		•	
				TC9-NB-L	Near-bottom single point sample; left			•			
				TC9-NS-M	Near-surface single point sample; middle	•		•		•	
				TC9-NB-M	Near-bottom single point sample; middle				•		
				TC9-NS-R	Near-surface single point sample; right	•		•		•	
				TC9-NB-R	Near-bottom single point sample; right				•		
				TC9-NSH-L	Near-shore single point sample; left (undisturbed)	•	•			•	•
				TC9-NSH-R	Near-shore single point sample; right (undisturbed)	•	•			•	•
TC1	Northport	734	Riverine reach; low annual/seasonal variability in surface water COIs based on historical data; sediments contain metals associated with slag; expand existing surface water dataset for this location; EPA Phase I sediment transect	TC1-NS-L	Near-surface single point sample; left	•		•		•	
				TC1-NB-L	Near-bottom single point sample; left				•		
				TC1-NS-M	Near-surface single point sample; middle	•		•		•	
				TC1-NB-M	Near-bottom single point sample; middle				•		
				TC1-NS-R	Near-surface single point sample; right	•		•		•	
				TC1-NB-R	Near-bottom single point sample; right				•		
				TC1-NSH-L	Near-shore single point sample; left (undisturbed)	•	•			•	•
				TC1-NSH-L	Near-shore single point sample; left (disturbed)						•
TC1-NSH-R	Near-shore single point sample; right (undisturbed)	•	•			•	•				
	TC1-NSH-R	Near-shore single point sample; right (disturbed)						•			
TC2	China Bend	724	Riverine reach; sediments contain metals associated with slag; EPA Phase I sediment transect; EPA Focus Area 2	TC2-NS-L	Near-surface single point sample; left	•		•		•	
				TC2-NB-L	Near-bottom single point sample; left				•		
				TC2-NS-M	Near-surface single point sample; middle	•		•		•	
				TC2-NB-M	Near-bottom single point sample; middle				•		
				TC2-NS-R	Near-surface single point sample; right	•		•		•	
				TC2-NB-R	Near-bottom single point sample; right				•		
				TC2-NSH-L	Near-shore single point sample; left (undisturbed)	•	•			•	•
				TC2-NSH-L	Near-shore single point sample; left (disturbed)						•
TC2-NSH-R	Near-shore single point sample; right (undisturbed)	•	•			•	•				
	TC2-NSH-R	Near-shore single point sample; right (disturbed)						•			
TC3	Marcus Flats	704	Slag depositional area; sediments contain metals associated with slag; EPA Phase I sediment transect; EPA Focus Area 3	TC3-NS-L1	Near-surface single point sample; left	•		•		•	
				TC3-NB-L1	Near-bottom single point sample; left				•		
				TC3-NS-L2	Near-surface single point sample; left	•		•		•	
				TC3-NB-L2	Near-bottom single point sample; left				•		
				TC3-NS-M	Near-surface single point sample; middle	•		•		•	
				TC3-NB-M	Near-bottom single point sample; middle				•		
				TC3-NS-R	Near-surface single point sample; right	•		•		•	
				TC3-NB-R	Near-bottom single point sample; right				•		
TC3-NSH-L	Near-shore single point sample; left (undisturbed)	•	•			•	•				
	TC3-NSH-L	Near-shore single point sample; left (disturbed)						•			
TC3-NSH-R	Near-shore single point sample; right (undisturbed)	•	•			•	•				
	TC3-NSH-R	Near-shore single point sample; right (disturbed)						•			

Table A-12. Rationale for Transect and Station Placement

						Station Rationale					
Transect	Name	RM	Transect/Station Rationale	Station ID ^a	Station Description	Assess Exposure to Plankton	Assess Exposure to Nearshore Fish	Assess Exposure to Pelagic Fish	Assess Exposure to Demersal Fish	Assess Exposure to Aquatic- Dependent Wildlife	Human Health Risk Assessment
TC4	Inchelium	678	Lacustrine reach subject to drawdown; deep-water depositional area; elevated cadmium and mercury in sediment; EPA Phase I sediment transect; EPA Focus Area 4	TC4-NS-L1	Near-surface single point sample; left	•		•		•	
				TC4-NB-L1	Near-bottom single point sample; left			•			
				TC4-NS-L2	Near-surface single point sample; left	•		•		•	
				TC4-NB-L2	Near-bottom single point sample; left				•		
				TC4-NS-M	Near-surface single point sample; middle	•		•		•	
				TC4-NB-M	Near-bottom single point sample; middle				•		
				TC4-NS-R	Near-surface single point sample; right	•		•		•	
				TC4-NB-R	Near-bottom single point sample; right				•		
				TC4-NSH-L	Near-shore single point sample; left (undisturbed)	•	•			•	
					Near-shore single point sample; left (disturbed)						•
TC5	Upstream of Spokane River	642	Lacustrine reach subject to drawdown; deep-water depositional area prior to confluence with Spokane River; elevated cadmium and mercury in sediment; EPA Phase I sediment transect; EPA Focus Area 5	TC4-NSH-R	Near-shore single point sample; right (undisturbed)	•	•			•	•
					Near-shore single point sample; right (disturbed)						•
				TC5-NS-L1	Near-surface single point sample; left	•		•		•	
				TC5-NB-L1	Near-bottom single point sample; left				•		
				TC5-NS-L2	Near-surface single point sample; left	•		•		•	
				TC5-NB-L2	Near-bottom single point sample; left				•		
				TC5-NS-M	Near-surface single point sample; middle	•		•		•	
				TC5-NB-M	Near-bottom single point sample; middle				•		
				TC5-NS-R	Near-surface single point sample; right	•		•		•	
				TC5-NB-R	Near-bottom single point sample; right				•		
TC6	Downstream of Spokane River	637	Lacustrine reach subject to drawdown; deep-water depositional area located downstream of the confluence with the Spokane River; elevated cadmium and mercury in sediment; EPA Phase I sediment transect	TC5-NSH-L	Near-shore single point sample; left (undisturbed)	•	•			•	•
					Near-shore single point sample; left (disturbed)						•
				TC5-NSH-R	Near-shore single point sample; right (undisturbed)	•	•			•	•
					Near-shore single point sample; right (disturbed)						•
				TC6-NS-L	Near-surface single point sample; left	•		•		•	
				TC6-NB-L	Near-bottom single point sample; left				•		
				TC6-NS-M	Near-surface single point sample; middle	•		•		•	
				TC6-NB-M	Near-bottom single point sample; middle				•		
				TC6-NS-R1	Near-surface single point sample; right	•		•		•	
				TC6-NB-R1	Near-bottom single point sample; right				•		
TC7	Plum Point	605	Lacustrine reach subject to drawdown; deep-water depositional area; elevated cadmium and mercury in sediment; EPA Phase I sediment transect; EPA Focus Area 6; located near Grand Coulee Dam	TC6-NS-R2	Near-surface single point sample; right	•		•		•	
				TC6-NB-R2	Near-bottom single point sample; right				•		
				TC6-NSH-L	Near-shore single point sample; left (undisturbed)	•	•			•	•
					Near-shore single point sample; left (disturbed)						•
				TC6-NSH-R	Near-shore single point sample; right (undisturbed)	•	•			•	•
					Near-shore single point sample; right (disturbed)						•
				TC7-NS-L	Near-surface single point sample; left	•		•		•	
				TC7-NB-L	Near-bottom single point sample; left				•		
				TC7-NS-M	Near-surface single point sample; middle	•		•		•	
				TC7-NB-M	Near-bottom single point sample; middle				•		
TC7	Plum Point	605	Lacustrine reach subject to drawdown; deep-water depositional area; elevated cadmium and mercury in sediment; EPA Phase I sediment transect; EPA Focus Area 6; located near Grand Coulee Dam	TC7-NS-R	Near-surface single point sample; right	•		•		•	
				TC7-NB-R	Near-bottom single point sample; right				•		
				TC7-NSH-L	Near-shore single point sample; left (undisturbed)	•	•			•	•
					Near-shore single point sample; left (disturbed)						•

Table A-12. Rationale for Transect and Station Placement

						Station Rationale					
Transect	Name	RM	Transect/Station Rationale	Station ID ^a	Station Description	Assess Exposure to Plankton	Assess Exposure to Nearshore Fish	Assess Exposure to Pelagic Fish	Assess Exposure to Demersal Fish	Assess Exposure to Aquatic-Dependent Wildlife	Human Health Risk Assessment
TC8	Black Sand Beach	742	Riverine reach; low annual/seasonal variability in surface water COIs based on historical data; sediments contain metals associated with slag; additional sample requested by EPA	TC7-NSH-R	Near-shore single point sample; right (undisturbed)	●	●			●	●
					Near-shore single point sample; right (disturbed)						●
				TC8-NSH-L	Near-shore single point sample; left (disturbed)						●
Canadian Transect/Station CAN1	Birchbank, B.C.	762	Riverine reach; low annual/seasonal variability in surface water ; for use in assessing evaluating surface water quality entering the Site	CAN1-NS-L	Near-surface single point sample; left	●		●		●	
				CAN1-NB-L	Near-bottom single point sample; left				●		
				CAN1-NS-R	Near-surface single point sample; right	●		●		●	
				CAN1-NB-R	Near-bottom single point sample; right				●		
CAN2	Waneta, B.C.	745	Riverine reach; low annual/seasonal variability in surface water ; for use in assessing evaluating surface water quality entering the Site	CAN2-NSH-L	Near-shore single point sample; left (undisturbed)	●	●			●	●
Total # Samples for Risk Evaluation						47	17	30	30	47	30

^a Definitions
NSH=Nearshore station (~1 ft water depth)
NS=Near-surface station
NB=Near-bottom station
L=Left side of transect
M=Middle of transect
R=Right side of transect

Table B-1. Sample Containers, Preservation, and Holding Time Requirements

	Container ^a		Preservation	Holding Time	Proposed Laboratory
	Type	Size			Sample Size ^b
Conventional Parameters					
Alkalinity as CaCO ₃	HDPE	250 mL	4±2°C	28 days	50 mL
Dissolved organic carbon	HDPE	250 mL	H ₂ SO ₄ to pH <2; 4±2°C	28 days	20 mL
Hardness as CaCO ₃	HDPE	250 mL	4±2°C	28 days	50 mL
Total dissolved solids	HDPE	1 L	4±2°C	7 days	200 mL
Total suspended solids	HDPE	1 L	4±2°C	7 days	200 mL
Total organic carbon	HDPE	250 mL	H ₂ SO ₄ to pH <2; 4±2°C	28 days	20 mL
pH	HDPE	1 L	4±2°C	28 days	50 mL
Silicon dioxide (silica) (dissolved)	HDPE	1 L	4±2°C	28 days	50 mL
Cations/Anions					
Calcium, magnesium, potassium, sodium	HDPE	250 mL	HNO ₃ to pH <2; 4±2°C	28 days	60 mL
Chloride, fluoride, sulfate	HDPE	250 mL	H ₂ SO ₄ to pH <2; 4±2°C	28 days	60 mL
Nutrients, Cations/Anions					
Ammonia	HPDE	250 mL	H ₂ SO ₄ to pH <2; 4±2°C	28 days	5 mL
Nitrate-nitrite	HDPE	250 mL	H ₂ SO ₄ to pH <2; 4±2°C	28 days	60 mL
Total phosphorus	HDPE	250 mL	H ₂ SO ₄ to pH <2; 4±2°C	28 days	100 mL
Common Metals and Metalloids ^c	HDPE	two 1 L two 250 mL	5 mL of 1:1 HNO ₃ ; 4±2°C	6 months	1 L
Mercury ^c	FP or G w/ FP-lined lids	two 500 mL	BrCl in lab within 28 days of collection; 4±2°C	90 days	500 mL
Other Metals and Metalloids ^c	HDPE	two 500 mL	HNO ₃ in lab within 28 days of collection; 4±2°C	6 months	250 mL

Table B-1. Sample Containers, Preservation, and Holding Time Requirements

	Container ^a		Preservation	Holding Time	Proposed Laboratory Sample Size ^b
	Type	Size			
Stable Isotopes					
Deuterium	HDPE	125 mL	4±2°C	N/A	100 mL
Oxygen-18					
Pesticides	AG	1 L	4±2°C	7/40 days ^d	1 L
SVOCs	AG	1 L	4±2°C	7/40 days ^d	1 L
PAHs	AG	1 L	4±2°C	7/40 days ^d	1 L
PCB Congeners	PUF	40 L	4±2°C	7/40 days ^d	1 PUF
PBDEs	AG	1 L	4±2°C	7/40 days ^d	1 L
Radionuclides					
Ra-226	HDPE	1 L	HNO ₃ to pH<2	180 days	1 L
U-238	HDPE	1 L	HNO ₃ to pH<2	180 days	300 mL

Notes:

AG = amber glass

FP = fluoropolymer

G = glass

HDPE = high density polyethylene bottle

N/A = not available

PUF = polyurethane foam

^a Sample container sizes may be modified to meet laboratory requirements.

^b Extra sample volume will be collected at a frequency of 5 percent of samples to accommodate requirements for laboratory QC samples.

^c Surface water samples will be collected and analyzed for total and dissolved metals and metalloids and mercury. A total of 2 L of water will be collected for the common metals/metalloids analyses (1 L each for total and dissolved), and 500 mL will be collected for the "other" metals/metalloids analyses (250 mL each for total and dissolved). 250 mL bottles will be collected for possible arsenic analysis at Frontier GeoSciences.

^d The holding time is 7 days from collection to extraction and 40 days from extraction to analysis.

Table B-2. Derivation of Surface Water Analytical Concentration Goals and Proposed Laboratory Reporting and Detection Limits Based on Ecological Screening Criteria and Available Data for the Site

		Ecological Screening Criteria						Analytical Concentration Goal (µg/L) ^b	Proposed	
		Chronic EPA AWQC (µg/L)	Ecology Chronic WQS (µg/L)	Colville Confederated Tribes, Aquatic Life Chronic Criteria (µg/L)	Spokane Tribe of Indians, Aquatic Life Chronic Criteria (µg/L)	USGS Paulson et al. (2006) ^a Reporting Limits (µg/L)	Risk-Based Concentration Values (Woodbury 2008, pers. comm.)		MDL (µg/L) ^c	MRL (µg/L) ^c
Conventional Parameters	Alkalinity	NA	NA	NA	NA	NA	NA	NA	1000	2000
	DOC	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Hardness	NA	NA	NA	NA	NA	NA	NA	700	2000
	TDS	NA	NA	NA	NA	NA	NA	NA	NA	NA
	TSS	NA	NA	NA	NA	NA	NA	NA	NA	NA
	TOC	NA	NA	NA	NA	NA	NA	NA	40	500
	pH	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Silicon dioxide (silica) (dissolved)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cations/Anions	Calcium	NA	NA	NA	NA	1,000	NA	1000	30	50
	Chloride	230,000	230,000	230,000	230,000	NA	NA	46000	9.0	200
	Fluoride	NA	NA	NA	NA	NA	52	52	6.0	200
	Magnesium	NA	NA	NA	NA	20	NA	20	0.70	20
	Potassium	NA	NA	NA	NA	500	NA	500	1.3	4
	Sodium	NA	NA	NA	NA	50	NA	50	50	100
	Sulfate	NA	NA	NA	NA	10,000	NA	10000	7.0	200
Nutrients	Ammonia	NA	NA	NA	NA	NA	NA	NA	20	50
	Total Phosphorus	NA	NA	NA	NA	NA	NA	NA	2	10
	Nitrate-Nitrite	NA	NA	NA	NA	NA	NA	NA	3	100
Common Metals and Metalloids ^d	Aluminum	87	NA	87	87	15	23	23	0.30	2.0
	Antimony	NA	NA	NA	NA	0.30	0.34	0.34	0.030	0.050
	Arsenic	150	190	150	150	1.0	0.013	0.013	0.080	0.50
	Barium	NA	NA	NA	NA	1.0	3.3	3.3	0.020	0.050
	Beryllium	NA	NA	NA	NA	0.050	0.029	0.029	0.0080	0.020
	Cadmium	0.25	0.77 ^e	0.19 ^e	0.77 ^e	0.10	0.039	0.039	0.0080	0.020
	Chromium	74	128 ^e	53 ^e	53	5.0	100.0	10.6	0.070	0.20
	Cobalt	NA	NA	NA	NA	0.10	0.025	0.025	0.0050	0.020
	Copper	9.0	8.1 ^e	6.4 ^e	6.4	0.50	34	1.28	0.020	0.10
	Iron	1,000	NA	1,000	1,000	250	600	600	3	20
	Lead	2.5	1.6 ^e	1.6 ^e	1.6	0.25	15	0.32	0.0090	0.020
	Manganese	NA	NA	NA	NA	5.0	0.33	0.33	0.020	0.050
	Mercury	0.80	0.012	0.80	0.012	NA	0.000000089	0.000000089	0.0001	0.00025
	Molybdenum	NA	NA	NA	NA	2.0	4.3	2.0	0.030	0.050
	Nickel	52	112 ^e	37 ^e	37 ^e	0.40	17	17	0.070	0.20
	Selenium	5.0	20	5.0	5.0	5.0	4.3	4.3	0.40	1.0
	Silver	1.6 ^{e,1}	1.7 ^{e,1}	1.6	1.7 ^{e,1}	15	4.3	0.32	0.0090	0.020
	Thallium	NA	NA	NA	NA	0.20	0.06	0.06	0.0030	0.020
	Vanadium	NA	NA	NA	NA	2.5	0.86	0.86	0.080	0.20
	Uranium	NA	NA	NA	NA	0.50	2	2	0.0050	0.020
	Zinc	120	74 ^e	84 ^e	74	2.5	260	14.8	0.10	0.50

Table B-2. Derivation of Surface Water Analytical Concentration Goals and Proposed Laboratory Reporting and Detection Limits Based on Ecological Screening Criteria and Available Data for the Site

		Ecological Screening Criteria					Analytical Concentration Goal (µg/L) ^b	Proposed	
		Chronic EPA AWQC (µg/L)	Ecology Chronic WQS (µg/L)	Colville Confederated Tribes, Aquatic Life Chronic Criteria (µg/L)	Spokane Tribe of Indians, Aquatic Life Chronic Criteria (µg/L)	USGS Paulson et al. (2006) ^a Reporting Limits (µg/L)		MDL (µg/L) ^c	MRL (µg/L) ^c
Other Metals and Metalloids	Bismuth	NA	NA	NA	NA	0.20	NA	0.20	0.10
	Boron	NA	NA	NA	NA	NA	130	130	0.3
	Cerium	NA	NA	NA	NA	0.050	NA	0.050	0.020
	Cesium	NA	NA	NA	NA	0.020	NA	0.020	0.020
	Dysprosium	NA	NA	NA	NA	0.040	NA	0.040	0.020
	Erbium	NA	NA	NA	NA	0.025	NA	0.025	0.020
	Europium	NA	NA	NA	NA	0.025	NA	0.025	0.020
	Gadolinium	NA	NA	NA	NA	0.025	NA	0.025	0.020
	Gallium	NA	NA	NA	NA	0.050	NA	0.050	0.10
	Germanium	NA	NA	NA	NA	0.250	NA	0.250	0.10
	Gold	NA	NA	NA	NA	NA	NA	NA	0.020
	Holmium	NA	NA	NA	NA	0.025	NA	0.025	0.020
	Indium	NA	NA	NA	NA	NA	NA	NA	0.020
	Lanthanum	NA	NA	NA	NA	0.10	NA	0.10	0.020
	Lithium	NA	NA	NA	NA	4.5	17	17	0.050
	Lutetium	NA	NA	NA	NA	0.50	NA	0.50	0.020
	Niobium	NA	NA	NA	NA	1.0	NA	1.0	0.020
	Neodymium	NA	NA	NA	NA	0.1	NA	0.1	0.020
	Praseodymium	NA	NA	NA	NA	0.1	NA	0.1	0.020
	Rubidium	NA	NA	NA	NA	0.05	NA	0.05	0.10
	Samarium	NA	NA	NA	NA	0.09	NA	0.09	0.02
	Scandium	NA	NA	NA	NA	3.0	NA	3.0	0.10
	Silicon (Silica)	NA	NA	NA	NA	1.0	NA	1.0	NA
	Strontium	NA	NA	NA	NA	2.5	520	520	0.50
	Tantalum	NA	NA	NA	NA	0.10	NA	0.10	0.020
	Tellurium	NA	NA	NA	NA	NA	NA	NA	0.100
	Terbium	NA	NA	NA	NA	0.10	NA	0.10	NA
	Thorium	NA	NA	NA	NA	1.0	NA	1.0	0.020
	Thulium	NA	NA	NA	NA	0.045	NA	0.045	0.020
	Tin	NA	NA	NA	NA	NA	NA	NA	0.040
	Titanium	NA	NA	NA	NA	2.5	NA	2.5	0.040
	Tungsten	NA	NA	NA	NA	0.5	NA	0.5	0.020
	Ytterbium	NA	NA	NA	NA	0.025	NA	0.025	0.020
	Yttrium	NA	NA	NA	NA	0.050	NA	0.050	0.020
Stable Isotopes	Deuterium	NA	NA	NA	NA	NA	NA	NA	NA
	Oxygen-18	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides	2,4'-DDD	NA	NA	NA	NA	NA	0.08	0.08	6.0E-05
	2,4'-DDE	NA	NA	NA	NA	NA	0.056	0.056	4.7E-05
	2,4'-DDT	NA	NA	NA	NA	NA	0.056	0.056	1.2E-04
	4,4'-DDD	NA	1.1	NA	NA	NA	0.08	0.08	1.0E-04

Table B-2. Derivation of Surface Water Analytical Concentration Goals and Proposed Laboratory Reporting and Detection Limits Based on Ecological Screening Criteria and Available Data for the Site

		Ecological Screening Criteria					Analytical Concentration Goal (µg/L) ^b	Proposed	
		Chronic EPA AWQC (µg/L)	Ecology Chronic WQS (µg/L)	Colville Confederated Tribes, Aquatic Life Chronic Criteria (µg/L)	Spokane Tribe of Indians, Aquatic Life Chronic Criteria (µg/L)	USGS Paulson et al. (2006) ^a Reporting Limits (µg/L)		MDL (µg/L) ^c	MRL (µg/L) ^c
	4,4'-DDE	NA	1.1	NA	NA	NA	0.056	1.6E-04	5.0E-04
	4,4'-DDT	0.001	1.1	NA	NA	NA	0.056	3.3E-04	5.0E-04
	Aldrin	NA	0.0019	3.0	0.0019	NA	0.0011	5.4E-05	5.0E-04
	alpha-BHC	NA	NA	NA	NA	NA	0.003	6.0E-05	5.0E-04
	alpha-Chlordane	NA	NA	0.0043	0.0043	NA	0.055	7.2E-05	5.0E-04
	beta-BHC	NA	NA	NA	NA	NA	0.011	3.8E-04	5.0E-04
	cis-Nonachlor	NA	NA	NA	NA	NA	NA	9.3E-04	1.0E-02
	delta-BHC	NA	NA	NA	NA	NA	NA	1.8E-04	5.0E-04
	Dieldrin	0.056	0.0019	0.056	0.0019	NA	0.0012	4.0E-04	5.0E-04
	Endosulfan I	NA	NA	NA	NA	NA	NA	1.0E-04	5.0E-04
	Endosulfan II	NA	NA	NA	NA	NA	NA	6.3E-05	5.0E-04
	Endosulfan sulfate	NA	NA	NA	NA	NA	5.2	6.2E-05	5.0E-04
	Endrin	0.036	0.18	0.036	0.0023	NA	0.26	8.3E-05	5.0E-04
	Endrin aldehyde	NA	NA	NA	NA	NA	NA	1.3E-04	5.0E-04
	Endrin ketone	NA	NA	NA	NA	NA	NA	1.5E-04	5.0E-04
	gamma-BHC (Lindane)	NA	NA	NA	NA	NA	NA	2.0E-04	5.0E-04
	gamma-Chlordane	NA	NA	NA	NA	NA	0.055	1.5E-04	5.0E-04
	Heptachlor	0.0038	0.52	0.0038	0.0038	NA	0.0043	1.0E-04	5.0E-04
	Heptachlor epoxide	0.0038	NA	0.0038	0.0038	NA	0.0021	6.5E-05	5.0E-04
	Hexachlorobenzene	NA	NA	NA	NA	NA	0.012	1.3E-04	5.0E-04
	Hexachlorobutadiene	NA	NA	NA	NA	NA	0.25	6.7E-03	1.0E-02
	Methoxychlor	NA	NA	0.030	0.030	NA	4.3	1.7E-04	5.0E-04
	Oxychlordane	NA	NA	NA	NA	NA	NA	3.2E-03	1.0E-02
	Total Chlordane	0.0043	NA	NA	NA	NA	NA	2.2E-02	2.0E-01
	Toxaphene	0.0020	0.73	0.00020	0.00020	NA	0.017	5.5E-03	2.5E-02
	trans-Nonachlor	NA	NA	NA	NA	NA	NA	NA	5.0E-04
Semivolatile Organic Compounds	1,1'-Biphenyl	NA	NA	NA	NA	NA	43	43	0.037
	1,2,4-Trichlorobenzene	NA	NA	NA	NA	NA	8.6	8.6	0.015
	1,2-Dichlorobenzene	NA	NA	NA	NA	NA	NA	NA	0.020
	1,3-Dichlorobenzene	NA	NA	NA	NA	NA	NA	NA	0.020
	1,4-Dichlorobenzene	NA	NA	NA	NA	NA	NA	NA	0.020
	2,2'-oxybis(1-Chloropropane)	NA	NA	NA	NA	NA	0.27	0.27	0.017
	2,4,5-Trichlorophenol	NA	NA	NA	NA	NA	86	86	0.025
	2,4,6-Trichlorophenol	NA	NA	NA	NA	NA	0.86	0.86	0.037
	2,4-Dichlorophenol	NA	NA	NA	NA	NA	2.6	2.6	0.024
	2,4-Dimethylphenol	NA	NA	NA	NA	NA	17	17	0.32
	2,4-Dinitrophenol	NA	NA	NA	NA	NA	1.7	1.7	0.53
	2,4-Dinitrotoluene	NA	NA	NA	NA	NA	1.7	1.7	0.019
	2,6-Dinitrotoluene	NA	NA	NA	NA	NA	0.86	0.86	0.0088
	2-Chloronaphthalene	NA	NA	NA	NA	NA	69	69	0.015
	2-Chlorophenol	NA	NA	NA	NA	NA	4.3	4.3	0.015
	2-Methylphenol (o-cresol)	NA	NA	NA	NA	NA	43	43	0.059

Table B-2. Derivation of Surface Water Analytical Concentration Goals and Proposed Laboratory Reporting and Detection Limits Based on Ecological Screening Criteria and Available Data for the Site

		Ecological Screening Criteria					Analytical Concentration Goal (µg/L) ^b	Proposed	
		Chronic EPA AWQC (µg/L)	Ecology Chronic WQS (µg/L)	Colville Confederated Tribes, Aquatic Life Chronic Criteria (µg/L)	Spokane Tribe of Indians, Aquatic Life Chronic Criteria (µg/L)	USGS Paulson et al. (2006) ^a Reporting Limits (µg/L)		MDL (µg/L) ^c	MRL (µg/L) ^c
	2-Nitroaniline	NA	NA	NA	NA	NA	NA	0.015	0.20
	2-Nitrophenol	NA	NA	NA	NA	NA	NA	0.013	0.50
	3,3'-Dichlorobenzidine	NA	NA	NA	NA	NA	0.043	0.43	2.0
	3-Nitroaniline	NA	NA	NA	NA	NA	NA	0.23	1.0
	4,6-Dinitro-2-methylphenol	NA	NA	NA	NA	NA	NA	0.013	2.0
	4-Bromophenyl phenyl ether	NA	NA	NA	NA	NA	NA	0.018	0.20
	4-Chloro-3-methylphenol	NA	NA	NA	NA	NA	NA	0.029	0.50
	4-Chloroaniline	NA	NA	NA	NA	NA	3.4	0.017	0.20
	4-Chlorophenyl phenyl ether	NA	NA	NA	NA	NA	NA	0.0084	0.20
	4-Methylphenol (p-cresol)	NA	NA	NA	NA	NA	NA	0.0600	0.50
	4-Nitroaniline	NA	NA	NA	NA	NA	NA	0.16	1.0
	4-Nitrophenol	NA	NA	NA	NA	NA	NA	0.53	2.0
	Acetophenone	NA	NA	NA	NA	NA	86	0.16	0.50
	Benzaldehyde	NA	NA	NA	NA	NA	86	0.046	0.20
	Benzoic acid	NA	NA	NA	NA	NA	NA	2.0	5.0
	Benzyl alcohol	NA	NA	NA	NA	NA	430	0.97	5.0
	Bis(2-Chloroethoxy)methane	NA	NA	NA	NA	NA	NA	0.011	0.20
	Bis(2-chloroethyl)ether	NA	NA	NA	NA	NA	0.017	0.014	0.20
	Bis(2-Ethylhexyl)phthalate	NA	NA	NA	NA	NA	1.4	0.27	1.0
	Butyl benzyl phthalate	NA	NA	NA	NA	NA	170	0.025	0.20
	Caprolactam	NA	NA	NA	NA	NA	430	0.22	0.50
	Dibenzofuran	NA	NA	NA	NA	NA	0.86	0.013	0.20
	Diethyl phthalate	NA	NA	NA	NA	NA	NA	0.030	0.20
	Dimethyl phthalate	NA	NA	NA	NA	NA	NA	0.020	0.20
	Di-n-butyl phthalate	NA	NA	NA	NA	NA	86	0.026	0.20
	Di-n-octylphthalate	NA	NA	NA	NA	NA	NA	0.032	0.20
	Hexachlorocyclopentadiene	NA	NA	NA	NA	NA	1.3	0.041	1.0
	Hexachloroethane	NA	NA	NA	NA	NA	0.86	0.018	0.20
	Isophorone	NA	NA	NA	NA	NA	20	0.0084	0.20
	Nitrobenzene	NA	NA	NA	NA	NA	0.43	0.0074	0.20
	N-Nitrosodi-n-propylamine	NA	NA	NA	NA	NA	0.0027	0.032	0.20
	N-Nitrosodiphenylamine	NA	NA	NA	NA	NA	3.9	0.028	0.20
	Pentachlorophenol	15	NA	19.9	18	NA	0.16	0.028	1.0
	Phenol	NA	NA	NA	NA	NA	260	0.020	0.50
Polycyclic	2-Methylnaphthalene	NA	NA	NA	NA	NA	3.4	0.0042	0.020
Aromatic	Acenaphthene	NA	NA	NA	NA	NA	52	0.0031	0.020
Hydrocarbons	Acenaphthylene	NA	NA	NA	NA	NA	NA	0.0023	0.020
	Anthracene	NA	NA	NA	NA	NA	260	0.0039	0.020
	Benzo(a)anthracene	NA	NA	NA	NA	NA	0.013	0.0039	0.020
	Benzo(a)pyrene	NA	NA	NA	NA	NA	0.0013	0.0043	0.020
	Benzo(b)fluoranthene	NA	NA	NA	NA	NA	0.013	0.0046	0.020
	Benzo(e)pyrene	NA	NA	NA	NA	NA	NA	0.0048	0.020

Table B-2. Derivation of Surface Water Analytical Concentration Goals and Proposed Laboratory Reporting and Detection Limits Based on Ecological Screening Criteria and Available Data for the Site

		Ecological Screening Criteria					Analytical Concentration Goal (µg/L) ^b	Proposed	
		Chronic EPA AWQC (µg/L)	Ecology Chronic WQS (µg/L)	Colville Confederated Tribes, Aquatic Life Chronic Criteria (µg/L)	Spokane Tribe of Indians, Aquatic Life Chronic Criteria (µg/L)	USGS Paulson et al. (2006) ^a Reporting Limits (µg/L)		MDL (µg/L) ^c	MRL (µg/L) ^c
	Benzo(g,h,i)perylene	NA	NA	NA	NA	NA	NA	0.0041	0.020
	Benzo(k)fluoranthene	NA	NA	NA	NA	NA	0.13	0.0051	0.020
	Carbazole	NA	NA	NA	NA	NA	0.96	0.0033	0.020
	Chrysene	NA	NA	NA	NA	NA	1.3	0.0053	0.020
	Dibenz(a,h)anthracene	NA	NA	NA	NA	NA	0.0013	0.0036	0.020
	Dibenzothiophene	NA	NA	NA	NA	NA	NA	0.0038	0.020
	Fluoranthene	NA	NA	NA	NA	NA	34	0.0047	0.020
	Fluorene	NA	NA	NA	NA	NA	34	0.0036	0.020
	Indeno(1,2,3-cd)pyrene	NA	NA	NA	NA	NA	0.013	0.0033	0.020
	Naphthalene	NA	NA	NA	NA	NA	17	0.0065	0.020
	Perylene	NA	NA	NA	NA	NA	NA	0.0050	0.020
	Phenanthrene	NA	NA	NA	NA	NA	NA	0.0032	0.020
	Pyrene	NA	NA	NA	NA	NA	26	0.0047	0.020
Polychlorinated Biphenyls	209 PCB Congeners	NA	NA	NA	NA	NA	NA	Various	Various
	Total PCBs (TEQ)	0.014	2.0	0.014	0.014	NA	0.00000013	NA	NA
Polybrominated Diphenyl Ethers (PBDEs - most environmentally significant congeners)	2,2',4-TriBDE (BDE-17)	NA	NA	NA	NA	NA	NA	0.20	2.0
	2,4,4'-TriBDE (BDE-28)	NA	NA	NA	NA	NA	NA	0.20	2.0
	2,2',4,4'-TetraBDE (BDE-47)	NA	NA	NA	NA	NA	NA	0.20	2.0
	2,2',4,5'-TetraBDE (BDE-49) ^g	NA	NA	NA	NA	NA	NA	0.20	2.0
	2,3',4,4'-TetraBDE (BDE-66)	NA	NA	NA	NA	NA	NA	0.10	2.0
	2,3',4',6-TetraBDE (BDE-71)	NA	NA	NA	NA	NA	NA	0.20	2.0
	2,2',3,4,4'-PentaBDE (BDE-85)	NA	NA	NA	NA	NA	NA	0.30	2.0
	2,2',4,4',5-PentaBDE (BDE-99)	NA	NA	NA	NA	NA	NA	0.30	2.0
	2,2',4,4',6-PentaBDE (BDE-100)	NA	NA	NA	NA	NA	NA	0.30	2.0
	2,2',3,3',4,4'-HexaBDE (BDE-128)	NA	NA	NA	NA	NA	NA	0.40	40
	2,2',3,4,4',5'-HexaBDE (BDE-138)	NA	NA	NA	NA	NA	NA	0.40	10
	2,2',4,4',5,5'-HexaBDE (BDE-153)	NA	NA	NA	NA	NA	NA	0.40	2.0
	2,2',4,4',5,6'-HexaBDE (BDE-154)	NA	NA	NA	NA	NA	NA	0.40	2.0
	2,2',3,4,4',5',6-HeptaBDE (BDE-183)	NA	NA	NA	NA	NA	NA	0.40	10
	2,2',3,4,4',6,6'-HeptaBDE (BDE-184) ^g	NA	NA	NA	NA	NA	NA	0.40	10
	2,3,3',4,4',5,6-HeptaBDE (BDE-190)	NA	NA	NA	NA	NA	NA	0.60	40
	2,3,3',4,4',5',6-HeptaBDE (BDE-191) ^g	NA	NA	NA	NA	NA	NA	0.60	40
	2,2',3,4,4',5,5',6-OctaBDE (BDE-203)	NA	NA	NA	NA	NA	NA	0.40	40
	2,2',3,3',4,4',5,5',6-NonaBDE (BDE-206)	NA	NA	NA	NA	NA	NA	30	200
	Decabromodiphenyl ether (BDE-209)	NA	NA	NA	NA	NA	NA	40	400

Table B-2. Derivation of Surface Water Analytical Concentration Goals and Proposed Laboratory Reporting and Detection Limits Based on Ecological Screening Criteria and Available Data for the Site

		Ecological Screening Criteria						Analytical Concentration Goal (µg/L) ^b	Proposed	
		Chronic EPA AWQC (µg/L)	Ecology Chronic WQS (µg/L)	Colville Confederated Tribes, Aquatic Life Chronic Criteria (µg/L)	Spokane Tribe of Indians, Aquatic Life Chronic Criteria (µg/L)	USGS Paulson et al. (2006) ^a Reporting Limits (µg/L)	Risk-Based Concentration Values (Woodbury 2008, pers. comm.)		MDL (µg/L) ^c	MRL (µg/L) ^c
Radionuclides	Ra-226	NA	NA	NA	NA	NA	NA	NA	NA	1 pCi/L
	U-238	NA	NA	NA	NA	NA	NA	NA	NA	1 pCi/L

Notes:

TBD - To be determined

Analytical concentration goals (ACGs) for arsenic, mercury, gallium, rubidium, total chlordane, toxaphene, 3,3'-dichlorobenzidine, N-nitrosodi-n-propylamine, benzo(a)pyrene, and dibenz(a,h)anthracene are lower than their associated anticipated MDLs and may be achieved with minor method modifications. These ACGs are displayed with borders and are in bold text.

Revisions to ACGs may be appropriate following input from EPA on human health risk assessment data needs

^a Paulson et al. 2006. Concentrations of Elements in Sediments and Selective Fractions of Sediments, and in Natural Waters in Contact with Sediments from Lake Roosevelt, Washington, September 2004. Reporting limits compiled from Tables 23-25.

^b Analytical concentration goals (ACGs) are 1/5th of lowest value of the screening benchmarks and historical reporting limits for the site, unless Woodbury (2008) is the lowest value, then they are used in their entirety OR unless Paulson et al. (2006) was the only reference and then the Paulson et al. (2006) values were used in their entirety

^c For HRGS/MS methods non-detects will be reported to the sample specific detection limit (SDL). For all other methods non-detects will be reported to the MRL. For all methods values between SDL/MDL and MRL will be estimated (i.e. "J" qualified).

^d Total and dissolved metals and metalloids will be collected and analyzed for in surface water samples

^e Criteria are hardness or pH dependent and are calculated using the means of those parameters from the Ecology (2006) surface water data. Mean hardness = 66.89 mg/L, Mean pH = 8.11 s.u., Mean temperature = 9.5°C.

^f Value represents the acute criterion as no chronic criterion exists for this analyte.

^g Capability to analyze tissues for these BDE congeners is uncertain, and will depend on the selected laboratory.

Table B-3. Measurement Quality Objectives for Surface Water Study

Analysis	Bias ^a (percent)	Precision ^a (RPD)	Completeness (percent)
Conventional Parameters ^b	80–120	±20	95
Cations/Anions ^c	80–120	±20	95
Nutrients ^d	80–120	±20	95
Common Metals and Metalloids	80–120	±20	95
Other Metals and Metalloids	80–120	±20	95
Stable Isotopes			
Deuterium	--	±2	--
Oxygen-18	--	±0.1	--
Pesticides	70–130	±20	95
SVOCs	70–130	±20	95
PAHs	70–130	±20	95
PCB Congeners	70–130	±20	95
PBDEs	70–130	±20	95
Radionuclides			
Ra-226	70–130	±20	95
U-238	70–130	±20	95

Notes:

^a Includes calcium, chloride, fluoride, magnesium, potassium, sodium, and sulfate.

^b Includes ammonia, total phosphorus, nitrate, and nitrite.

^c Criteria for bias and precision are provided as general guidelines. Data will be qualified according to the procedures described in Section D1.

^d Conventional parameters include alkalinity as CaCO₃, DOC, hardness as CaCO₃, TDS, TSS, TOC, pH, and silica as dissolved SiO₂.