FINAL

Quality Assurance Project Plan – Upper Columbia River Northern Pike Tissue Study

Addendum No. 2 to the 2009 Fish Tissue Study Quality Assurance Project Plan

Prepared for

U.S. Environmental Protection Agency Region 10
Seattle, Washington

Prepared by

CH2MHill and SRC Inc.

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Section A. Project Management

A1. Title and Approval Sheet

Quality Assurance Project Plan for the Upper Columbia River Northern Pike Tissue Study

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Executive Summary

This Quality Assurance Project Plan (QAPP) represents an addendum to the Upper Columbia River (UCR) QAPP for the 2009 Fish Tissue Study (Parametrix et al., 2009). The fish tissue study is being conducted as part of the UCR Site remedial investigation and feasibility study (RI/FS). The primary objectives of the RI/FS are to investigate the nature and extent of contamination at the Site and to 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, and statutory and regulatory requirements.

The overarching QAPP for the fish tissue study was prepared in 2009 and focused on collection of several fish species and size classes in six reaches of the UCR Site. Sampling and analysis associated with the 2009 Fish Tissue Study QAPP was conducted in September and October 2009. Results of the 2009 investigation were documented in the UCR Fish Tissue Study Data Summary Report (Exponent and Parametrix 2013). Addendum No. 1 to the overarching 2009 QAPP focused on sampling and analysis of selected age classes of hatchery sturgeon tissue. The sturgeon tissue sampling program was conducted in 2016. Results of the sturgeon tissue investigation were documented in White Sturgeon Tissue Data Summary Report (Windward, 2017).

This document presents Addendum No. 2 to the overarching fish tissue study QAPP and focuses on collection and analysis of Northern Pike tissue samples.

WHAT is the purpose of Addendum No. 2?

Addendum No. 2 to the 2009 Fish Tissue Study QAPP describes how samples of Northern Pike tissue will be collected and analyzed to support the human health risk assessment (HHRA) and to assist the Washington Department of Health (WDOH) in their review of the potential need for a UCR Northern Pike fish consumption advisory.

WHY are we sampling Northern Pike fish tissue now?

Fish tissue sampling conducted in 2009 focused on fish species from different feeding guilds and diets so that a range of tissue concentrations of commonly consumed fish were represented. Not all fish species present in the UCR were sampled.

Northern Pike were not sampled in 2009 because they had not yet expanded their range to the UCR. The fish were not detected in the UCR until 2011.[1] Since then, Northern Pike, a non-native invasive species, have become the top predator in Lake Roosevelt and have rapidly increased in abundance, negatively impacting both native and hatchery prey fish (Lee and King 2015; Lee and King 2016; Lake Roosevelt Fisheries Co-managers 2018). Smallmouth Bass and Walleye were both sampled during the 2009 sampling event but may not serve as appropriate surrogates for Northern Pike in the UCR. This is because Northern Pike are voracious predators with piscivory beginning in earlier life stages than for Walleye or Smallmouth Bass, which feed on aquatic invertebrates for a much longer period of time (Walrath 2013). As a result, Northern Pike have a much faster growth trajectory and larger terminal size compared to Walleye and Smallmouth Bass, which may result in differences in bioaccumulation of contaminants of potential concern (COPCs) in Northern Pike relative to Smallmouth Bass and Walleye. Given that the WDOH has a state-wide mercury fish consumption advisory for Northern Pikeminnow, Largemouth Bass, and Smallmouth Bass, and additional advisories for Walleye and other species in the UCR, and because Northern Pike consumption is encouraged due to a Colville Confederated Tribes (CCT) $10 bounty per head incentive for anglers to remove them from the UCR and distribution of suppression

[1] https://www.nwcouncil.org/news/blog/lake-roosevelt-pike-update-july-2017

event-caught fish to CCT members, sampling and analysis of Northern Pike tissue is needed to better understand COPC concentrations in fish tissue consumed by anglers.

WHERE will the fish be collected?

Northern Pike will be caught by the Lake Roosevelt Fisheries Co-Managers as part of Northern Pike suppression efforts scheduled for July 2018. The fish are anticipated to be caught using gill nets deployed between Gifford and Northport, Washington with an emphasis in areas where Northern Pike are expected to be most abundant (the fish were most abundant around Kettle Falls and the Evans area in 2017).

HOW will the sample processing and analysis be performed?

A total of 60 appropriately-sized fish in two edible size classes (30 fish in the 300 to 449 millimeters [mm] total length [TL] size range and 30 fish in the greater than 450 mm TL size range) will be caught, weighed, and measured by the Co-manager team. The fish will then be transferred from the Co-manager's boats to EPA's contractor (CH2M) on a separate boat operated by the National Park Service for examination and collection of tissue samples (skinless fillets) in the field.

Each fish will be photographed and examined for external abnormalities, scaled, and filleted with skin removed. Filleting will follow general EPA guidelines for assessing chemical contaminant data for use in fish advisories. Fillet tissue will be individually wrapped in aluminum foil and placed in a resealable plastic bag. The bagged fillets will then be placed inside a second bag with the fish identification label so that this label is between the 2 resealable plastic bags. This will facilitate identification and sample organization at the laboratory without unwrapping the fish. The bagged and labelled fillets will be stored in a cooler on wet ice while on the sampling boat. The fillets will then be frozen and transferred to a cooler with dry ice for shipment to the laboratory. The fillets will be shipped to the laboratory as individual samples. Compositing will take place in the laboratory after additional processing steps are complete. After sampling is complete, EPA will prepare a specific compositing plan that identifies the individual fish that will be used to create each size class composite. The compositing approach will consist of a stratified random approach based on size class (i.e., individual fillets from each size bin will be randomly assigned to 1 of 6 composite samples for that size bin).

Upon receipt at the laboratory, the tissue samples will logged-in and stored in a freezer at -20°C. Processing at the laboratory will consist of thawing and homogenization of each fillet in a high-speed blender. The homogenate from each fillet will then be mixed with other designated samples from the size class to create a composited aliquot for freeze-drying, grinding, digestion, and analysis. Each composite will be created from the homogenate from 5 fillets in that size class, which will be randomly selected. A total of 12 composite samples will be prepared (6 composites for the 300 to 449 mm TL size range and 6 composites for the greater than 450 mm TL size range). The samples will be analyzed for COPCs (TAL metals, inorganic arsenic, and mercury), percent moisture and percent lipids.

How will the Northern Pike data be used?

The Northern Pike tissue data will be combined with data from all other species collected at this Site from UCR Reaches 1 to 6, and an exposure point concentration (EPC) will be calculated for each COPC utilizing all of the fillet data collected to date for this risk assessment. Risk will be calculated using the data from all species, all reaches combined. Additionally, a species- and size-class-specific EPC will be calculated for each COPC, and risk calculations will utilize all fillet data for this species. Risk estimates for exposure to COPCs via consumption of the two different size classes of Northern Pike will be compared with risk estimates for consumption of each of the other species collected for this risk assessment, using data for each species from Reaches 1 to 6 combined. The risk assessment will discuss differences in tissue concentrations, representative of human exposure, by species and size class.

WHEN will the fish be collected?

The field event to collect Northern Pike tissue samples is planned for late July 2018.

Contents

Appendices

Tables

Figures

Acronyms and Abbreviations

Agreement	June 2, 2006 Settlement Agreement
ACG	analytical concentration goal
BW	body weight
CCT	Confederated Tribes of the Colville Reservation
CF	conversion factor
CFR	Code of Federal Regulations
COC	chain-of-custody
COPC	contaminant of potential concern
CSF	cancer slope factor
CSM	conceptual site model
CV	coefficient of variation
DL	dioxin-like
DMP	data management plan
DQO	data quality objective
DSR	data summary report
EDD	electronic data deliverable
EF	exposure frequency
EPA	U.S. Environmental Protection Agency
ERT	Environmental Response Team
ESI	Environmental Standards, Inc.
FSP	field sampling plan
FSR	field sampling report
GIS	geographic information system
GPS	global positioning system
HHRA	human health risk assessment
HIF	human intake factor
HQ	hazard quotient
HRMS	high resolution mass spectrometry
ID	identification
IR	ingestion rate
Lake Roosevelt	Franklin D. Roosevelt Lake
LCS	laboratory control sample
LT	lifetime

MDL	method detection limit
MQOs	measurement quality objectives
MRL	method reporting limit
MS/MSD	Matrix spike/matrix spike duplicate
NA	not applicable
NFGs	national functional guidelines
NIST	National Institute of Standards and Technology
Parametrix	Parametrix, Inc.
PARCC	precision, accuracy or bias, representativeness, completeness, and comparability
QA	quality assurance
QA/QC	quality assurance and quality control
QC	quality control
QAPP	quality assurance project plan
RBCs	risk-based-concentrations
RfD	reference dose
RI/FS	remedial investigation and feasibility study
RM	river mile
RPD	relative percent difference
RPM	Remedial Project Manager
RQAM	Regional Quality Assurance Manager
RSCC	Regional Sample Control Coordinator
RSD	relative standard deviation
RSL	Regional Screening Level
S4VM	Stage 4 manual validation
SHSP	site health and safety plan
Site	Upper Columbia River site
SOP	standard operating procedure
SRM	Standard reference material
STI	Spokane Tribe of Indians
TAL	Target Analyte List
TAI	Teck American Incorporated
TBD	to be determined
TCAI	Teck Cominco American, Inc.
THQ	target hazard quotient
TL	total length

TRC	tissue residue criterion
TWA	time-weighted average
UCL95	95 percent upper confidence limit
UCR	Upper Columbia River
WAM	Work Assignment Manager
WDFW	Washington Department of Fish and Wildlife
WDOH	Washington Department of Health

Units of Measure

cm	centimeter(s)
dw	dry weight
g	gram(s)
g/day	grams per day
kg	kilograms
kg/g	kilograms per gram
mg	milligram(s)
mg/kg	milligrams per kilogram
mg/kg-day	milligrams per kilogram per day
mL	milliliter(s)
pg/g	picograms/gram

SECTION 1

Introduction and Task Organization (A4)

1.1 Introduction (A4.1)

This document presents Addendum No. 2 to the quality assurance project plan (QAPP) for the 2009 fish tissue study of the Upper Columbia River (UCR) (hereafter the Site[2]), which extends from river mile (RM) 745[3] to RM 596 near the Grand Coulee Dam. The fish tissue 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 (TAI) for the Site. The objective of the RI/FS is to investigate and describe 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, and statutory and regulatory requirements. The human health risk assessment (HHRA) will be completed by the U.S. Environmental Protection Agency (EPA), and the remaining RI/FS tasks will be completed by TAI, with EPA oversight.

The overarching QAPP for the fish tissue study was prepared in 2009 and focused on collection of several fish species and size classes in six reaches of the UCR Site (Parametrix et al., 2009). Sampling and analysis associated with the 2009 Fish Tissue Study QAPP was conducted in September and October 2009. The results of the 2009 investigation were documented in the UCR Fish Tissue Study Data Summary Report (Exponent and Parametrix 2013). Addendum No. 1 to the overarching 2009 QAPP focused on sampling and analysis of selected age classes of hatchery sturgeon tissue. The sturgeon tissue sampling program was conducted in 2016 and the results of the sturgeon tissue investigation were documented in White Sturgeon Tissue Data Summary Report (TAI 2017).

Northern Pike were not sampled in 2009 because they were not present in the UCR at that time. Recent monitoring has shown rapidly increasing number of Northern Pike, with evidence of widespread and undesirable fish predation in the UCR. As a result, the Confederated Tribes of the Colville Reservation (CCT), one of the Lake Roosevelt fishery co-managers[4], is offering a $10 per head bounty on Northern Pike collected from the UCR. Mercury concentrations in Northern Pike from the UCR are unknown but may be high enough to warrant a fish consumption advisory such as those placed on other piscivorous species in the UCR (e.g., Smallmouth and Largemouth Bass, Walleye) and on Northern Pike present in other water bodies in the region. Tissue data are needed for both the UCR HHRA and to assist Washington Department of Health (WDOH) in their review of the potential need for a UCR Northern Pike fish advisory.

This addendum describes the organization, data quality objectives (DQOs), study design, analytical procedures, and quality assurance and quality control (QA/QC) procedures to characterize contaminant of potential concern (COPC) concentrations in Northern Pike tissue that might be caught in the UCR and consumed by recreational and subsistence anglers. The field sampling plan (FSP) describes field sampling

[2] The Site is located wholly within Washington State and includes the portion of the UCR extending from the U.S.-Canadian border to Grand Coulee Dam, including Franklin D. Roosevelt Lake (Lake Roosevelt), and the areal extent of related contamination within the United States adjacent to the UCR. The Site includes the areal extent of contamination and all suitable areas in proximity to such contamination necessary for implementation of the response actions described in the Settlement Agreement.

[3] There is a discrepancy in river mile designations by U.S. Geological Survey (USGS) and by EPA (2006a). 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 EPA (2006b) increases from RM 680 to RM 681 over the same segment. To remain consistent with international borders, the USGS river mile designations are used herein.

[4] Lake Roosevelt Fisheries Co-Managers include the Colville Confederated Tribes (CCT), the Spokane Tribe of Indians (STI), and the Washington Department of Fish and Wildlife (WDFW).

and field and lab processing protocols that will be followed to collect and process the Northern Pike tissue samples; the FSP is presented as an appendix to this addendum (Appendix A). This format was adopted to provide a stand-alone document for use in the field during sample collection activities.

1.2 TASK ORGANIZATION (A4.2)

This section presents the organizational structure for activities associated with the Northern Pike tissue study, including task planning, management and oversight, fieldwork, sample analysis, and data management.

The Lake Roosevelt Fishery Co-Managers will catch the Northern Pike to be sampled as part of a July 2018 Northern Pike suppression effort. The Co-Manager team will catch, euthanize, measure, and weigh the Northern Pike, which will be caught with gill nets. A total of 60 appropriately-sized fish in two edible size classes found in the UCR (30 fish in the 300 to 449 millimeters [mm] total length [TL] size range and 30 fish in the greater than 450 mm TL size range]) will be transferred to EPA's contractor (CH2M) for examination and collection of tissue samples (skinless fillets) in the field. The tissue samples will be frozen and shipped to an offsite laboratory for processing, compositing, and laboratory analysis. The offsite laboratory, ALS Environmental (ALS) in Kelso, Washington, is contracted to TAI.

1.2.1 Planning and Field Personnel (A4.2.3)

EPA and TAI technical team members for the Northern Pike tissue study and their respective responsibilities are identified below and illustrated in Figure 1.

- **EPA Project Manager –**Monica Tonel the EPA remedial project manager (RPM) is responsible for ensuring that the work performed is consistent with applicable EPA guidance. Ms. Tonel will oversee work conducted by EPA's contractor, CH2M, and coordinate comments on planning documents and reports by U.S. Department of the Interior, Washington Department of Ecology, CCT, STI, and TAI. Marc Stifelman will assist and support Ms. Tonel.
- **Senior Technical Advisor(s)—**Marc Stifelman (EPA Region 10) and Mark Follansbee (SRC) are senior technical advisors for the Northern Pike tissue study, and are responsible for providing technical oversight in the design and implementation of the study, and ensuring that it meets the objectives of the RI/FS.
- **EPA Quality Assurance Support—**Donald M. Brown (EPA Region 10) is the regional quality assurance manager (RQAM) and is responsible, through delegated quality assurance (QA) chemist support, for providing overall QA review and concurrence/approval for the Northern Pike tissue study; review and approval of any change orders; ensuring that the QAPP and FSP addenda contain all components necessary to meet EPA guidelines (USEPA 2002a); reviewing produced project documents as requested (i.e. data summary reports and/or data validation reports) and working with data users to address any data limitations. Mr. Brown / QA designee will work closely with the RPM, technical team coordinator, the regional sample control coordinator (RSCC), Jennifer Crawford, and the field supervisor to ensure that the objectives of the QAPP are met. The QA Chemists assigned by EPA are Jennifer Crawford and Don Matheny.
- **Technical Team Coordinator**—Marilyn Gauthier (CH2M) is responsible for coordinating the tasks of all the team members to ensure that required activities are completed in sequence and on time. Ms. Gauthier will work closely with the senior technical advisors, TAI, and EPA QA personnel to ensure that all requirements are met and study objectives achieved.
- **Task Safety Officer and Field Supervisor**— Dr. Kelly O'Neal is the Task Safety Officer and Field Supervisor and is responsible for providing health and safety oversight for the field staff that will

be processing the fish tissue samples and for overseeing the planning and coordination of the Northern Pike tissue 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 Supervisors will ensure that proposed changes are coordinated with EPA's project coordinators or other designated EPA staff according to the established lines of communication as noted in Figure 1 and approved for the RI/FS.

- **Analytical Chemistry Laboratory Coordinator—**Marilyn Gauthier (CH2M) and the TAI Analytical Chemistry Laboratory Coordinator (Cristy Kessel) will work closely with the contract laboratories to coordinate the analytical task implementation. Ms. Gauthier is responsible for ensuring that laboratory method selection and/or development is satisfactorily completed prior to the analysis of samples collected for this task and coordinating sample shipment, delivery and analytical methods with the testing laboratory. Ms. Cristy Kessel (TAI Analytical Chemistry Laboratory Coordinator) is responsible for tracking the laboratory's progress; verifying that the laboratory has implemented the requirements of this QAPP; addressing QA issues related to the laboratory analyses; ensuring that laboratory capacity is sufficient to undertake the required analyses in a timely manner; and addressing scheduling issues related to laboratory analyses. Ms. Kessel will report directly to the TAI Project Coordinator and will work closely with Ms. Gauthier. The EPA R10 QA/RSCC (Jennifer Crawford) will review the methodology for processing and analysis of samples, along with providing the R10 project code and project sample numbers for CH2M Sample Management.
- **TAI Project Coordinator—**Kris McCaig will serve as TAI's project coordinator and will have primary responsibility for TAI's coordination with EPA Project Managers and ensuring that laboratory analysis and reporting, and data validation activities meet all requirements and associated deliverables specified within the June 2, 2006 Settlement Agreement (USEPA 2006b). Ms. Denise Mills will serve as TAI's assistant project coordinator to support Ms. McCaig.
- **TAI Technical Team Coordinator**—Dr. Rosalind Schoof (Ramboll) will oversee task activities, review QA reports, and ensure that required activities are completed in sequence. Dr. Schoof will work closely with TAI's project coordinator, and task QA coordinator to ensure that all requirements are met and study objectives achieved.
- **TAI Task QA Coordinator**—Rock Vitale (Environmental Standards, Inc. [ESI]) is the task QA coordinator and is responsible for providing overall QA support for the study. Mr. Vitale will coordinate validation of laboratory data; communicate data quality issues to the analytical chemistry laboratory coordinator, and will work with the database administrator to address potential data limitations. Mr. Vitale will report directly to the analytical chemistry laboratory coordinator, and will work closely with the database administrator to ensure that the data are of the highest quality.
- **TAI Analytical Chemistry Laboratory Coordinator**—Cristy Kessel (TAI) will serve as the analytical chemistry laboratory coordinator. She will be responsible for ensuring that laboratory coordination is satisfactorily completed prior to the analysis of samples for this task; tracking the laboratories' progress; verifying that the laboratories have implemented the requirements of this FSP; addressing QA issues related to the laboratories' analyses; ensuring that the laboratories' capacities are sufficient to undertake the required analyses in a timely manner; and addressing scheduling issues related to laboratory analyses. Ms. Kessel will report directly to TAI's project coordinator and will work closely with EPA's technical team coordinator.
- **TAI Database Administrator—** Randy O'Boyle (Exponent) is the database administrator and will have primary responsibility for data management and database maintenance and development.

The database administrator will be responsible for overseeing and/or conducting the following activities: establishing storage formats and procedures appropriate for all Northern Pike tissue data collected; 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. The database administrator will report directly to the TAI technical team coordinator and will work closely with the field supervisor, task QA coordinator, and the TAI data validation firm.

1.2.2 Laboratory Personnel (A4.2.4)

The following responsibilities apply to the project manager and QA manager at ALS Environmental in Kelso, Washington, the analytical laboratory for the Northern Pike tissue study. TAI will contract the analytical laboratory. The laboratory will have the following staff available for this project.

- **Laboratory Project Manager**—Laboratory project manager, Mark Harris (ALS), 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 for processing and analysis, 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 TAI analytical chemistry laboratory coordinator (Cristy Kessel) of the schedule and status of sample analyses and data package preparation.
  - Notify the TAI analytical chemistry 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.
  - Provide electronic data deliverables (EDDs) with the analytical data in a format compatible with the project database.
- **Laboratory QA Manager**—The laboratory QA manager, Carl Degner (ALS), 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 QC issues that affect this task with the laboratory project manager.

SECTION 2

PROBLEM DEFINITION AND BACKGROUND (A5)

Chemicals present in fish tissues have the potential to adversely affect human health. The conceptual site model (CSM) for the Site provides the framework for considering the relationships between fish tissues and exposure to people (see Figure A-2 in the 2009 QAPP [Parametrix et al. 2009]). Available fish tissue data were identified and evaluated in the RI/FS Work Plan (USEPA 2008), Appendix B of the 2009 QAPP (Parametrix et al. 2009), and the 2013 UCR Fish Tissue Data Summary and Data Gap Report (Exponent and Parametrix, 2013). This section provides the updated problem definition and background relevant to the Northern Pike tissue study.

2.1 PRELIMINARY CONCEPTUAL SITE MODEL (A5.1)

The preliminary CSM provides a framework within which complex chemical, physical, and biological processes and interactions can be viewed in a systematic and organized manner. The preliminary CSM (Figure A-2 in the 2009 QAPP [Parametrix et al. 2009]) identifies fish tissue as a potentially important exposure medium and transport pathway for COPCs. Aspects of the preliminary CSM that relate specifically to fish tissue and human exposures (Figure A-3 in the 2009 QAPP [Parametrix et al. 2009]) provide the foundation for problem definition and are discussed in detail in Steps 1 and 2 of the DQO process (Sections 2.5.1 and 2.5.2).

2.2 APPLICABILITY OF AVAILABLE DATA TO RISK ASSESSMENT (A5.4)

Mercury, inorganic arsenic and TAL metal concentrations in Northern Pike fillets collected from the Upper Columbia River are unknown, but are needed to inform fish consumers, inform a fish consumption advisory, and update the HHRA. Available data for other top predators in the UCR, Smallmouth Bass and Walleye, may adequately represent tissue concentrations of Northern Pike. In other systems where mercury tissue concentrations are reported for these species, concentrations in Northern Pike were consistent with those reported for Smallmouth Bass and Walleye. Nevertheless, CCT and STI fisheries biologists indicate that UCR Northern Pike occupy a unique trophic level due to their voracious feeding habits and do not expect Smallmouth Bass or Walleye tissues to be representative. Due to this uncertainty, Northern Pike will be collected and fillets will be sampled to provide COPC concentration data for the HHRA.

2.3 DATA GAPS (A6)

The UCR HHRA work plan (USEPA 2009a) identified fish consumption by people residing near or visiting the UCR Site as an exposure pathway. As such, it is critical to have appropriate fish tissue data for COPCs that can be used to estimate health risks from fish consumption. The data obtained from the 2009 fish tissue study (Parametrix et al. 2009; Exponent and Parametrix 2013) addressed data gaps including sport fish such as Smallmouth Bass, Walleye, and kokanee, and fillet data for key sport fish. Because Northern Pike have only recently become established in the UCR, the need to characterize COPC concentrations in edible Northern Pike tissue was unforeseen at the time the 2009 study was conducted.

2.4 TASK DESCRIPTION (A8)

The Northern Pike tissue study will support the HHRA to be conducted as part of the RI/FS, and review by WDOH of the potential need for a UCR Northern Pike fish advisory. The DQOs and rationale for the sampling design are provided in Section 2.5.

2.4.1 OVERVIEW OF FIELD ACTIVITIES (A8.1)

Field work, documentation and QA/QC activities, are described in detail in the FSP (Appendix A). The following sections provide a brief overview of the specific elements for the scope of the Northern Pike tissue study. Details on study design rationale and specific information inputs are described in Sections 2.5 3.

Fish Tissue Samples (A8.1.1)

Northern Pike will be caught by the Lake Roosevelt Fisheries Co-Managers as part of Northern Pike suppression efforts scheduled for July 2018. The fish are anticipated to be caught using gill nets deployed between Gifford and Northport, Washington with an emphasis in areas where Northern Pike are expected to be most abundant.

A total of 60 appropriately-sized fish in two edible size classes (30 fish in the 300 to 449 mm TL size range and 30 fish in the greater than 450 mm TL size range) will be caught, weighed, and measured by the Co-manager team. The fish will then be transferred from the Co-manager's boats to EPA's contractor (CH2M) on a separate boat operated by the National Park Service for examination and collection of tissue samples (skinless fillets) in the field.

Each fish will be photographed and examined for external abnormalities, scaled, and filleted with skin removed. Filleting will follow general EPA guidelines for assessing chemical contaminant data for use in fish advisories. Fillet tissue will be individually wrapped in aluminum foil and placed in a resealable plastic bag. The bagged fillets will then be placed inside a second bag with the fish identification label so that this label is between the 2 resealable plastic bags. This will facilitate identification and sample organization at the laboratory without unwrapping the fish. The bagged and labelled fillets will be stored in a cooler on wet ice while on the sampling boat. The fillets will then be frozen and transferred to a cooler with dry ice for shipment to the laboratory. The fillets will be shipped to the laboratory as individual samples. Compositing will take place in the laboratory after additional processing steps are complete.

Upon receipt at the laboratory, the tissue samples will be logged-in and stored in a freezer at -20°C. Processing at the laboratory will consist of thawing and homogenization of each fillet in a high-speed blender. The homogenate from each fillet will then be mixed with other designated samples from the size class to create a composited aliquot for freeze-drying, grinding, digestion, and analysis. Each composite will be created from the homogenate from 5 randomly-selected fillets in that size class. A total of 12 composite samples will be prepared (6 composites for the 300 to 449 mm TL size range and 6 composites for the greater than 450 mm TL size range). The samples will be analyzed for COPCs (TAL metals, inorganic arsenic, and mercury), percent moisture and percent lipids.

Number and Timing of Sampling Events (A8.1.2)

Sampling will take place during Northern Pike suppression efforts conducted by the Lake Roosevelt Fisheries Co-Managers in late July 2018.

2.4.2 LABORATORY ANALYSES (A8.2)

The following will be analyzed in Northern Pike fillets collected during sampling in July 2018 (see Table 2 for a complete list of analytes).

- Conventional Parameters
  - Total length (mm)
  - Total mass
  - Fillet mass
  - Percent moisture
  - Percent lipids
- Metals
  - Mercury
  - Inorganic arsenic
  - TAL metals[5]

Current EPA analytical methods for analysis of TAL metals plus inorganic arsenic and mercury in fish tissue will be used (Table 3). Reporting limits for the analytical methods are described in Section 2.5.6 and listed in Table 2. All analyses will be performed by ALS except total length and mass of each fish, which will be measured in the field by the Lake Roosevelt Fisheries Co-Managers and the fish fillet weights which will be measured in the field by CH2M.

Sample analysis and data validation for all laboratory analyses are each expected to require approximately 8 to 14 weeks for completion, from the time that sample collection is completed until finalization of the database. This period is commensurate with the 90-day reporting requirement as defined in the Agreement (USEPA 2006b).

2.5 DATA QUALITY OBJECTIVES, CRITERIA, AND DESIGN RATIONALE (A9)

Northern Pike (*Esox lucius*) were not sampled in 2009 as they were not previously known to be present in large numbers in the UCR. Northern pike are an invasive undesirable species in the UCR and population suppression measures have been implemented. Current incentive payments of $10 per head encourage consumption by people. Northern Pike will be evaluated to determine potential human health risks for both an HHRA and to support WDOH's review of the potential need for a UCR-specific Northern Pike fish consumption advisory.

The following amendments to the 2009 DQOs supplement the original DQOs by providing additional details specific to Northern Pike. To facilitate the review/QA process, we have included text from the 2009 DQOs below.

DQOs define the type, quality, quantity, purpose, and intended uses of data to be collected. As described in the EPA's DQO guidance (2006a), the DQO process typically follows a seven-step procedure, as follows.

2.5.1 STEP 1—STATE THE PROBLEM (A9.1)

The UCR HHRA work plan (USEPA 2009a) identified fish consumption by people residing near or visiting the UCR site as an exposure pathway. Previous fish tissue DQOs were based on collecting fish representative of different guilds, trophic levels, and habitats; not all fish species were sampled (or needed to be sampled). A large amount of information has been gathered on fish species and fish communities in the UCR (e.g., Blake et al. 2017). EPA conducted a fish tissue study in 2005 (USEPA 2007) which identified the presence of some COPCs in fish tissues; several historical studies also measured COPCs in UCR fish tissues

[5] TAL metals include aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, potassium, selenium, silver, sodium, sulfur, thallium. uranium, vanadium, and zinc.

and are summarized by EPA (2005a). The 2005 EPA study targeted fish species that were abundant in the UCR and commonly consumed by recreational and/or subsistence anglers. To address data gaps such as smaller sized fish, sport fish such as Smallmouth Bass and kokanee, fillet data for key sport fish, and additional COPCs identified during the draft screening level ecological risk assessment (TCAI 2008), Teck Cominco American, Incorporated (TCAI) conducted an additional fish tissue study in 2009 (Parametrix et al. 2009; Exponent and Parametrix 2013). At that time, Northern Pike were not present in the UCR and were therefore not recognized as a top UCR predator with consequently high potential for mercury bioaccumulation.

Since 2009, the Northern Pike population in the UCR has rapidly increased and is causing undesirable predation (Lee and King 2015; Lee and King 2016). Incentives are being used to encourage anglers to remove Northern Pike for fishery management purposes with the side effect of potentially increasing human consumption of fish likely to be high in mercury and other bioaccumulative contaminants. The Lake Roosevelt Fishery Co-Managers (STI, CCT and WDFW) will collect Northern Pike in July of 2018 for analysis to provide tissue data for the HHRA and to support WDOH in review of the potential need for a consumption advisory. This effort is limited to estimating the concentration of mercury, inorganic arsenic and TAL metals in Northern Pike fillets that may be eaten by people.

2.5.2 STEP 2—IDENTIFY THE GOAL OF THE STUDY (A9.2)

This amendment to the DQOs addresses human consumption of Northern Pike:

1. To provide information to the HHRA to determine whether contaminants in Northern Pike tissue in the UCR Site pose an unacceptable risk to human health; and
2. To provide data to WDOH to evaluate the need for a fish consumption advisory for Northern Pike.

Principal Human Health Risk Study Question:

- Does consumption of Northern Pike pose an unacceptable risk to people?

The following are alternative actions for the Site if unacceptable risk is calculated (modified from the 2009 DQOs):

- Evaluate remedial alternatives for source control, surface water, and sediment to reduce fish uptake of COPCs within the UCR if unacceptable risk is calculated;
- Issue a consumption advisory for Northern Pike caught in the UCR

Northern Pike consumption will be evaluated along with other fish species previously sampled from the UCR. The Northern Pike tissue data will be combined with data from all other species collected at this Site and an exposure point concentration (EPC) will be calculated for each COPC utilizing all of the fillet data collected to date for this risk assessment. Risk calculations will be done using the data from all species, all reaches combined. Additionally, a species- and size-specific EPC will be calculated for each COPC, and risk calculations will be done utilizing all fillet data for this species. Risk estimates for exposure to COPCs via consumption of the two different size classes of Northern Pike will be compared with risk estimates for consumption of each species collected for this risk assessment, using data for each species from Reaches 1 to 6 combined. The risk assessment will discuss differences in tissue concentrations, representative of human exposure, by species and size class.

2.5.3 STEP 3—IDENTIFY INFORMATION INPUTS (A9.3)

Step 3 of the DQO process requires consideration of the types and potential sources of information that should be considered to provide estimates or resolve decisions, information needed to provide a basis for specifying performance or acceptance criteria, and information on the performance of appropriate

sampling and analysis methods. Determination or estimation of risks requires representative data for COPCs in Site fish tissues. Information inputs that are needed to conduct this analysis include knowledge about the likelihood and ability of recreational or subsistence anglers in the UCR to harvest and consume Northern Pike, methods of preparing Northern Pike for cooking and eating, and COPC concentrations in Northern Pike fillets. Sampling and analytical methods must be appropriate to ensure that chemical measures of exposure can be properly estimated and compared to toxicity benchmarks or other acceptance criteria.

Information that will inform the sampling design and/or the analysis of Northern Pike include:

- QAPP and data summary reports from the 2005 fish tissue, the 2009 fish tissue and the 2016 sturgeon tissue collection efforts (USEPA 2007, Parametrix et al. 2009, Exponent and Parametrix 2013, TAI 2017)
- HHRA Work Plan for the UCR (USEPA 2009a)
- Human Health Evaluation of Contaminants in Upper Columbia River Fish (WDOH, 2012).
- Lake Roosevelt Creel Study http://spokanetribalfisheries.com/projects/the-lake-roosevelt-creel-survey/

Northern Pike tissue concentrations will be used by EPA to estimate risks from exposure to mercury, inorganic arsenic and TAL metals via fish consumption. The methods are described in the EPA HHRA work plan (USEPA 2009a). The benchmarks used for risk analysis provide information that will guide decisions used in the DQO process and may be used to assess risk from exposure to COPCs once the Northern Pike tissue data are available. The benchmarks are specifically used to establish analytical concentration goals (ACGs; achievable analytical laboratory limits) to ensure that reporting limits are sufficiently low to provide data below the benchmarks and therefore can be used by EPA in the HHRA and by WDOH to evaluate the need for a fish consumption advisory for Northern Pike.

Risk-based concentrations (RBCs) for HHRA, which aid in specifying performance or acceptance criteria (i.e., determination of acceptable or unacceptable level of risk), are provided in Table 2. The Regional Screening Level (RSL) Calculator states that "wet or dry weight is not an inherent assumption of the screening level (SL) numbers. …users of the Table should consider whether the population of interest is more likely to consume the fish using a preparation method that is better simulated by a wet or dry weight." Consumption of raw or cooked fish would be represented by wet weight, while smoked fish would be dry weight. Laboratory method reporting limits(MRLs) and method detection limits (MDLs were provided on a dry weight basis. The RBCs presented in Table 2 are shown on both a wet and dry weight basis. On a dry weight basis, ACGs exceed the RBC for the following metals: antimony, arsenic, cadmium, cobalt, selenium, silver, thallium, uranium, and vanadium. The COPCs included in Table 2 are a subset of those included in the 2009 fish tissue study QAPP and include conventional parameters, mercury, inorganic arsenic and TAL metals as updated for COPCs (SRC 2018). Parameters and equations used to derive the RBCs are provided in Appendix E-1.

2.5.4 STEP 4—DEFINE THE BOUNDARIES OF THE STUDY (A9.4)

This step specifies the population of interest for the study, the geographical boundaries of the Site, and any temporal considerations that may be required. The target population of interest for the study are people who eat Northern Pike caught in the UCR Site.

Northern Pike sample collection will occur where the fish are found, the locations will not be defined by or limited to targeted sample locations. The tissue concentrations will represent the entire Site, and do not reflect reach-specific concentrations. As such, data collected from the current study will satisfy questions

regarding current and future human health risk associated with Northern Pike consumption for all areas of the Site.

Data from this sampling event may be used for the following: 1) to provide information to the HHRA to determine whether COPCs in Northern Pike tissue pose an unacceptable risk to human consumers; and 2) to provide data that will be used by WDOH to assess the need for a fish consumption advisory for Northern Pike.

2.5.5 STEP 5—IDENTIFY THE ANALYTICAL APPROACH (A9.5)

Step 5 of the DQO process provides the analytical approach for evaluating the fish tissue data in the HHRA. Concentrations of COPCs in fish tissue will be used to estimate dietary exposure of people who consume Northern Pike and other fish in the UCR. These data will also be used by WDOH to determine whether a fish consumption advisory is needed for Northern Pike in the UCR. The analytical procedures for this study are standard EPA-approved analytical protocols with detection limits that are generally sufficiently low to provide detects that are below RBCs.

Six composite samples comprised of a minimum of five fish per composite will be submitted for analysis. Six composite samples per size bin will allow calculation of a size bin-specific 95UCL and evaluation of risk from consumption of a particular size class, if tissue concentrations differ based on fish size.

Methods for analysis of metals/metalloids in fish tissue are EPA Methods 1632, 6010C, 6020B, and 7471B/1631E. Laboratory method reporting limits (MRLs) and method detection limits (MDLs) for TAL metals, inorganic arsenic and mercury are given in Table 2 (pers. comm. Poyfair 2016).

Northern Pike consumption will be evaluated along with other fish species previously sampled from the UCR. The Northern Pike tissue data will be combined with data from all other species collected at this Site and an EPC will be calculated for each COPC utilizing all of the fillet data collected to date for this risk assessment. Risk calculations will be done using the data from all species, all reaches combined. Additionally, a species- and size class-specific EPC will be calculated for each COPC, and risk calculations will be done utilizing all fillet data for this species. Risk estimates for exposure to COPCs via consumption of the two different size classes of Northern Pike will be compared with risk estimates for consumption of each species collected for this risk assessment, using data for each species from Reaches 1 to 6 combined. The risk assessment will discuss differences in tissue concentrations, representative of human exposure, by species and size class.

2.5.6 STEP 6—SPECIFY PERFORMANCE OR ACCEPTANCE CRITERIA (A9.6)

The DQO process is designed to ensure that the type, quantity, and quality of environmental data used in decision making will be appropriate for its intended use, resulting in decisions that are technically and scientifically sound and defensible. ACGs are the desired analytical quantitation limits for the study. If possible, ACGs will be sufficiently low to provide reporting limits below the RBCs, such that non- detected data can be “screened out” as less than RBCs. RBCs were calculated based on the maximally exposed receptor population from the HHRA Work Plan (Appendix F, Human Intake Factor for ingestion of fish; USEPA 2009a). As shown in Table A-2, some COPCs have reporting limits that are below RBCs; for those chemicals, the ACGs are the RBCs for human health and should result in analytical COPC concentrations in fish tissue that are useable for HHRA. For other COPCs, however, the RBC is lower than the MRL or MDL, or an RBC is not available. In these cases, the MRL is used as the ACG. Some of these COPCs, such as calcium, sodium, and potassium, are considered essential nutrients and will not drive the risk assessment. Others, such as total arsenic and total inorganic arsenic, are Site-related chemicals; use of the MRL as the ACG for these COPCs will result in uncertainty in the HHRA. The ACGs for each COPC are listed in Table 2.

Finally, laboratory duplicates, matrix spike/matrix spike duplicates (MS/MSD), and standard reference materials (SRM) samples will be used to evaluate analytical variability and method performance. Analytical data meeting the ACGs and found within analytical method performance criteria will be considered adequate to answer the questions defined in Step 2 above.

2.5.7 STEP 7—DEVELOP THE PLAN FOR OBTAINING DATA (A9.7)

As stated above, the Lake Roosevelt Fisheries Co-Managers (CCT, STI, and WDFW) will catch the Northern Pike to be sampled in July 2018. Fish included in this study will be >300 mm total length and will be separated into two size bins (300 to 449 mm, and > 450 mm), as these are the sizes typically caught for human consumption in the UCR. The size bins proposed are based on existing catch and harvest data for Lake Roosevelt and are representative of what anglers are encountering and consuming. An upper bound for the larger size class was not applied because very large sizes are rare in the UCR.

Specific sample collection and processing details are provided in the FSP (Appendix A). The following paragraphs provide the basis for the number of composite samples and the number of fillets per composite.

In the 2009 sampling effort, 6 composite samples per species were targeted for each of the 6 sampling areas, with each composite generally consisting of 5 individual fish (approximately 90% of samples of >30 cm fish consisted of 5 fish per composite; 10% ranged from 2-4 fish per composite)[6]. Even though compositing of Northern Pike is not necessary to achieve the mass of tissue required for analysis due to its large size, Northern Pike will be composited prior to tissue analysis to better estimate the average tissue concentration. In 2009, the target fish sample size was determined based on a statistical analysis of the 2005 fish sampling data, as summarized in Appendix D of Parametrix et al. (2009). SRC evaluated that analysis and found that 6 composites of at least 5 fish per composite would produce reliable 95 percent upper confidence limits (UCL95s) (SRC, 2010). The SRC recommendations were based on a Monte Carlo simulation that used a maximum coefficient of variation (CV) of 0.6 among the 6 composites (SRC, 2010).

The 2009 sampling event produced between 11 and 36 composite samples per species (for the 6 sample areas combined) for use in the HHRA. The 2009 data include 35-36 composite samples for Kokanee, Rainbow Trout, and Walleye; fewer samples (n) are available for Burbot (22), Smallmouth Bass (11), Sucker (21), and Whitefish (16). Kokanee (mainly of hatchery origin), Rainbow Trout, and Walleye were caught in all six sample areas. A preliminary HHRA screen for the 2009 fish tissue data identified mercury, thallium, dioxin-like PCBs, and PBDE-47 as potential risk drivers. In the 2009 fish (≥30cm) fillet composite data that will be used in the HHRA, the CV for mercury and thallium ranged from 0.1 to 0.5 (thallium, sucker).

Composites of Northern Pike fillets collected in July 2018 are expected to produce data that exhibit variability less than or equal to the variability found in the 2009 fish tissue composite data. To increase the likelihood of producing data with sufficiently low variability, EPA will request a minimum of 60 Northern Pike from the Co-managers. Thirty fish will be collected from each size bin (300 – 449 mm, and greater than or equal to 450 mm), and six composite samples comprised of a minimum of five fish will be submitted for analysis, similar to the approach used in the 2009 sampling event. Compositing will take place in the laboratory. Similar to the 2009 study, each composite will be created from the homogenate from 5 randomly-selected fillets in the same size class. A total of 12 composite samples will be prepared (6 composites for the 300 to 449 mm TL size range and 6 composites for the greater than 450 mm TL size

[6] Mercury analysis on Walleye and Smallmouth Bass were conducted on individual fish fillets in the 2009 study. Other analyses were performed on composites.

range). The samples will be analyzed for COPCs (TAL metals, inorganic arsenic, and mercury), percent moisture and percent lipids.

Locations where fish are collected will be recorded with a global positioning system (GPS) receiver; however, it is understood that location of collection may not necessarily correlate with exposure area. Because of this, fish will not be composited based on sample location. Northern Pike tissue concentrations will represent the entire site, and do not reflect reach-specific exposure concentrations. Once collected, fish will be euthanized and transferred to EPA for processing, as described in the FSP (Appendix A).

Analyses will be conducted on composites of the fillets (skin-off). Additional details on fish sampling and processing are found in the FSP (Appendix A) and the 2009 QAPP and field sampling plan (Parametrix et al. 2009).

2.6 SPECIAL TRAINING/CERTIFICATES (A10)

EPA Region 10 has assembled a technical team with the requisite experience and technical skills to successfully complete the Northern Pike tissue study. All technical team personnel involved in sample collection have extensive environmental sampling experience. The field sampling team will have the necessary knowledge and experience to perform all field activities. This will include experience in the collection of fish, the use of the specified sampling gear, and operation of small boats.

Sampling personnel who enter an exclusion zone or 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. 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.

2.7 DOCUMENTATION AND RECORDS (A11)

Records will be maintained documenting all activities and data related to field sampling and to 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), and Site Health and Safety Plan (SHSP) (see Appendix A) will be provided to each person listed in Section 1.2. Any revisions or amendments to any of the documents that make up the FSP will also be provided to these individuals.

A Field Sampling Report (FSR) will be prepared by EPA and will include field documentation provided by the Lake Roosevelt Co-Managers. A Data Summary Report (DSR) will be prepared by TAI after data validation is completed and the database is finalized. Validated data is due to EPA within 90 days of receipt of all samples at the laboratory, and the DSR is due to EPA within 150 days of receipt of all samples at the lab. The reporting schedules are discussed further in the RI/FS Work Plan and in Section 4.3 of the FSP (Appendix A).

2.7.1 FIELD DOCUMENTATION (A11.1)

The EPA Region 10 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/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). EPA SCRIBE software will be used by CH2M for sample management and generation of COCs/labels associated with the field samples shipped to ALS. This project file is published to Scribe.net at the conclusion of the sampling event, with the released .bac file provided to the EPA RSCC.

2.7.2 LABORATORY DOCUMENTATION (A11.2)

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 laboratories 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:

- A cover letter discussing analytical procedures and any difficulties that were encountered
- A case narrative referencing or describing the procedures used and discussing any analytical problems and deviations from SOPs and this QAPP
- COC and cooler receipt forms
- A summary of analyte concentrations (to two significant figures for results <10, three significant figures for results >10), MRLs, and MDLs
- Laboratory data qualifier codes appended to analyte concentrations, as appropriate, and a summary of code definitions
- Sample preparation, digestion, extraction, dilution, and cleanup logs
- Documentation of laboratory processing procedures including individual fillet subsample and total composite weight, subsample mass, any identified anomalies in fish observed upon receptor.
- Instrument run logs
- Initial and continuing calibration data, including instrument printouts and quantification summaries, for all analytes
- Results for method and calibration blanks
- Results for all QA/QC checks, including serial dilutions, laboratory control samples (LCSs), matrix spike samples, laboratory duplicate or triplicate samples, and any other QC procedures required by applicable method protocols and laboratory SOPs
- Original data quantification reports and printouts of chromatograms and mass spectra for all analyses and samples as applicable
- All laboratory worksheets and standards preparation logs
- A page of example calculations for each analytical method included in the data package

- A documented data deliverable for each analytical method performed and reported.

Full laboratory data reports will be provided in both hard copy and electronic format to the TAI task QA coordinator, who will oversee data verification and validation, for the purpose of archiving the final data and data quality reports in the project file. EDDs will be provided in a format that is compatible with the EPA technical team's database. A relational database will be used to manage the laboratory data as described in the RI/FS Work Plan.

2.7.3 DATA QUALITY DOCUMENTATION (A11.3)

Data verification (i.e., confirming the accuracy and completeness of field and laboratory data) will be completed by the EPA technical team for data generated in the field, and by each laboratory for the data that it generates. Data validation and data quality assessment for this task will be completed by TAI and provided to the task QA coordinator. All data generated by the laboratory will undergo Stage 4 data validation (S4VM).

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

Data validation reports will be prepared and provided to the TAI Task QA manager. Results of the validation reports will be summarized in the field report. Any limitation to the usability of the data will also be discussed in this report. Completed data validation checklists will also be provided to the TAI task QA coordinator by the data validator.

SECTION 3

DATA GENERATION AND ACQUISITION (B)

3.1 SAMPLING PROCESS DESIGN AND RATIONALE (B1)

Sampling protocols to be implemented by the Lake Roosevelt Fishery Co-Managers are not addressed by this QAPP Addendum, but may be accessed at:

https://www.monitoringresources.org/Document/Protocol/Details/3354.

This section presents the design and rationale for the Northern Pike sampling program that pertains to receipt of the selected fish by EPA's field team for processing, labeling, and shipment to the analytical laboratory for further processing, compositing and chemical analysis. Northern Pike tissue data is intended to support assessing risk to humans that consume fish. The sampling approach was developed based on information from previous investigations and discussions with UCR fishery managers.

3.1.1 INVESTIGATION CONSIDERATIONS (B1.1)

In 2005, the EPA targeted fish species that were abundant in the UCR and were known to be commonly consumed by recreational or subsistence anglers (Walleye, wild and hatchery Rainbow Trout, Lake and Mountain Whitefish, Largescale Sucker, and Burbot > 30 cm) (USEPA 2005a). For the HHRA, the 2009 fish sampling study targeted additional fish species representing varying feeding guilds known to be abundant in the UCR and commonly consumed by anglers (Walleye, Burbot, Smallmouth Bass, Largescale Sucker, Rainbow Trout, Kokanee Salmon and Mountain and Lake Whitefish > 30 cm). Northern Pike (*Esox lucius*) were not included in the 2005 and 2009 sampling efforts because they were not present in the UCR system until 2011. Northern Pike are a prohibited species in the State of Washington and the Lake Roosevelt Fishery Co-Managers have implemented an aggressive mechanical suppression and removal program. UCR fishers are currently offered a bounty of $10 per Northern Pike head (McLellan 2016a).

3.1.2 TARGET SPECIES, SIZE CLASSES, AND RATIONALE (B1.2)

Due to concerns about the negative impact of this invasive, highly predatory fish on native fish species and the potential for mercury bioaccumulation due to its piscivorous diet, Northern Pike greater than 300 mm will be targeted for this study. A total of 60 fish will be collected; 30 for each of two size bins (300 to 449 mm, and greater than or equal to 450 mm). These bins were selected based on the following rationale:

- Northern Pike smaller than 300 mm are not likely to be consumed by anglers (McLellan 2016b). Northern Pike are a slender fish with y-bones that make it challenging to fillet, and fillets from whole 300 mm Northern Pike are small before removing the y-bones. Professional judgement was used to determine the lower bound of the size class as a reasonable assumption for angler consumption of Northern Pike in the UCR.
- Northern pike collected during the suppression efforts are currently provided to CCT members. Therefore, the size classes collected during the suppression efforts are representative of the size classes consumed by people.
- Size distribution data from 2017 suppression efforts indicated fish from the >450 mm size range may be more similar in age compared to the smaller cohort (<450 mm TL).

Additional sampling details can be found in the FSP in Appendix A.

3.1.3 TARGET TISSUE TYPES AND RATIONALE (B1.3)

Northern Pike fillets will be collected to provide additional data for the human health risk assessment. Skin-on fillets from other species were collected in 2005 and 2009. Skin-off fillets were collected during the 2016 sturgeon tissue sampling effort as sturgeon skin is inedible. Similar to sturgeon, fillets with skin removed will be collected from Northern Pike. Additionally, the y-bone will be removed.

3.1.4 TARGET SAMPLE TYPES, LOCATIONS, AND RATIONALE (B1.4)

Northern Pike will be collected from the UCR extending from the Gifford area to near Northport, Washington. The Lake Roosevelt Fisheries co-managers will conduct random exploratory surveys prior to targeted suppression to help maximize sampling in areas of greater Northern Pike abundance (Lake Roosevelt Fisheries Co-Managers 2018). Northern Pike tissue concentrations are expected to be representative of exposure to the site-overall, and do not reflect reach-specific exposure concentrations.

A composite sampling approach, modified from the approaches used in 2005 and 2009[7], will be used. A total of 60 fillets will be sorted into two size bins (300 to 449 mm, and greater than or equal to 450 mm TL). Each size bin will be comprised of 6 composite samples with a minimum of 5 randomly-selected fillets per composite, consistent with the 2009 fish study. A total of 12 composite samples will be analyzed. Refer to the FSP (Appendix A) for further details.

3.1.5 TARGET ANALYTE LIST (B1.5)

All samples will be analyzed for TAL metals, inorganic arsenic and mercury, percent lipids, and percent moisture. Total length and mass, and fillet mass will also be measured.

3.2 SAMPLING METHODS (B2)

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

- Fishing Method (Section 2.1.2)
- Fish Processing and Sample Collection (Section 2.1.5)
- Sample Packaging and Transport (Section 2.1.6)
- Management of Study-derived Waste (Section 2.1.7)
- Field Documentation and Chain of Custody Procedures (Section 2.2)

Standard operating procedures (SOPs) for each element of the fieldwork are provided in Attachment A2 to the FSP.

In the event unanticipated or changed circumstances occur in the field, the field supervisor will institute the necessary changes and issue a QAPP change order (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 and submitted to EPA. 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 CH2M technical team coordinator and EPA. EPA will be notified of any problems that

[7] Mercury analysis on Walleye and Smallmouth Bass were conducted on individual fish fillets in the 2009 study. Other analyses were performed on composites.

may affect the final outcome of this task. Additional information regarding corrective actions and related documentation is provided in Section 4.

3.3 SAMPLE HANDLING AND CUSTODY (B3)

Fish caught by the Lake Roosevelt Fisheries Co-Manager field crews will be measured by the field crews with a measuring board and scale to obtain gross length (total length; mm TL) and weight measurements of specimens that will be retained for tissue samples.

Whole fish within the targeted size ranges will be transferred to CH2M personnel by the Lake Roosevelt Fishery Co-Manager field crews. All processing will be performed on the boat provided by the National Parks Service. The processing boat will travel to shore and fish processing will be conducted on the boat while beached to provide a stable platform. The fish will be held in a lexan bin with site water prior to processing. Fish will be processed and filleted by CH2M personnel as described in the FSP. Fish will be photographed and examined for external abnormalities (Appendix A), filleted without skin, and the fillets will be shipped to the laboratory on dry ice for processing, compositing, and chemical analysis. After sampling is complete, EPA will prepare a specific compositing plan that identifies the individual fish that will be used to create each size class composite. The compositing approach will consist of a stratified random approach based on size class (i.e., individual fillets from each size bin will be randomly assigned to 1 of 6 composite samples for that size bin).

Fish fillets will be shipped from the field to ALS under COC as described in Sections 2.1 and 2.2 of the FSP (Appendix A). The samples will be stored frozen at –20 degrees Celsius (°C) or lower. The processing laboratory will homogenize fillets from each discrete fish individually. Equal portions (by mass) of each discrete homogenate will then be combined. The combined homogenates are then subjected to an additional mixing procedure to ensure a homogenous composite, which will be freeze-dried and ground before analysis. Requirements for sample containers, sample preservation, storage temperature, and holding times are summarized in Table 3.

Documents used to identify samples and to document possession will be field logbooks (Lake Roosevelt Fishery Co-Manager and CH2M 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 Section 2.2 of the FSP.

Upon receipt of samples at the laboratory, the physical integrity of the containers and custody 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 exceptions will be noted and reported in writing to the laboratory coordinator within 24 hours of receipt of the samples. The laboratory QA plan will include procedures used for accepting custody of samples and documenting samples at the laboratories. The laboratory project manager will ensure that a sample-tracking record is maintained that follows each sample through all stages of sample processing at the laboratory.

Fish fillets will be stored in accordance with Table 3 (frozen at -20˚C) and partially thawed only immediately prior to processing. Homogenized samples will be stored in accordance with Table 3 (frozen at -20˚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 in writing by the EPA RPM.

3.4 ANALYTICAL METHODS (B4)

Fish tissue samples collected for this study will be analyzed for chemical parameters shown on Tables 2 and 3. Laboratory methods that will be used to complete the respective analyses are described below.

3.4.1 CHEMICAL ANALYSES (B4.1)

Fish tissue samples will be analyzed for TAL metals, inorganic arsenic, mercury, percent lipids and percent moisture, using the recommended methods listed in Table 3.

Consistent with the DQOs identified in Section 2.5, the ACGs for the Northern Pike tissue study are below RBCs derived for human receptors for most analytes (see Appendix E-1 for human health RBCs). The RBCs are concentrations associated with no significant effect on the receptor, under a given set of assumptions about exposure. The ACGs and the RBCs from which they were derived are presented in Table 2.

The human health RBCs were set equal to a hazard quotient (HQ) of 0.1 or cancer risk of 1x10-6 (see Appendix E-1). The ACGs are provided in Table 2 alongside expected MDLs and MRLs as reported by ALS Environmental, Kelso, Washington (pers. comm. Poyfair 2016). These expected MDLs and MRLs are below the ACGs in most cases. Every effort will be made to select laboratories and methodology that will provide MDLs and MRLs that are below the ACGs. Every effort will be made to ensure that MRLs will be no more than 2 times greater than MDLs. Standard laboratory methodology is not expected to be sufficiently sensitive to provide MRLs or MDLs below the ACG for several analytes (Table 2). For most COPCs, however, the standard analytical methods for tissue analysis will provide adequate sensitivity for the risk assessment.

MRLs generally are equivalent to the concentration of the lowest calibration standard (i.e., the practical quantification limit) and represent the low end of the analytical calibration range. Analytes that are detected at concentrations below the reporting limit but above the MDL will be reported, but will be qualified as estimated (i.e., a "J" qualifier or equivalent will be appended to the result by the laboratory). Non-detects will be reported at the MRL with a "U" qualifier.

3.4.2 FIELD MEASUREMENTS (B4.2)

Field operations will include measurement of fish TL and weight. Measurements will be recorded by the Lake Roosevelt Fishery Co-Managers and will be provided to CH2M with the fish (Appendix A, FSP, Section 2.1.3). CH2M will process the fish after receipt; fillet weight will be recorded.

3.5 QUALITY CONTROL (B5)

QC samples will be prepared in the laboratories to monitor the precision of the sample homogenization procedures and the bias and precision of the sample analysis procedures. At least one homogenized composite sample will be used to produce triplicate samples for quality assurance of the homogenization if sufficient tissue mass is available. Details are provided in Section 3.3 of the FSP (Appendix A). Laboratory QC procedures are described below.

3.5.1 LABORATORY QUALITY CONTROL (B5.1)

Extensive and detailed requirements for laboratory QC procedures are provided in the EPA methods that will be used for this study (Table 3). Each 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 their internal SOPs, and as indicated in this QAPP.

The frequency of analysis for LCSs, matrix spike samples, spike or 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. Equipment (e.g., cutting boards, knives, blenders/Tissuemizers™, and bowls) blanks will be subjected to the same processes as the fish tissue before being poured into a sample bottle.

As required for EPA SW-846 methods (USEPA 2005b), 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 (including certified reference material), matrix spikes, and LCSs, and for relative percent difference (RPD) of laboratory duplicates, are provided in the analytical laboratory's QA manual (to be submitted following laboratory selection). Because high resolution mass spectrometry (HRMS) analyses 1613B, 1668a and 1614 use isotope dilution techniques, analysis of matrix spike and matrix spike duplicate QC samples are not necessary.

3.5.2 DATA QUALITY INDICATORS FOR LABORATORY (B5.2)

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 guidance. Data quality indicators such as the precision, accuracy or bias, representativeness, completeness, and comparability (PARCC) parameters and analytical sensitivity will be used to assess conformance of data with quality control criteria (USEPA 2002b). Measurement quality objectives (MQOs) for the quantitative PARCC parameters are provided in Table B-4 of the 2009 QAPP (Parametrix et al. 2009). Data quality indicators and quality control objectives are described in this section.

Precision reflects the reproducibility between individual measurements of the same property. Precision will be evaluated using the results of laboratory duplicates and at least one lab processing triplicate (for fish samples with sufficient mass). Precision is expressed in terms of the 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

For three or more measurements, the relative standard deviation (RSD) is used to evaluate precision. The RSD is calculated as the ratio of the standard deviation of three or more measurements to the average of the measurements, expressed as a percentage.

Accuracy and bias represent the degree to which a measured concentration conforms to a reference value. The results for SRM, matrix spikes, LCSs, field blanks, and method blanks will be reviewed to evaluate the accuracy and 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 LCS 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 in field or method blanks will be evaluated as potential indicators of bias.

QC samples and procedures are specified in each method protocol (analytical methods are presented in Table 3). 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
- Continuing calibration
- Calibration or instrument blanks
- Method blanks
- Standard or Certified Reference Materials – fish tissue
- Laboratory control samples
- Internal standards
- Serial dilutions
- Matrix spikes
- Laboratory duplicates

To alert the data user to possible bias or imprecision, data qualifiers will be applied to reported analyte concentrations when associated QC samples or procedures do not meet the criteria identified in this QAPP. Laboratory control limits for the methods that will be used for this study will be provided to EPA by ALS Kelso. Data validation criteria and procedures are described in Section 4.3 of this QAPP.

ACGs provide the target concentration required for the chemical analysis. Methods selected for this study are expected to provide sufficient sensitivity to yield ACGs that are below the lowest reference value for this study (Table 2).

The laboratory will determine a MDL for each analyte, as required by EPA (USEPA 2014a, USEPA 2017). MDLs are statistically derived and reflect the concentration at which an analyte can be detected in a clean matrix with 99 percent confidence that a false positive result has not been reported. The analytical

laboratory will have established MRLs at levels above the MDLs for the task analytes. These values are based on the laboratory's experience analyzing environmental samples and reflect the typical sensitivity obtained by the analytical system; they represent the level of analyte above which concentrations are accurately quantified. Analyte concentrations for this study will be reported to the MDL. 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). Non-detects will be reported at the MRL with a "U" Qualifier and will be adjusted by the laboratory as necessary to reflect sample dilution or matrix interference.

Representativeness and comparability are qualitative QA/QC parameters. 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, the use of standard performance-based methods, and initiation of analyses 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 use of field and laboratory methods that are consistent with methods and procedures recommended by EPA.

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

3.6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE (B6)

Analytical instrument testing, inspection, maintenance, setup, and calibration will be conducted by the laboratories in accordance with the requirements identified in the laboratory's 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 laboratory's maintenance logs or record books.

3.6.1 INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY (B7)

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

All calibration standards will be obtained from either the EPA repository or a commercial vendor, and the laboratories will maintain traceability back to the National Institute of Standards and Technology (NIST). Stock standards will be used to establish intermediate standards and calibration standards.

Special attention will be given to expiration dating, proper labeling, proper refrigeration, and prevention of contamination. Documentation relating to the receipt, mixing, and use of standards will 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.

3.6.2 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES (B8)

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 3.2, certified clean sample containers, if required, 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).

3.7 DATA MANAGEMENT (B10)

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 EPA technical team will follow the draft data management plan (DMP) established for the Site (TAI, 2010) as described in the RI/FS Work Plan (USEPA 2008). 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 relational[8] database will be used to facilitate data retrieval and interpretation. Both current and historical data will be stored in the project database.

[8] 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).

- 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. TAI 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.

3.7.1 FIELD DATA (B10.1)

Data that are generated during fish tissue collection and sample preparation will be manually entered into the field logbook, field data forms, and COC forms. Data from these sources will be entered into the project database directly from the field logbook and field data forms. These data include sample collection coordinates, station names, sampling dates, sample identifiers and numbers, and additional station and sample information. 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.

3.7.2 LABORATORY DATA (B10.2)

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

- Standard logbooks
- Lab fish processing/homogenization logbooks
- Digestion and Extraction logs
- Storage temperature logs
- Balance calibration logs
- Instrument logs
- Sample preparation and analysis worksheets
- Maintenance logs
- Individual laboratory notebooks
- Results tables for fish measurements (i.e., tissue sample weights during homogenization)

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. A detailed description of procedures for laboratory data management and data review and verification is provided in the laboratory QA plan.

Laboratory data will be entered directly into the project database from the EDD. The electronic data for each data package will be provided for QA review in spreadsheet format. These database entries will be verified against the hard-copy laboratory data packages. Data qualifiers will be entered into the spreadsheet and subsequently entered into the database by the data manager. Data management procedures for this project are provided in the RI/FS Work Plan.

SECTION 4

ASSESSMENT AND OVERSIGHT (C)

This task will rely on the knowledge and expertise of the EPA technical team, as described in the FSP. The field team and laboratories will stay in close verbal contact with the task manager 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.

4.1 ASSESSMENTS AND RESPONSE ACTIONS (C1)

Assessment activities will include readiness reviews prior to sampling and prior to release of the final data to the data users, as well as 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.

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

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

Technical review of intermediate and final work products generated for this task will be completed throughout the course of all sampling, laboratory, data validation, data management, and data interpretation activities to ensure that every phase of work is accurate and complete and follows the QA procedures outlined in this QAPP. Any problems that are encountered will be resolved between the reviewer and the person completing the work. 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 EPA technical team coordinator and EPA project coordinator. EPA will be notified of any problems that may affect the final outcome of this task, according to the Agreement. Samples will not be discarded by the lab until written permission to do so is provided by the RPM.

The laboratory will be required to have implemented a review system that serves as a formal surveillance mechanism for all laboratory activities. Each phase of work is reviewed by a supervisor before it is approved for release. Details are provided in the laboratory QA plan. EPA's QA personnel may elect to observe, witness, and critique a dry run of the laboratory sample processing –homogenization, compositing, and documentation – prior to project initiation.

Technical system audits may be conducted if serious problems are encountered during sampling or analysis operations.

Any task team member who discovers or suspects a non-conformance is responsible for reporting the non-conformance to the task manager, the RPM, or the laboratory project or QA manager, as applicable. The task QA coordinator will ensure that no additional work dependent on the non-conforming activity is performed until a confirmed non-conformance is corrected. Any confirmed non-conformance issues will be relayed to the EPA technical team coordinator. In addition, communication between corrective actions by the field personnel and the laboratory relative to the accuracy and completeness of the chain-of-custody documents will follow corrective-action procedures.

4.2 REPORTS TO MANAGEMENT (C2)

The laboratories will keep TAI's Analytical Chemistry Laboratory Coordinator 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 that resulted in a requirement for corrective action and a description of the corrective actions implemented.
- Descriptions and justification for any significant changes in methodology or QA/QC procedures.

The Laboratory Project Manager and Laboratory QA Manager will provide this information to the TAI Analytical Chemistry Laboratory Coordinator. The laboratory will be required to have implemented routine systems of reporting non- conformance issues and their resolution. These procedures are described in the laboratory QA manuals (to be submitted following laboratory selection). Laboratory non-conformance issues will also be described in the field sampling report if they affect the quality of the data.

Data packages and EDDs will be prepared by the laboratory upon completion of analyses for each sample delivery group. The case narrative will include a description of any problems encountered, control limit exceedances (if applicable), and a description and rationale for any deviations from protocol. Copies of corrective action reports generated at the laboratory will also be included with the data package.

Data that has undergone validation by TAI's Technical Team will be provided electronically to EPA within 90 days of receipt of all samples from the field. These data will also be provided in the DSR, containing an overview of the field event, a sampling location map, sample collection methods used, rationale for any deviations from the FSP and QAPP, validated data, data validation report and summary statistics. EPA will provide documentation and the rationale for all deviations from the FSP and QAPP that occur while samples are in EPA custody.

The draft DSR will be prepared by the TAI technical team and submitted to EPA within 150 days following receipt of all samples from the field.

4.3 DATA VALIDATION AND USABILITY (D)

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.

4.3.1 DATA REVIEW, VERIFICATION, AND VALIDATION (D1)

Field and laboratory data for this task will undergo a formal verification and validation process. Data validation and data quality assessment will be completed and provided to the task QA coordinator. 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 for TAL metals, inorganic arsenic and mercury will be completed by ESI under the oversight of the TAI Task QA Coordinator according to methods described in EPA's guidance documents, including EPA's national functional guidelines (NFGs) and associated analytical method requirements for inorganic data review (USEPA 2002b, 2014a and 2017). Data validation will be performed in accordance with the "Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use" (USEPA 2009b). Data will be qualified or rejected as necessary if results for laboratory control samples, matrix spike samples, laboratory duplicates or other required method QC do not meet QC acceptance criteria outlined in this QAPP, the specific analytical methods, or laboratory performance-based control limits, as applicable. Data may also be qualified as undetected based on concentrations of target analytes detected in laboratory or field blanks. Current performance-based control limits will be provided in the laboratory QA plans (to be submitted following laboratory selection), as applicable. All data generated by the laboratory will undergo Stage 4 data validation (S4VM).

Equipment rinse blanks will be evaluated, and data qualifiers will be applied in the same manner as method blanks. The equipment blank will be subjected to the same processes as the fish tissue (e.g., cutting boards, knives, blenders/Tissuemizers™, and bowls) before being poured into a sample bottle. Data will be flagged if the RPD for lab processing triplicates exceeds 30%.

4.3.2 VERIFICATION AND VALIDATION METHODS (D2)

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

All chemistry data will be fully validated. If problems or questions are encountered during validation, the laboratory will be contacted for resolution. Additional full or focused validation will be completed if required to fully assess the quality of the data or to verify that laboratory errors have been addressed.

Procedures for verification and validation of laboratory data and field QC samples will be completed as summarized in Section 4.3.1 above. 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. EDD completeness will be verified electronically to the sample and analyte level when data from the laboratory and from the data validation firm are entered into the database. 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.

ACGs and targeted MRLs for this task are provided in Tables 2. Any exceedance of actual MRLs over the target MRLs or ACGs will be discussed in the data validation report.

4.3.3 RECONCILIATION WITH USER REQUIREMENTS (D3)

The goal of data validation is to determine the quality of each datum and to identify those that do not meet the task measurement quality objectives. Non-conforming data may be qualified as estimated (i.e., a "J" qualifier appended to the result) or rejected as unusable (i.e., an "R" qualifier appended 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 (rinsate) 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 may be less precise or less accurate than unqualified data. Data users, in cooperation with the EPA technical team coordinator and the task QA coordinator, are responsible for assessing the effect of the inaccuracy or imprecision of the qualified data on statistical procedures and other data uses. The data quality discussion in the data validation report will include information regarding the direction or magnitude of bias or the degree of imprecision for qualified data to facilitate the assessment of data usability. The data validation report will also include a discussion of data limitations and their effect on data interpretation activities.

SECTION 5

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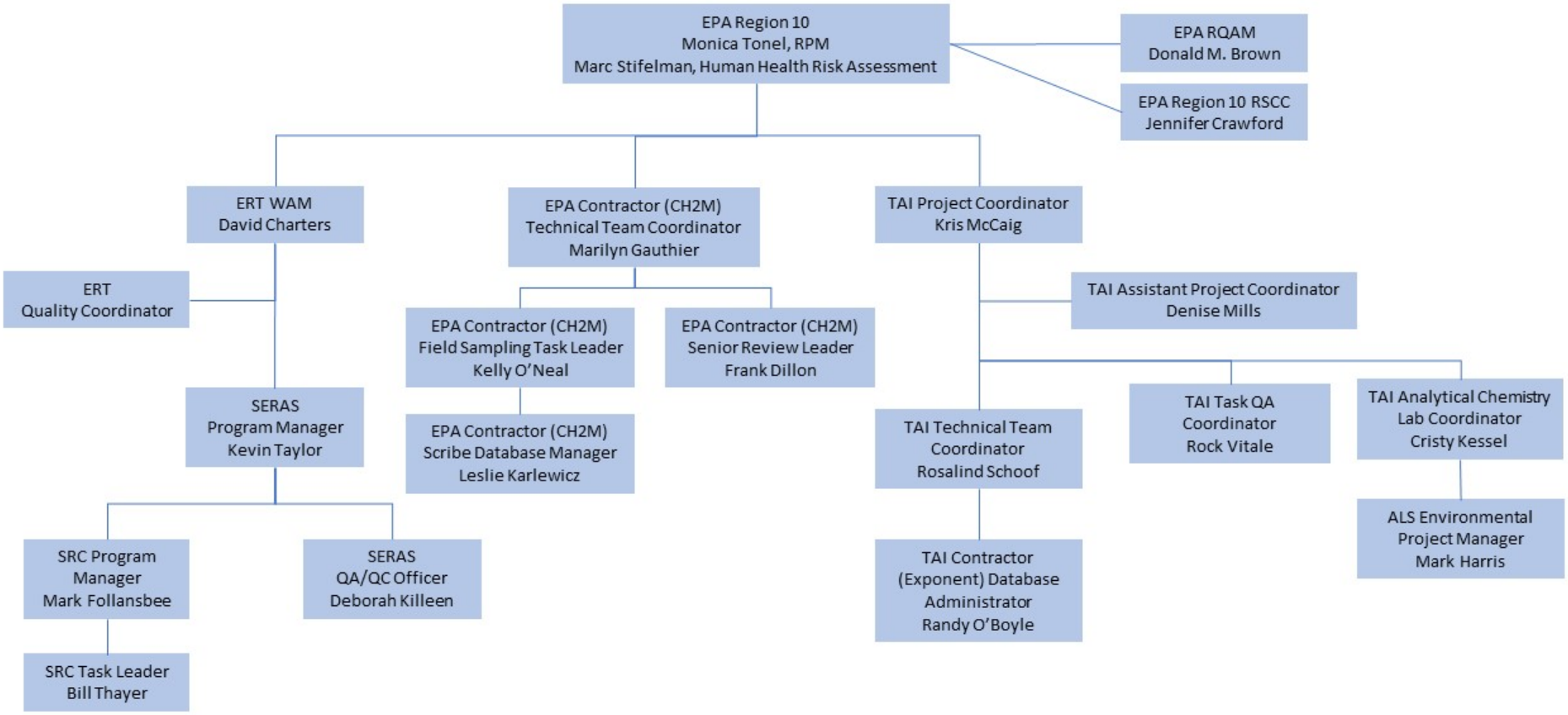
Figures

Figure 1 – Organizational Chart for Northern Pike Tissue Study



Tables

Table 1. Fish Tissue Task, Team Contact Information				
Name	**Task/Role**	**Organization**	**Office Phone Number**	**Email Address**
Environmental Protection Agency				
Monica Tonel	UCR Site RPM	EPA R10	206-553-0323	Tonel.monica@epa.gov
Donald M. Brown	Regional QA Manager	EPA R10	206-553-0717	brown.donaldm@epa.gov
Marc Stifelman	Human Health Risk Assessor	EPA R10	206-553-6979	stifelman.marc@epa.gov
Jennifer Crawford	Regional Sample Control Coordinator/QA Chemist	EPA R10	206-553-6261	crawford.jennifer@epa.gov
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Table 2. Target Analyte List, Method Detection and Reporting Limits, Analytical Concentration Goals, and Human Health Risk-Based Concentrations for Addendum No. 2 to the 2009 Fish Tissue Study Quality Assurance Project Plan

Analyte	2009 RBC[a] (mg/kg ww)	2018 RBC (mg/kg ww)	2018 RBC[b] (mg/kg dw)	MRL[c] (mg/kg dw)	MDL[c] (mg/kg dw)	ACG[d] (mg/kg dw)
Conventional Parameters						
Total Length	NAe	NA	NA	NA	NA	NA
Total Mass	NA	NA	NA	NA	NA	NA
Percent Moisture	NA	NA	NA	0.1	NA	0.1
Percent Lipids	NA	NA	NA	0.1	NA	0.1
Metals						
Aluminum	3.2	239	956	2	0.2	13
Antimony	0.0013	0.0955	0.382	0.05	0.002	0.05
Arsenic – Total	0.00048	0.00338	0.0135	0.5	0.02	0.5
Arsenic – Total inorganic[f]	0.00048	0.00038	0.0135	0.02	0.007	0.02
Barium	0.65	NA	NA	0.05	0.005	2.6
Beryllium	0.0065	NA	NA	0.02	0.003	0.026
Cadmium	0.0032	NA	NA	0.02	0.002	0.02
Calcium	NA	NA	NA	4	2	4
Chromium	4.9	0.0102	0.0404	0.2	0.02	19.6
Cobalt	0.065	NA	NA	0.02	0.003	0.02
Copper	0.13	NA	NA	0.1	0.02	0.52
Iron	2.3	NA	NA	1	0.2	9.1
Lead	NA	NA	NA	0.02	0.0005	0.02
Magnesium	NA	NA	NA	2	0.6	2
Manganese	0.45	NA	NA	0.05	0.008	1.8
Mercury	0.00024	0.0239	0.0956	0.001	0.00009	0.0013
Nickel	0.065	NA	NA	0.2	0.02	0.26
Potassium	NA	NA	NA	20	9	20
Selenium	0.016	1.19	4.76	0.1	0.05	0.1
Silver	0.016	NA	NA	0.02	0.006	0.064
Sodium	NA	NA	NA	20	2	20
Sulfur	NA	NA	NA	8	4	8
Thallium	0.00023	0.00239	0.00956	0.02	0.0009	0.02

Table 2. Target Analyte List, Method Detection and Reporting Limits, Analytical Concentration Goals, and Human Health Risk-Based Concentrations for Addendum No. 2 to the 2009 Fish Tissue Study Quality Assurance Project Plan

Analyte	2009 RBC[a] (mg/kg ww)	2018 RBC (mg/kg ww)	2018 RBC[b] (mg/kg dw)	MRL[c] (mg/kg dw)	MDL[c] (mg/kg dw)	ACG[d] (mg/kg dw)
Uranium	0.0097	NA	NA	0.02	0.0008	0.02
Vanadium	0.0032	NA	NA	0.2	0.007	0.2
Zinc	**0.97**	**NA**	**NA**	**0.5**	**0.06**	3.88

[a] 2009 RBCs taken from Parametrix et al. (2009)

[b] 2018 RBCs taken from SRC (2018) and were calculated for both adults and children who consume fish; when calculating the RBC, the human intake factor (HIF) was based on the child for non-cancer and the time-weighted average (TWA) for cancer. The lower of these values was then selected as the RBC. See Appendix E-1 for additional detail.

[c] MRLs and MDLs were taken from ALS Environmental in Kelso, WA (pers. comm. from Poyfair, August 2016). Laboratory MDLs, and MRLs were provided on a dry weight basis. The RBCs were calculated using the RSL Calculator, which states that "wet or dry weight is not an inherent assumption of the SL numbers. …users of the Table should consider whether the population of interest is more likely to consume the fish using a preparation method that is better simulated by a wet or dry weight." Consumption of raw or cooked fish would be represented by wet weight, while smoked fish would be dry weight. Wet weight RBC values were converted to dry weight values using 75% moisture for bony fishes, cited in EPA (1993), and the formula Dry Weight = Wet Weight / (Total Solids/100).

[d] ACGs represent the human health RBC unless the RBC is lower than the MRL. In that case, the MRL is used as the ACG. Bolded ACGs are different from those in the 2009 QAPP (Parametrix et al. 2009) due to either changes in laboratory MRLs, or updated RfDs

[e] NA = not available, analyte is not a COPC for the human health risk assessment.

[f] Inorganic arsenic will be analyzed using EPA Method 1632.

Table 3. Recommended Methods for Analysis of Contaminants of Potential Concern in Fish Tissue Samples								
Analytical Group	**Analytical and Preparation Method/SOP Reference**	**Description**	**Analytical Sample Volume**	**Containers (number, size and type)**	**Homogenized Sample Volume per container (need wet, dry or freeze dry basis)**	**Container after Homogenization**	**Preservation Requirements (chemical, temperature, light protected)**	**Maximum Holding Time (Preparation/ Analysis)**
TAL Metals (plus mercury)	EPA Method 6010C	ICP-AES	30 g	Aluminum foil, resealable plastic bag	0.5 to 1 g freeze-dried tissue	Two 4 oz glass jars	Chemical: None Temperature: ambient (if freeze-dried), frozen at - 20˚C (if frozen) Light: None	Storage up to 1 year after freeze-drying Digestion and Analysis: 180 days except for mercury at 28 days
	ALS Kelso SOP#: MET TDIG/EPA Method 6020B	ICP-MS			0.5 to 1 g freeze-dried tissue			
	EPA Method 1631E	CV-AFS			0.5 to 0.6 g freeze-dried tissue			
	EPA 7742 (selenium)	Hydride AA			0.5 to 1 g freeze-dried tissue			
Inorganic Arsenic	EPA Method 1632A	HG-OFAAS	30 g	Aluminum foil, resealable plastic bag	0.5 g	Two 4 oz glass jars	Chemical: None Temperature: Frozen at -20 ° C Light: None	Storage: up to 1 year Analysis: No demonstrated holding time
Percent Lipids		Bligh-Dyer/ Gravimetric	30 g	Aluminum foil, resealable plastic bag			Chemical: None Temperature: Frozen at - 20˚C Light: None	1 year
Percent Moisture		Freeze-dry/ Gravimetric	30 g	Aluminum foil, resealable plastic bag			Chemical: None Temperature: Frozen at - 20˚C Light: None	1 year

Final

Appendix A
Field Sampling Plan Addendum
Upper Columbia River
Northern Pike Tissue Study
(Addendum No. 2 to the 2009 Fish Tissue Study QAPP and FSP)

Upper Columbia River, Washington

Prepared for

U.S. Environmental Protection Agency
Region 10

June 2018

Prepared by

CH2MHILL®

RAC 6
Remedial Action Contract EP-W-06-021

Contents

SECTION 1

Introduction

This document presents the field sampling plan (FSP) for the 2018 Northern Pike tissue study for the Upper Columbia River (UCR), Addendum No. 2 to the 2009 Fish Tissue Study Quality Assurance Project Plan (QAPP) (Parametrix et al. 2009).

The primary objective of the 2018 Northern Pike tissue study is to characterize the concentrations of target analyte list (TAL) metals, mercury, and inorganic arsenic in Northern Pike from the UCR that might be consumed by recreational and subsistence anglers. Data from the Northern Pike tissue study will be used to support the human health risk assessment (HHRA) to be conducted by the United States Environmental Protection Agency (EPA) as part of the remedial investigation and feasibility study (RI/FS) for the UCR Site and to support Washington State Department of Health (WDOH) efforts in evaluating the need for a Northern Pike fish consumption advisory.

1.1 Overview of Sampling and Analysis Program

The Northern Pike tissue sampling and analysis program consists of the following elements:

1. Northern Pike in the designated study area (portion of the UCR, extending from approximately Gifford to Northport, Washington) will be caught, euthanized, measured, and weighed by the Lake Roosevelt Fisheries Co-Managers[1] as part of Northern Pike suppression efforts scheduled for July 2018.
2. A total of 60 appropriately-sized fish in two edible size classes (30 fish in the 300 to 449 millimeters [mm] total length [TL] size range and 30 fish in the greater than 450 mm TL size range]) will be transferred to EPA's contractor (CH2M) for examination and collection of tissue samples (fillets) in the field.
3. The tissue samples will be frozen and shipped to an offsite laboratory for processing, compositing, and laboratory analysis. The offsite laboratory, ALS Environmental in Kelso, Washington, is contracted to Teck American Incorporated (TAI), a potentially responsible party (PRP) for the UCR Site. Processing at the laboratory will consist of thawing and homogenization of each fillet in a high-speed blender. The homogenate from each fillet will then be mixed with other designated samples from the size class to create a composited aliquot for freeze-drying, grinding, digestion, and analysis. Each composite will be created from the homogenate from 5 randomly selected fillets in that size class. A total of 12 composite samples will be prepared (6 composites for the 300 to 449 mm TL size range and 6 composites for the greater than 450 mm TL size range). The composited samples will be analyzed for TAL metals, mercury, inorganic arsenic, percent moisture, and percent lipids.

1.2 Task Organization

The organizational structure for activities associated with the study is summarized in Figure A-1 and described in Section 1.2 of the QAPP addendum. Table A-1 lists the contact information for management, field, and laboratory personnel.

[1] Lake Roosevelt Fisheries Co-Managers include the Colville Confederated Tribes (CCT), the Spokane Tribe of Indians (STI), and the Washington Department of Fish and Wildlife (WDFW).

1.3 Document Organization

This FSP describes the field and laboratory methods that will be used to collect fish tissues for the Northern Pike study. The background, rationale, data quality objectives (DQOs), and overall study design for this study are described in detail in the QAPP Addendum. Section 2 of this FSP describe the field procedures that will be followed by the technical team in the field. Section 3 summarizes laboratory protocols for processing the tissue samples prior to laboratory analyses. Section 4 provides information on data management procedures. References cited in this document are listed in Section 5.

The following documents are provided as attachments to this FSP:

- **Attachment A1. Site Health and Safety Plan (SHSP) Addendum.** This document describes the specific requirements and procedures that will be implemented to minimize the safety risk to CH2M personnel who carry out the field study program.
- **Attachment A2. Standard Operating Procedures (SOPs).** The SOPs describe the procedures that will be used to collect and ship the fish tissue samples. These are revised versions of the 2009 fish tissue study SOPs (Parametrix et al. 2009). The SOPs include:

  SOP-1 – Sample Labeling
  SOP-2 – Sample Processing for Target Fish Species
  SOP-3 – Sample Storage, Packing and Shipping
  SOP-4 – Field Documentation
  SOP-5 – Sample Custody
- **Attachment A3. Field Forms.** This attachment contains examples of various forms that will be used during field sampling: fish collection, processing, and external examination forms.

SECTION 2

Sample Collection and Processing Procedures

The following sections describe the detailed procedures and methods that will be used during the implementation of the 2018 Northern Pike tissue study, including sampling procedures, record keeping, sample handling, storage, and field quality control procedures.

The Northern Pike to be sampled will be caught by the Lake Roosevelt Fisheries Co-Managers, who will measure and weigh each whole fish. Whole fish within the targeted size ranges (300 to 449 mm, and greater than or equal to 450 mm TL) will then be transferred to CH2M personnel by the Lake Roosevelt Fisheries Co-Managers for initial processing (filleting and weighing fillets) and shipment to ALS for further processing, compositing, and analysis. Depending on field conditions, procedures specified in the referenced SOPs may be modified if necessary.

2.1 Field Sampling Methods

2.1.1 Task Schedule

The 2018 Northern Pike tissue sampling program is anticipated to occur in July 2018, but the schedule is subject to EPA approval of the QAPP and FSP addenda.

2.1.2 Fishing Method

The Northern Pike to be sampled will be caught as part of the Northern Pike gill net suppression program conducted by the Lake Roosevelt Fisheries Co-Managers. The objective of the gill net suppression program is to reduce or eliminate Northern Pike in the Lake Roosevelt watershed. More information about the types of gill nets to be used and methods for net deployment and fish recovery is provided at https://www.monitoringresources.org/Document/Protocol/Details/3354. Northern Pike are an invasive species and are prohibited in the State of Washington and will therefore not be released back to the water. All Northern Pike caught during the gill net suppression program will be euthanized and removed.

2.1.3 Location, Target Species, and Size Classes

It is anticipated that the fish included in the sampling effort will be caught in the northern portion of the UCR extending from the Gifford area to Northport, Washington. The Lake Roosevelt Co-Manager sampling team will record the global positioning system (GPS) coordinates (latitude and longitude) and water depth measurement (to the nearest 0.5 meter) where fish to be sampled are collected (i.e., point coordinates for gill nets). However, it is understood that location of collection may not necessarily correlate with exposure areas used in the HHRA.

Only Northern Pike tissue will be sampled. Fish will be measured on the boat with a measuring board to obtain gross measurements of specimens that will be retained for tissue samples (total length and mass).

The Northern Pike tissue study targets two size bins; 300 to 449 mm, and 450 mm and greater; these bins represent the sizes of Northern Pike that are likely consumed by people throughout the UCR. The first 60 individual fish that meet size requirements for each bin (30 of each size bin) will be euthanized by the Lake Roosevelt Fisheries Co-Managers and transferred to CH2M staff. The Co-managers will tag each fish with a waterproof tag stating the fish length and weight. The tag will be physically attached to the fish with a cable tie. A sequential numerical coding system will be used (see Individual Fish Sample Numbering below). The tagged fish will be placed on ice in coolers or tubs prior to being transferred to CH2M sampling team.

2.1.4 Individual Fish Sample Numbering

Each fish transferred to CH2M for sampling will be numbered sequentially beginning with the letters “EPA”, a species abbreviation, length group and sequential number (e.g., EPA-NP-A-001). The codes will include the following information:

Species abbreviation:

- NP = Northern Pike

Length groups will be:

- A = 300 to 449 mm TL
- B = 450 mm and greater TL

Sequential fish numbers will be expressed as three digits starting with 001 (e.g. 001, 002, etc.). At the end of sampling there should be 30 Group A fish and 30 Group B fish.

In example above, EPA-NP-A-001 would be the first Northern Pike from the Group A (300 to 449 mm) size bin.

2.1.5 Fish Processing and Sample Collection

Once collected, fish will be euthanized by the Lake Roosevelt Fisheries Co-Managers and transferred to the CH2M team for processing. All processing will be performed on the boat provided by the National Parks Service. If water conditions prevent processing on-board, the processing boat will travel to shore and fish processing will be conducted on-board while the boat is beached to provide a stable platform.

2.1.5.1 Field Equipment and Supplies

Field equipment and supplies for the CH2M fish processing team include fish fileting equipment, decontamination supplies, sample containers, coolers, shipping containers, logbooks and forms, personal protection equipment, and personal gear. Protective wear (e.g., gloves) is required to minimize the possibility of cross-contamination between samples.

2.1.5.2 Sample Processing

Each fish will be photographed and examined for external abnormalities (see External Examination Form in Attachment A3 for details), scaled (Smith et al. 2002), and filleted with skin and y-bone removed. Filleting will follow general EPA guidelines for assessing chemical contaminant data for use in fish advisories (USEPA 2000) and procedures described in SOP-2. At least 40 grams (g) of tissue are needed from each fish for laboratory processing, compositing, and analysis. Fillet tissue will be weighed and individually wrapped in aluminum foil and placed in a resealable plastic bag. The bagged fillets will then be placed inside a second bag with the fish ID label so that this label is between the 2 resealable plastic bags. This will facilitate identification and sample organization at the laboratory without unwrapping the fish. The bagged and labelled fillets will be stored in a cooler on wet ice while on the sampling boat. These tissues will then be transferred to a cooler with dry ice for shipment to the laboratory. The fillets will be shipped to the laboratory as individual samples. After sampling is complete, EPA will prepare a specific compositing plan that identifies the individual fish that will be used to create each size class composite. The compositing approach will consist of a stratified random approach based on size class (i.e., individual fillets from each size bin will be randomly assigned to 1 of 6 composite samples for that size bin). Compositing will take place in the laboratory after additional processing steps are complete (see Section 4).

2.1.5.3 Sample Documentation

The following documentation will be provided with the tissue samples:

- A field record form that contains information about each fish and sampling area

- A sample identification label that accompanies and identifies each individual fish fillet
- A chain-of -custody (COC) form that provides continuous tracking information for all samples
- A custody label that seals each shipping container.

The following information will be handwritten on the sample label at the time of collection with an indelible marker:

- Size bin
- Individual fish sample number
- Analysis
- Samplers
- Date
- Time

An example label is provided in Attachment A3. If necessary, corrections will be made on the sample labels by drawing a single line through the error and entering the correct information with an indelible marker. All corrections will be initialed and dated by the person performing the correction. If possible, the individual who made the error will correct it.

The sample labels will be placed inside resealable plastic bags and inserted with each foil- wrapped fish inside a large resealable plastic bag. When the individual fish are wrapped for shipment, this sample label will remain with the specimen. Sample packaging is discussed in the following section.

2.1.6 Sample Packaging and Transport

After completing each day of fish tissue processing, the processing vessel will return to the boat launch and the field crew will prepare the fillets for shipment to the laboratory.

Sturdy plastic coolers will be used as shipping containers. Enough samples will be placed in each cooler to occupy no more than 60 to 70 percent of the cooler volume, and the remaining space in the cooler will be filled with dry ice. Enough dry ice will be used to keep the samples frozen for at least 48 hours. A completed COC form and copies of the field record forms for the samples will be included in each cooler. Examples of both forms are presented in Attachment A3.

After each cooler is packed with fish samples and dry ice, it will be secured at both ends with nylon strapping tape and the following items will be attached:

- Address label for processing laboratory
- Two custody seals

A courier will receive samples at the end of the work week and deliver the samples to the processing lab the next day.

2.1.7 Management of Study-Derived Waste

All disposable materials used for sample collection and processing, such as paper towels and gloves, will be placed in heavyweight garbage bags or other appropriate containers. Disposable supplies will be removed from the site by sampling personnel and placed in a normal refuse container for disposal at a solid waste landfill.

Once filleted, fish swim bladders will be punctured and the remaining fish carcass will be sunk in the river channel away from the shoreline.

Measurement, examination, and dissection equipment will be decontaminated after each sample and at the end of the study.

2.2 Field Documentation and Chain of Custody Procedures

The integrity of each sample from the time of collection to the point of data reporting must be maintained. Proper record-keeping and COC procedures will be implemented to allow samples to be traced from collection to final disposition. Representative photographs will be taken of each type of sampling activity performed during the fish tissue study. Site photographs from various angles and views of the sampling locations will also be collected.

2.2.1 Field Logbook

All field activities and observations will be noted in a field logbook. The field logbook will be a bound document containing individual field and sample log forms. Information will include personnel, date, time, sampler, types of samples collected, and general observations. Any changes that occur during sampling (e.g., personnel, responsibilities, deviations from the FSP) and the reasons for these changes will be documented in the field logbook. The logbook will identify onsite visitors (if any) and the number of photographs taken at each sampling location. The field supervisor is responsible for ensuring that the field logbook and all field data forms are correct. Requirements for logbook entries will include the following:

- Logbooks will be bound, with consecutively numbered pages.
- Removal of any pages, even if illegible, will be prohibited.
- Entries will be made legibly with black (or dark) waterproof ink.
- Unbiased, accurate language will be used.
- Entries will be made while activities are in progress or as soon afterward as possible (the date and time that the notation is made should be noted, as well as the time of the observation itself).
- Each consecutive day's first entry will be made on a new, blank page.
- The date and time, based on a 24-hour clock (e.g., 0900 a.m. for 9 a.m. and 2100 for 9 p.m.), will appear on each page.

When field activity is complete, the logbook will be entered into the project file.

In addition to the preceding requirements, the person recording the information must initial and date each page of the field logbook. If more than one individual makes entries on the same page, each recorder must initial and date each entry. The bottom of the page must be signed and dated by the individual who makes the last entry. The field supervisor, after reading the day's entries, also must sign and date the last page of each daily entry in the field logbook.

Logbook corrections will be made by drawing a single line through the original entry, allowing the original entry to be read. The corrected entry will be written alongside the original. Corrections will be initialed and dated and may require a footnote for explanation.

The type of information that may be included in the field logbook and/or field data forms includes the following:

- Task name, task location, and task number
- Task start date and end date
- Weather conditions
- Name of person making entries and other field staff

- Onsite visitors, if any
- Sampling vessel, if any
- Sample location
- Date and collection time of each sample
- The sampling location name, date, gear and sampling location coordinates derived from GPS
- Specific information on each type of sampling activity
- Observations made during sample collection, including weather conditions, complications, and other details associated with the sampling effort
- Number of photographs taken at each sampling location
- A record of site health and safety meetings, updates, and related monitoring
- Any deviation from the FSP and reasons for deviation.

All logbooks must be completed at the time any observations are made. Copies of all logbooks and forms will be retained by the technical team.

2.2.2 Chain-of-Custody Procedures

Samples are in custody if they are in the custodian's view, stored in a secure place with restricted access, or placed in a container secured with custody seals. A COC record will be signed by each person who has custody of the samples and will accompany the samples at all times. Copies of the COC will be included in laboratory and quality assurance/quality control (QA/QC) reports. Attachment A3 of the main QAPP contains an example of the COC form that will be used during the 2018 study.

Samples must be accompanied by a chain-of-custody record generated using Scribe sample management software. When transferring samples, the individuals relinquishing and receiving the samples should sign, date, and note the time on the record. This record documents custody transfer from the sampler, often through another person, to the analyst at the laboratory. The COC must be submitted to the EPA Remedial Program Manager (RPM), laboratory and CH2M project manager on the day of shipment for all samples with shipment notification information.

Samples will be packaged properly for shipment and dispatched to the appropriate laboratory for analysis with a separate chain-of-custody record accompanying each shipping container (one for each field laboratory, and one for samples driven to the laboratory). Courier names and other pertinent information are entered in the "Received by" section of the chain-of-custody record.

All shipments will be accompanied by the chain-of-custody record identifying its contents. The original record and one copy will accompany the shipment to the laboratory, and a second copy will be retained by the PM.

Freight bills, postal service receipts, and bills of lading will be retained as part of the permanent documentation.

The laboratory will designate a sample custodian who will be responsible for receiving samples and documenting their progress through the laboratory analytical process. The sample custodian will establish the integrity of the custody seals upon sample arrival at the laboratory. The laboratory sample custodian will also ensure that the COC and sample tracking forms are properly completed, signed, dated and initialed upon receipt of the samples.

Upon receipt, the laboratory sample custodian will inventory the tissues by comparing labels (numbers and tags) to those on the COC document. If sample temperature rises above the acceptable range (i.e., < 0°C indicating

the tissues have thawed), the EPA project manager, CH2M, and TAI's lab coordinator must be alerted immediately. The custodian will enter the sample number into a laboratory tracking system by task code and sample designation. The custodian will assign a laboratory identifier to each fillet and will be responsible for distributing the samples to the appropriate analyst and for storing samples at the correct temperature in an appropriate secure area.

Samples will be submitted to the lab in the order they are collected. Once all samples have been received and the EPA has indicated which samples should be used to create each composite, the laboratory will pool the samples comprising each composite sample. This will be achieved using information provided by the field team on sample labels and the COC (i.e., fish and sample identification numbers).

SECTION 3

Laboratory Analyses

This section describes the general offsite sample processing and laboratory analyses to be performed by ALS in Kelso, Washington. The details provided below are subject to change once the QAPP and FSP have been reviewed by EPA.

3.1 Offsite Sample Processing

Fish tissue samples will be shipped via overnight delivery from the field to the laboratory. The samples will be stored frozen at –20 degrees Celsius (°C) or lower. Processing at the laboratory will consist of partial thawing and homogenization of each fillet in a high-speed blender. The homogenate from each fillet will then be mixed with other designated samples from the size class to create a composited aliquot for freeze-drying, grinding, digestion, and analysis. Each composite will be created from the homogenate from 5 randomly selected fillets in that size class. A total of 12 composite samples will be prepared (6 composites for the 300 to 449 mm TL size range and 6 composites for the greater than 450 mm TL size range). The composited samples will be analyzed for TAL metals, mercury, inorganic arsenic, percent moisture, and percent lipids.

This section describes the procedures that will be followed for these activities.

3.1.1 Processing Equipment

Processing procedures in the laboratory will follow the general guidance in USEPA (2000). Equipment that will be used to homogenize fillets includes pre-cleaned glass or stainless-steel homogenization containers, an automatic grinder (a high-speed blender or homogenizer is sufficient), aliquot containers (pre-cleaned glass jar with Teflon-lined lid) and a freezer capable of storing all samples at less than –20°C.

3.1.1.1 Initial Procedures for Homogenization and Compositing

Fillet homogenization will be conducted according to EPA's Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories Volume 1 (EPA 2000).

Each composite homogenate should be ground and homogenized using an automatic grinder or high-speed blender or homogenizer. Large fillets may be cut into 2.5-cm cubes with high-quality stainless steel or titanium knives or with a food service band saw prior to homogenization. Parts of the blender or homogenizer used to grind the tissue (i.e., blades, probes) should be made of tantalum or titanium rather than stainless steel. Stainless steel blades and/or probes have been found to be a potential source of nickel and chromium contamination (due to abrasion at high speeds) and should be avoided. Grinding and homogenization of tissue is easier when it is partially frozen (Stober, 1991). The fillet sample should be ground until it appears to be homogeneous. The ground sample should then be divided into quarters, opposite quarters mixed together by hand, and the two halves mixed together. The grinding, quartering, and hand-mixing steps should be repeated at least two more times. If chunks of tissue are present at this point, the grinding and homogenization should be repeated. No chunks of tissue should remain in the sample homogenate because these may not be extracted or digested efficiently and could bias the analytical results.

After sampling is complete, EPA will prepare a specific compositing plan that identifies the individual fish that will be used to create each size class composite. The compositing approach will consist of a stratified random approach based on size class (i.e., individual fillets from each size bin will be randomly assigned to 1 of 6 composite samples for that size bin). Composite samples will be created from equal weights of individual homogenates. If individual homogenates have been frozen, they should be thawed partially and re-homogenized prior to weighing and compositing. Any associated liquid should be kept as a part of the sample.

The weight of each individual homogenate used in the composite homogenate should be recorded, to the nearest gram, on the sample processing record.

The composite homogenate may be processed (freeze-dried and ground) immediately for analysis or frozen and stored at -20 °C (see Table A-2). The remainder of each individual homogenate should be archived at -20 °C with the designation "Archive" and the expiration date recorded on the sample label.

The location of the archived samples should be indicated on the sample processing record.

It is essential that the weights of individual homogenates yield a composite homogenate of adequate size to perform all necessary analyses. About 40 g of tissue are needed from each fish. Weights of individual homogenates required for a composite homogenate, based on the number of fish per composite and the weight of composite homogenate recommended for analyses of all screening study target analytes (200 g) are given in Table A-3.

The recommended sample size of 200 g for screening studies is intended to provide sufficient composited sample material to (1) analyze for all recommended target analytes at appropriate detection limits; (2) meet minimum QC requirements for the analyses of laboratory duplicate, matrix spike, and matrix spike duplicate samples; and (3) allow for reanalysis if the QC control limits are not met or if the sample is lost.

3.2 Laboratory Quality Assurance Procedures

QA procedures will be followed in the fish processing through record keeping and documenting procedures for processing of all individuals. Specific measures will include maintaining laboratory logs and data sheets, using standard data collection forms, and developing routine procedures, as discussed in this document, to assess the accuracy and completeness of records.

3.2.1 Sample Handling and Preservation

The tissue samples will be stored according to the methods protocols. COC procedures will be followed when the samples are shipped from the processing laboratory to other laboratories for chemical analysis. Sturdy shipping coolers with dry ice will be used for overnight shipping.

3.2.2 Equipment Decontamination Procedures

The tissue samples for this study will be analyzed for TAL metals, inorganic arsenic and mercury. Prior to preparing each sample, utensils and containers will be cleaned thoroughly with a detergent solution; rinsed with tap water; rinsed with 20 percent trace-metal-grade nitric acid (HNO3) and with trace-metal-free and organics-free deionized water, and solvent rinsed with methanol and methylene chloride. Stainless-steel parts will be cleaned using this procedure, but without the acid rinse (USEPA 2000).

3.2.3 Containment and Disposal of Investigation-Derived Waste

Waste materials generated during preparation of the fish tissue homogenates will be disposed of according to the SOPs of the processing laboratory.

Samples will not be discarded by the lab until written permission to do so is provided by the RPM.

3.3 Analytical Laboratory Methods

Project analytes, methods, analysis by species, and required quantitation limits are listed in Table 3 of the QAPP Addendum. The analyses for contaminants of potential concern (COPCs) will be performed in accordance with the project QAPP and laboratory SOPs. The analyses will be subject to quality control (QC) requirements specified in the QAPP Addendum. For fish analyses, the analytical/laboratory reporting limits are laboratory specific. The laboratory will target the needed levels and will report detection levels on a sample/analyte-

specific basis. The selected methods will be state of the art and only the methods that are practicable for this study will be used.

3.3.1 Laboratory Homogenate Replicates

One well-homogenized sample will be used to produce triplicate samples for quality assurance of the homogenization. These replicates primarily provide information about the uniformity of the homogenization procedure, but also provide information about the precision of the analysis.

3.3.2 Analytical Quality Control Samples

The laboratory that analyzes the samples will evaluate analytical accuracy by conducting matrix spike/matrix spike duplicate (MS/MSD) analyses on approximately 1 in 20 (or 1 per analytical batch, whichever is more frequent) of the samples and by analyzing certified reference materials. Precision will be evaluated by analyzing spike or laboratory sample duplicates. In addition, the laboratory will analyze reagent blanks to assess the magnitude of any incidental contamination that potentially may bias the results.

SECTION 4

Data Management and Reporting Procedures

During field, laboratory, and data evaluation operations, effective data management is critical to providing consistent, accurate, and defensible data and data products. Data management and reporting are discussed in the following sections.

4.1 Field Data

Daily field records (a combination of field logbooks, field forms [if any], and COC forms) will make up the main documentation for field activities. Upon completion of sampling, field notes, data sheets (if any), and COC forms will be scanned to create an electronic record for use in creating the field data report. Field data will be manually entered into the project database. One hundred percent of the transferred data will be verified based on hard copy records. Electronic QA checks to identify anomalous values will also be conducted following entry.

4.2 Laboratory Data

The contract laboratory will submit data in both electronic and hard-copy format as described in Section 2.7.2 of the QAPP Addendum. The laboratory project managers for the respective testing laboratories will contact each of their respective laboratory QA managers prior to data delivery to discuss specific format requirements. Written documentation will also be used to clarify how field replicate and split samples, and laboratory duplicates and QA/QC samples were recorded in the data tables, and to provide explanations of other issues that may arise. The data management task will include keeping accurate records of field and laboratory QA/QC samples so that personnel who use the data will have appropriate documentation. Data management files will be stored on a secure computer or on a removable hard drive that can be secured.

In addition to placing all data and identifiers in an electronic database, hard copies of all original analytical data or study records will be placed in a filing system. Each analytical data set (or supporting laboratory document) will be given a unique documentation code based on the original source of the data or information and filed based on that code.

A master list of all filed documents, sorted in order by filing code, will be maintained for easy retrieval from the document library.

4.3 Data Review and Reporting Schedule

Draft data validation reports will be prepared by an independent validator following receipt of the complete laboratory data package for each round of sampling. Validated data will be provided electronically to EPA approximately 90 days of completion of the data validation.

A Field Sampling Report (FSR) will be prepared by EPA and will include field documentation provided by the Lake Roosevelt Co-Managers. A Data Summary Report (DSR) will be prepared by TAI after data validation is completed and the database is finalized. Validated data is due to EPA within 90 days of receipt of all samples at the laboratory, and the DSR is due to EPA within 150 days of receipt of all samples at the lab.

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SECTION 5

References

Parametrix, Integral, and Exponent. 2009. Upper Columbia River Quality Assurance Project Plan for the 2009 Fish Tissue Study. Prepared for Teck American Incorporated, Spokane, WA. Prepared in consultation with HydroQual. September.

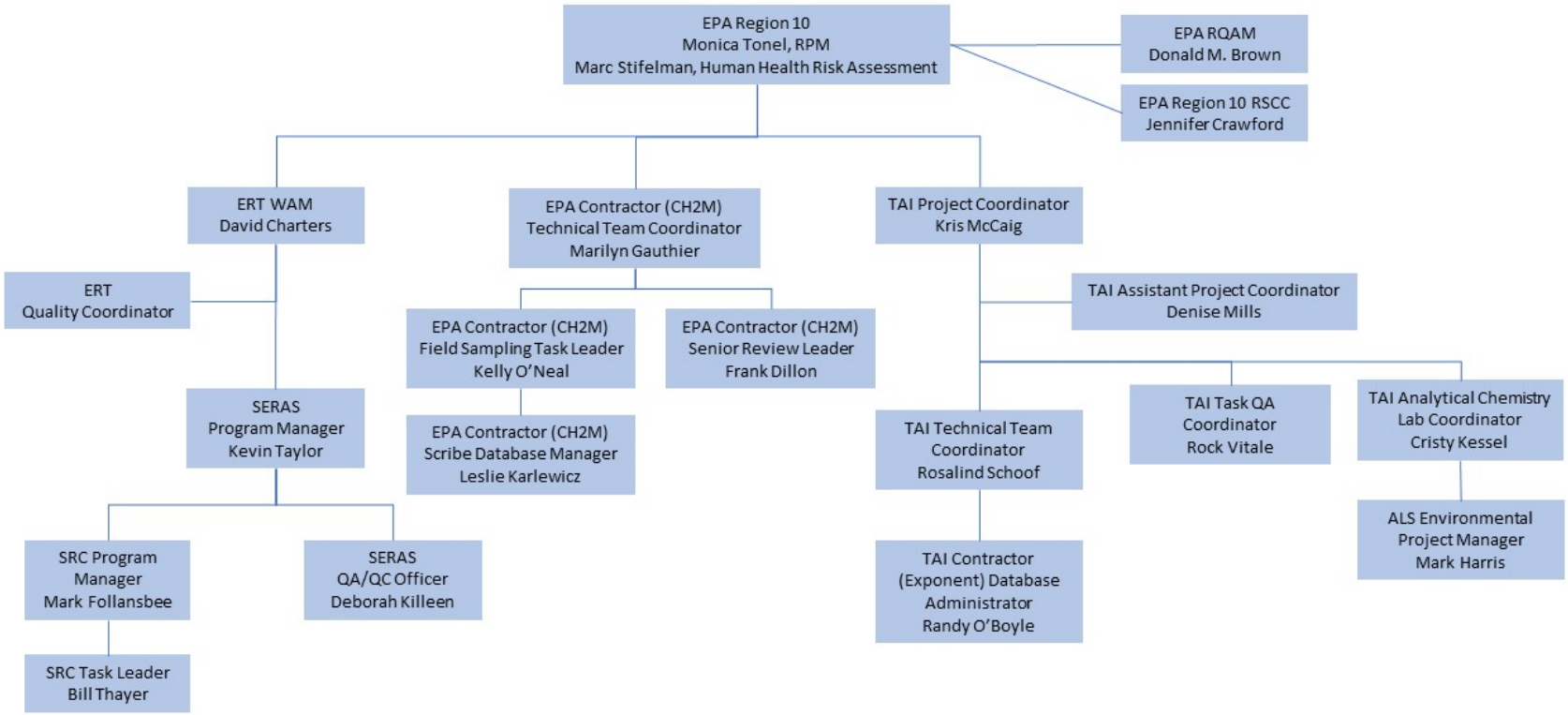
Smith, S.B., A.P. Donahue, R.J. Lipkin, V.S. Blazer, C.J. Schmitt, and R.W. Goede. 2002. Illustrated field guide for assessing external and internal anomalies in fish. U.S. Geological Survey Information and Technology Report USGS/BRD/ITR— 2002-0007. U.S. Geological Survey, Reston, Virginia. September.

Storber, Q. 1991. Guidelines for Fish Sampling and Tissue Preparation for Bioaccumulative Contaminants. Environmental Science Division. Region 4, US Environmental Protection Agency, Athens, GA.

USEPA. 2000. Guidance for assessing chemical contaminant data for use in fish advisories, Volume 1, Fish sampling and analysis, Third Edition. USEPA Office of Water. EPA 823-B-00-007.

Figures

Figure A-1. Northern Pike Study Organizational Chart



Tables

Table A-1. Fish Tissue Task, Team Contact Information				
Name	**Task/Role**	**Organization**	**Office Phone Number**	**Email Address**
Environmental Protection Agency				
Monica Tonel	UCR Site RPM	EPA R10	206-553-0323	Tonel.monica@epa.gov
Donald M. Brown	Regional QA Manager	EPA R10	206-553-0717	brown.donaldm@epa.gov
Marc Stifelman	Human Health Risk Assessor	EPA R10	206-553-6979	stifelman.marc@epa.gov
Jennifer Crawford	Regional Sample Control Coordinator/QA Chemist	EPA R10	206-553-6261	crawford.jennifer@epa.gov
Don Matheny	QA Chemist	EPA R10	206-553-2599	Matheny.Don@epa.gov
EPA Consultant Team				
Marilyn Gauthier	Technical Team Coordinator	CH2M	503-872-4800	Marilyn.gauthier@ch2m.com
Kelly O'Neal	Field Supervisor/Task Safety Officer	CH2M	(916) 286-0215	Kelly.ONeal@CH2M.com
Frank Dillon	Principal Investigator	CH2M	(517) 657-2417	Frank.Dillon@CH2M.com
Keith Holliday	Boat Operations	NPS	(509) 754-7858	keith_holliday@nps.gov
John Culley	Regional HSEM	CH2M	(509) 464-7228	John.Culley@CH2M.com
Bill Thayer	Task Leader	SRC	315-452-8424	thayer@srcinc.com
David Hohreiter	SRC Program Manager	SRC	315-452-8892	dhohreiter@srcinc.com
TAI Team				
Kris McCaig	Project Coordinator	TAI	509-623-4501	kris.mccaig@teck.com
Denise Mills	Assistant Project Coordinator	TAI	509-623-4515	denise.mills@teck.com
Rosalind Schoof	Technical Team Coordinator	Ramboll	206-336-1653	rschoof@ramboll.com
Cristy Kessel	Analytical Chemistry Laboratory Coordinator	TAI	509-496-1160	cristy.kessel@teck.com
Rock Vitale	Task QA Coordinator	ESI	610-935-5577	rvitale@envstd.com
Randy O/Boyle	Database Administrator	Exponent	425-519-8727	robolye@exponent.com
Laboratory (ALS Environmental)				
Mark Harris	Laboratory Project Manager	ALS	360-577-7222	mark.harris@alsglobal.com
Carl Degner	Laboratory QA Manager	ALS	360-577-7222	carl.degner@alsglobal.com

Table A-2. Recommended Methods for Analysis of Contaminants of Potential Concern in Fish Tissue Samples								
Analytical Group	**Analytical and Preparation Method/SOP Reference**	**Description**	**Analytical Sample Volume**	**Containers (number, size and type)**	**Homogenized Sample Volume per container (need wet, dry or freeze dry basis)**	**Container after Homogenization**	**Preservation Requirements (chemical, temperature, light protected)**	**Maximum Holding Time (Preparation/ Analysis)**
TAL Metals (plus mercury)	EPA Method 6010C	ICP-AES	30 g	Aluminum foil, resealable plastic bag	0.5 to 1 g freeze-dried tissue	Two 4 oz glass jars	Chemical: None Temperature: ambient (if freeze-dried), frozen at - 20˚C (if frozen) Light: None	Storage up to 1 year after freeze-drying Digestion and Analysis: 180 days except for mercury at 28 days
	ALS Kelso SOP#: MET TDIG/EPA Method 6020B	ICP-MS			0.5 to 1 g freeze-dried tissue			
	EPA Method 1631E	CV-AFS			0.5 to 0.6 g freeze-dried tissue			
	EPA 7742 (selenium)	Hydride AA			0.5 to 1 g freeze-dried tissue			
Inorganic Arsenic	EPA Method 1632A	HG-OFAAS	30 g	Aluminum foil, resealable plastic bag	0.5 g	Two 4 oz glass jars	Chemical: None Temperature: Frozen at -20 º C Light: None	Storage: up to 1 year Analysis: No demonstrated holding time
Percent Lipids		Bligh-Dyer/ Gravimetric	30 g	Aluminum foil, resealable plastic bag			Chemical: None Temperature: Frozen at - 20˚C Light: None	1 year
Percent Moisture		Freeze-dry/ Gravimetric	30 g	Aluminum foil, resealable plastic bag			Chemical: None Temperature: Frozen at - 20˚C Light: None	1 year

Table A-3. Weights (g) of Individual Homogenates Required for Screening Study Composite Homogenate Sample [a,b] (USEPA 2000)

Number of fish per sample	Total composite weight		
	100 g (minimum)	200 g (recommended)	500 g (maximum)
3	33	67	167
4	25	50	125
5	20	40	100
6	17	33	84
7	14	29	72
8	13	25	63
9	11	22	56
10	10	20	50

[a] Based on total number of fish per composite and the total composite weight required for analysis in screening studies. The total composite weight required in intensive studies may be less if the number of target analytes is reduced significantly.

[b] Individual homogenates may be prepared from one or both fillets from a fish. A composite homogenate should be prepared only from individual homogenates of the same type (i.e., **either** from individual homogenates each prepared from a single fillet **or** from individual homogenates each prepared from both fillets).

Attachment A1
Site Health and Safety Plan
Addendum

Revised Health and Safety Plan

Upper Columbia River (UCR) RI/FS Oversight and Field Sampling

Prepared for

EPA Region 10

April 2018

ch2m

Contents

Approval

This site-specific Health and Safety Plan (HSP) has been written for use by CH2M only. CH2M claims no responsibility for its use by others unless that use has been specified and defined in project or contract documents. The plan is written for the specific site conditions and identified scope(s) of work and must be amended if those conditions or scope(s) of work change.

By approving this HSP, the Responsible Health and Safety Manager (RHSM) certifies that the personal protective equipment has been selected based on the project-specific hazard assessment.

Original Plan

RHSM Approval: **John Culley/SPK** **Date**: April 17, 2012

Field Operations Manager Approval: **Date:**

Revisions

Revisions Made By: Marilyn Gauthier/PDX **Date:** August 30, 2012

Description of Revisions to Plan: Added field activities associated with sediment sampling oversight and collection of split samples for metals analysis

Revisions Approved By: John Culley/SPK **Date: August 31, 2012**

Revisions

Revisions Made By: Craig Sauer/SPK **Date:** March 2014

Description of Revisions to Plan: Updated tasks, hazards/controls, SC-HW, emergency information, and air monitoring and PPE tables

Revisions Approved By: John Culley/SPK **Date: March 4, 2014**

Revisions

Revisions Made By: Rueben Greer/SPK **Date:** July 2014

Description of Revisions to Plan: Updated tasks, client contact, hazards/controls, SC-HW, and PPE table

Revisions Approved By: John Culley/SPK **Date: July 21, 2014**

Revisions

Revisions Made By: Cameron Irvine/SPK **Date:** April 2016

Description of Revisions to Plan: Updated tasks, 3rd-party contractors, hazards/controls, SC-HW, and PPE table

Revisions Approved By: **John Culley/SPK** **Date: April 15, 2016**

Revisions

Revisions Made By: Kelly O'Neal/SAC **Date:** April 2018

Description of Revisions to Plan: Updated tasks, hazards/controls, emergency contacts, and various tables

Revisions Approved By: **John Culley/SPK** **Date: April 9, 2018**

Project HS&E Change Management Form

*This evaluation form should be reviewed on a **continuous** basis to determine if the current site health and safety plan adequately addresses ongoing project work, and should be completed whenever new tasks are contemplated or changed conditions are encountered..*

Project Task:	
Project Number:	Project/Task Manager:
Name:	Employee #:

	Evaluation Checklist	Yes	No
1.	Have the CH2MHILL staff listed in the original HSP/FSI changed?		
2.	Has a new subcontractor been added to the project?		
3.	Is any chemical or product to be used that is not listed in Attachment 2 of the plan?		
4.	Have additional tasks been added to the project which were not originally addressed in the plan?		
5.	Have new contaminants or higher than anticipated levels of original contaminants been encountered?		
6.	Have other safety, equipment, activity or environmental hazards been encountered that are not addressed in the plan?		

If the answer is "YES" to Question 3, an HSP/FSI revision is NOT needed. Please take the following actions:

- Add the chemical to Attachment 2, and ensure employees handling the chemical are trained, and training documentation is added to Attachment 3.

If the answer is "YES" to Questions 1, 2 or 4-6, an HSP/FSI revision MAY BE NEEDED. Please contact HS&E directly.

Emergency Contacts

24-hour CH2M Injury Reporting– 1-855-328-6547
24-hour CH2M Serious Incident Reporting Contact – 720-286-4911

Medical Emergency – 911 **Facility Medical Response #:** **Local Ambulance #:**	**JacobsCare@Work – Injury Reporting** 855-328-6547 For non-life-threatening injuries, call your Supervisor, Health and Safety Manager, and then JacobsCare@Work. See Hospital and Occupational Clinic.
Local Medical Clinic	**Global Environmental Solutions – Health, Safety & Environment** Name: Angelo Liberatore 770-335-2076 (cell) or 770-604-9095 x54210 (office)
Fire/Spill Emergency – 911 **Facility Fire Response #:** **Local Fire Dept #:**	**CH2M Responsible Health and Safety Manager (RHSM):** Name: John Culley/SPK Cellular Number: 206/660-3367
Security & Police – 911 **Facility Security #:** **Local Police #:**	**CH2M Human Resources Department** Phone: Employee Connect toll-free number 1-877-586-4411 (U.S. and Canada)
Utilities Emergency Phone Numbers Water: Gas: Electric:	**CH2M Worker's Compensation:** Phone: Employee Connect toll-free number 1-877-586-4411 (U.S. and Canada)
Safety Coordinator (SC-HW) Name: Kelly O'Neal/SAC Phone: 812/371-7476 Name: Rueben Greer/SPK Phone: 509/847-8819 Name: Steve Demus/SPK Phone: 509/ 944-1785 Name: Nathan Williams/PDX Phone: 509/ 999-2292 Name: Mark Endo/SEA Phone: 847/347-6607 Name: Shannon Bartow/PDX Phone: 541/337-4415	**Media Inquiries Corporate Strategic Communications** Name: Lorrie Paul Crum/DEN Phone: 303/525 2916
Project Manager Name: Marilyn Gauthier/PDX Phone: 425/894-6464	**Automobile Accidents:** See Attachment 5
Federal Express Dangerous Goods Shipping Phone: 800/238-5355	**CHEMTEL (hazardous material spills)** Phone: 800-255-3924

Hospital Name/Address: To be determined by the SC-HW once onsite; whether it is Northport or Colville, WA

Hospital Phone #:

Directions to Hospital

Take most direct route; SC-HW will develop hand-written map once onsite.

See map next page

Hospital Route Map

(SC-HW will develop hand-written map once onsite)

Incident Notification and Reporting

- Notify and submit reports to client as required in contract.
- Serious Incidents must be reported in accordance with CH2M Standard of Practice, *Serious Incident Reporting Process,* immediately. Serious incidents are those that involve any of the following:
  - Work related death, or life threatening injury or illness of a CH2M employee, subcontractor, or public
  - Kidnap/missing person
  - Acts or threats of terrorism
  - Event that involves a fire, explosion, or property damage that requires a site evacuation or is estimated to result in greater than $ 500,000 in damage.
  - Spill or release of hazardous materials or substances that involves a significant threat of imminent harm to site workers, neighboring facilities, the community or the environment.

In the event of an emergency, immediately call….. **911.**

  - Severe Bleeding
  - Loss of consciousness
  - Chest Pain
  - Broken bones
- All other injuries or illness' (even those that are minor and may only require First Aid) which occur at work, while on business travel or commute must be reported to your supervisor immediately.
- **After informing their supervisor, the injured employee calls CH2M's contracted Occupational Nurse**.

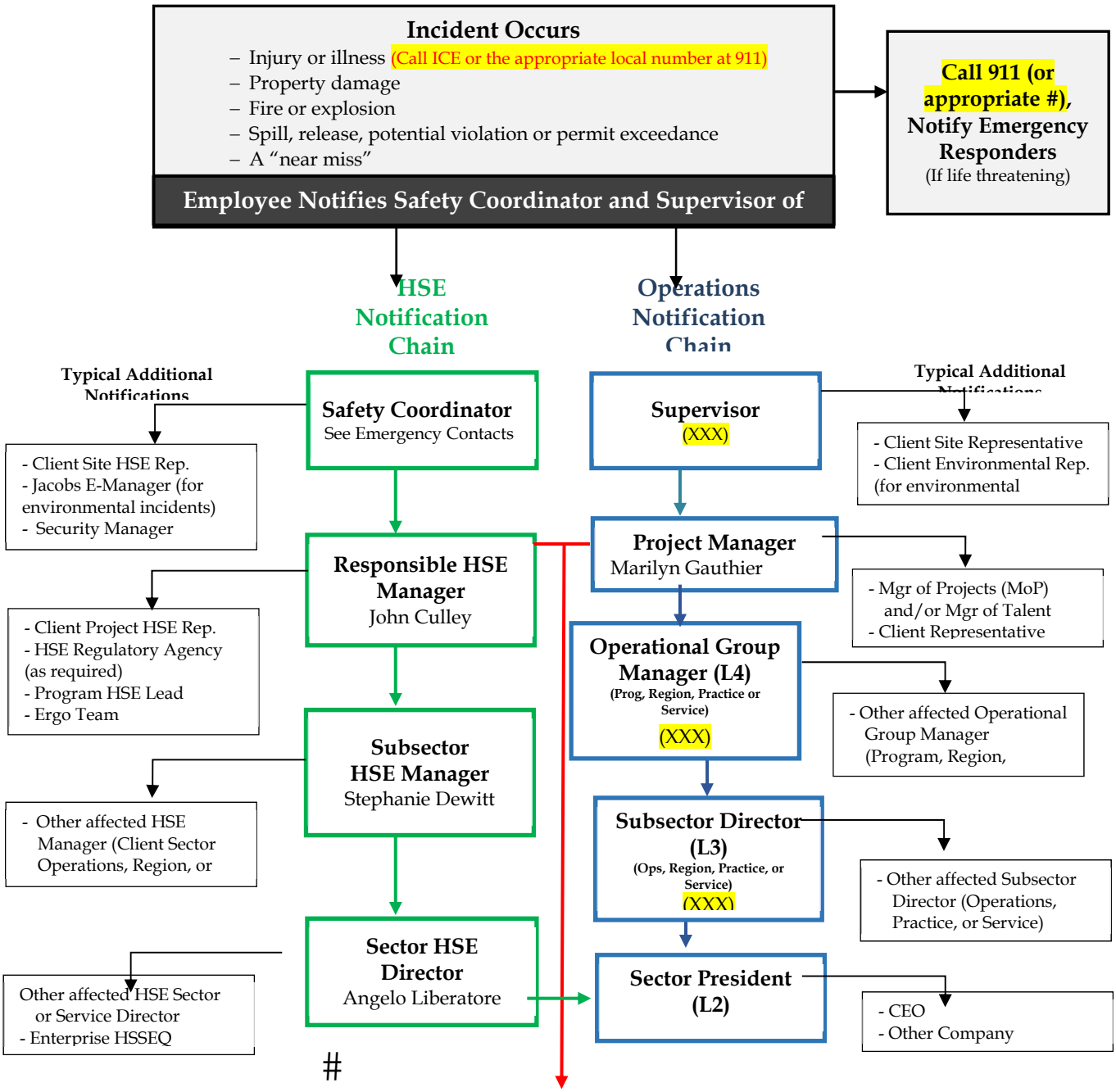
24-hour CH2M Emergency Nurse Assistance

1-855-328-6547

- The Occupational Injury Nurse listens to the injured employee to understand the injury/illness.
- Employee is provided guidance on appropriate treatment options (triage).
- Appropriate treatment details are handled by the Occupational Injury Nurse, and HR Groups.
- Nurse communicates and troubleshoots with and for employee through full recovery.
- Complete a HITS report and notify the HSM.

Verbal Incident Notification *– to be implemented as soon as possible after an incident.*

Verbal incident notification is made to **both the HSE and the Operations chains** to the indicated group depending on the severity, and any project, sector, geographic, or client specific notification and reporting requirements as shown below *(Refer to SOP HSE-111 for additional information)*. After verbal notification, complete a HITS report.



For "Serious Incidents" call the Security Duty Officer at +720 286-4911

(e.g., work related death, kidnapping terrorism, property damage in excess of $500,000, spill with significant threat, etc. ***Refer to SOP HSE-111 for additional***

Third Party Incidents –

Incidents outside of our contractual obligations do not need to be reported UNLESS they are serious and may adversely affect Jacobs, our clients, or project work. The Project and Sector HSE Managers will determine the level of

1.0 Introduction

1.1 CH2M Policy and Commitment

1.1.1 Safe Work Policy

It is the policy of CH2M to perform work in the safest manner possible. Safety must never be compromised. To fulfill the requirements of this policy, an organized and effective safety program must be carried out at each location where work is performed.

CH2M believes that all injuries are preventable, and we are dedicated to the goal of a safe work environment. To achieve this goal, every employee on the project must assume responsibility for safety.

Every employee is empowered to:

Conduct their work in a safe manner;

Stop work immediately to correct any unsafe condition that is encountered; and

Take corrective actions so that work may proceed in a safe manner.

Safety, occupational health, and environmental protection will not be sacrificed for production. These elements are integrated into quality control, cost reduction, and job performance, and are crucial to our success.

1.1.2 Health and Safety Commitment

CH2M has embraced a philosophy for health and safety excellence. The primary driving force behind this commitment to health and safety is simple: employees are CH2M's most significant asset and CH2M management values their safety, health, and welfare. Also, top management believes that all injuries are preventable. CH2M's safety culture empowers employees at all levels to accept ownership for safety and take whatever actions are necessary to eliminate injury. Our company is committed to world-class performance in health and safety and also understands that world-class performance in health and safety is a critical element in overall business success.

CH2M is committed to the prevention of personal injuries, occupational illnesses, and damage to equipment and property in all of its operations; to the protection of the general public whenever it comes in contact with the Company's work; and to the prevention of pollution and environmental degradation.

Company management, field supervisors, and employees plan safety into each work task in order to prevent occupational injuries and illnesses. The ultimate success of CH2M's safety program depends on the full cooperation and participation of each employee.

CH2M management extends its full commitment to health and safety excellence.

1.1.3 Project-Specific Health, Safety, and the Environment Goals

All management and employees are to strive to meet the project-specific Health, Safety, and the Environment (HSE) goals outlined below. The team will be successful only if everyone makes a concerted effort to accomplish these goals. The goals allow the project to stay focused on optimizing the health and safety of all project personnel and, therefore, making the project a great success.

The Project has established eleven specific goals and objectives:

Create an injury-free environment;

Have zero injuries or incidents;

Provide management leadership for HSE by communicating performance expectations, reviewing and tracking performance, and leading by example;

Ensure effective implementation of the HSP through education, delegation, and team work;

Ensure 100 percent participation in HSE compliance;

Continuously improve our safety performance;

Maintain free and open lines of communication;

Make a personal commitment to safety as a value;

Focus safety improvements on high-risk groups;

Continue strong employee involvement initiatives; and

Achieve health and safety excellence.

2.0 Applicability

This HSP applies to:

All CH2M staff, including subcontractors and tiered subcontractors of CH2M working on the site; and

All visitors to the construction site in the custody of CH2M (including visitors from the Client, the Government, the public, and other staff of any CH2M company).

This HSP does not apply to the third-party contractors, their workers, their subcontractors, their visitors, or any other persons not under the direct control or custody of CH2M.

This HSP defines the procedures and requirements for the health and safety of CH2M staff and visitors when they are physically on the work site. The work site includes the project area (as defined by the contract documents) and the project offices, trailers, and facilities thereon.

This HSP will be kept onsite during field activities and will be reviewed as necessary. The HSP will be amended or revised as project activities or conditions change or when supplemental information becomes available. The HSP adopts, by reference, the Enterprise-wide Core Standards and Standard Operating Procedures (SOPs), as appropriate. In addition, the HSP may adopt procedures from the project Work Plan and any governing regulations. If there is a contradiction between this HSP and any governing regulation, the more stringent and protective requirement shall apply.

All CH2M staff and subcontractors must sign the employee sign-off form included in this document as Attachment 1 to acknowledge review of this document. Copies of the signature page will be maintained onsite by the Safety Coordinator (SC).

3.0 General Project Information

3.1 Project Information and Background

PROJECT NO: 350521 or 670274

CLIENT: USEPA

PROJECT/SITE NAME: Upper Columbia River (UCR) RI/FS Oversight and Field Sampling

SITE ADDRESS: Kettle Falls, WA to the US/Canada border

CH2M PROJECT MANAGER: Marilyn Gauthier/PDX

DATE HEALTH AND SAFETY PLAN REVISED: April 2018

Date(s) of Site Work: April 9, 2018 through December 31, 2019

3.2 Site Background and Setting

Pending Superfund site; primarily concerned over mining/milling related impacts to WQ, sediment, and upland wind-blown effects. The largest concerns are the tailings discharges from Cominco smelter in Trail, BC

DESCRIPTION OF SPECIFIC TASKS TO BE PERFORMED: See Sections 3.3.1 and 3.3.2

3.3 Description of Tasks

Refer also to project documents (i.e., Work Plan) for detailed task information. Tasks other than those listed require an approved amendment or revision to this plan before tasks begin. All CH2M and Subcontractor employees engaging in hazardous waste operations (HAZWOPER) or emergency response shall receive appropriate training as required by 29 CFR 1910.120 and 29 CFR 1926.65 (or if required by Subcontract). Personnel who have not met these training requirements shall not be allowed to engage in hazardous waste operations or emergency response activities. See the following tasks that fall under HAZWOPER requirements.

3.3.1 HAZWOPER-Regulated Tasks

- 3rd-party observation of fish, biota, water, sediment, soil, and plant sampling
- Collection of split samples for analysis by EPA laboratory
- Collection of upland sub-surface soil samples from residential properties (using trowels or Terra Core device)

3.3.2 Non-HAZWOPER-Regulated Tasks

Under specific circumstances, the training and medical monitoring requirements of federal or state Hazwoper regulations are not applicable. The following tasks do not involve exposure to safety or health hazards associated with the hazardous waste operations. Hazwoper training or medical requirements do not apply for the tasks listed below.

TASKS	CONTROLS
• Surveying • Site reconnaissance	• Brief on hazards, limits of access, and emergency procedures. • Post areas of contamination as appropriate. • Perform air sampling/monitoring as specified in Section 13.0. • Wear PPE as outlined in Section 14.0

SITE MAP

4.0 Project Organization and Responsibilities

4.1 Client

Contact Name: Kathy Cerise
Phone: 206/553 2589

4.2 CH2M

4.2.1 Project Manager

Name: Marilyn Gauthier/PDX
Phone: 425/894-6464

The project manager (PM) is responsible for providing adequate resources (budget and staff) for project-specific implementation of HSE management process. The PM has overall management responsibility for the tasks listed below. The PM may explicitly delegate specific tasks to other staff, as described in sections that follow, but retains ultimate responsibility for completion of the following in accordance with this document:

Incorporate standard terms and conditions, and contract-specific HSE roles and responsibilities in contract and subcontract agreements (including flow-down requirements to lower-tier subcontractors).

Select safe and competent subcontractors by:

- Choosing potential subcontractors based on technical ability and HSE performance;
- Implementing the subcontractor prequalification process;
- Ensuring that acceptable certificates of insurance, including CH2M as named additional insured, are secured as a condition of subcontract award; and
- Ensuring HSE submittals, subcontract agreements, and appropriate site-specific safety procedures are in place and accepted prior field mobilization.

Ensure copies of training and medical monitoring records, and site-specific safety procedures are being maintained in the project file accessible to site personnel.

Provide oversight of subcontractor HSE practices per the site-specific safety plans and procedures.

Manage the site and interfacing with 3rd parties in a manner consistent with the contract and subcontract agreements and the applicable standard of reasonable care.

Ensure that the overall, job-specific, HSE goals are fully and continuously implemented.

Provide visible support and motivation for HSE programs, rules, procedures, processes, and training, leading by example and encouraging CH2M employees to take ownership of HSE issues.

Intervene or stop work when an unsafe condition or behavior is observed, and/or when an environmentally compromising condition is encountered.

Make available to and require CH2M employees to complete required HSE training within established timelines and provide project numbers for such training.

Consistently and even-handedly enforce HSE rules, procedures, and requirements at the office and/or on project work sites.

Promptly report all work-related HSE incidents or near misses.

Wear any required personal protective equipment.

Ensure CH2M employees complete required HSE training within established timelines.

Consult with the Human Resources Delivery Partner before taking any disciplinary action (other than verbal counseling) associated with CH2M Policy 203 and/or HSE programs rules, procedures, processes and training.

4.2.2 CH2M Responsible Health and Safety Manager

RHSM Name: John Culley/SPK
Cellular Number: 206/660-3367

The RHSM is responsible for the following:

Review and evaluate subcontractor HSE performance using the pre-qualification process;

Approve HSP and its revisions as well as Activity Hazard Analyses (AHA);

Review and evaluate subcontractor site-specific safety procedures for adequacy prior to start of subcontractor's field operations;

Support the oversight (or SC's direct oversight) of subcontractor and tiered subcontractor HSE practices;

Permit upgrades and downgrades in respiratory protection after reviewing analytical data;

Conduct audits as determined by project schedule and coordination with PM; and

Participate in incident investigations, lessons learned, loss and near loss reporting.

4.2.3 CH2M Project Environmental Manager

EM Name: Laura Brooks/DEN
Cellular Number: 303/994-5279

The Project EM is responsible for the following:

Provide environmental program support in areas such as training, auditing, planning, permit tracking, and subcontractor oversight as needed or as specified in the project environmental plan;

Review and evaluate qualifications for subcontractors with a history of environmental non-compliance and for waste transportation and disposal subcontractors;

Evaluate any spills, releases, or environmental permit incidents for appropriate follow-up actions, notifications, and recordkeeping requirements; and

Provide environmental compliance and environmental management expertise and advice to the project team as needed during the course of the project.

4.2.4 CH2M Safety Coordinator

Name: Kelly O'Neal/SAC
Phone: 812/371-7476
Name: Rueben Greer/SPK
Phone: 509/847-8819
Name: Steve Demus/SPK
Phone: 509/ 944-1785
Name: Nathan Williams/PDX
Phone: 509/ 999-2292
Name: Mark Endo/SEA
Phone: 847/347-6607
Name: Shannon Bartow/PDX
Phone: 541/337-4415

The SC is responsible for verifying that the project is conducted in a safe manner including the following specific obligations:

Verify this HSP is current and amended when project activities or conditions change;

Verify CH2M site personnel and subcontractor personnel read the HSP and sign the Employee Sign-Off Form, prior to commencing field activities;

Verify CH2M site personnel have completed any required specialty training (for example, fall protection, confined space entry, among others) and medical surveillance as identified in this HSP;

Verify that project files include copies of subcontractor training and medical monitoring records, and accepted site-specific safety procedures prior to start of subcontractor's field operations;

Act as the project "Hazard Communication Coordinator" and perform the responsibilities outlined in the HSP;

Act as the project "Emergency Response Coordinator" and perform the responsibilities outlined in the HSP;

Hold and/or verify that safety meetings are conducted and documented in the project file initially and as needed throughout the course of the project (as tasks or hazards change);

Verify that project health and safety forms and permits are being used as outlined this HSP;

Perform oversight and assessments of subcontractor HSE practices per the site-specific safety plan and verify that project activity self-assessment checklists are being used as outlined this HSP;

Coordinate with the RHSM regarding CH2M and subcontractor operational performance, and 3rd party interfaces;

Verify appropriate personal protective equipment (PPE) use, availability, and training;

Ensure that the overall, job-specific, HSE goals are fully and continuously implemented;

Conduct accident investigations including root cause analysis;

Calibrate and conduct air monitoring in accordance with the HSP; maintain all air monitoring records in project file;

Maintain HSE records and documentation;

Facilitate OSHA or other government agency inspections including accompanying inspector and providing all necessary documentation and follow-up;

Deliver field HSE training as needed based on project-specific hazards and activities;

Consistently enforce HSE rules, procedures, and requirements at the office and/or on project work sites;

Wear any required personal protective equipment;

Conduct, cooperate, or assist with HSE incident investigations;

Contact the PM and RHSM when standards of conduct or CH2M Policy 203 has been violated by a CH2M employee;

Contact the RHSM and PM in the event of an incident;

When an apparent imminent danger exists, immediately remove all affected CH2M employees and subcontractors, notify subcontractor safety representative, stop affected work until adequate corrective measures are implemented, and notify the PM and RHSM as appropriate; and

Document all oral health and safety-related communications in project field logbook, daily reports, or other records.

4.3 CH2M Subcontractors

(Reference CH2M SOP HSE-215, *Contracts and Subcontracts)*

Subcontractor: E2 Consulting Engineers
Subcontractor Contact Name:
Telephone:

Subcontractor Tasks: Sample transportation, documentation, and shipping
Safety Procedures Required: Must fully comply with our HSP

Subcontractors must comply with the following activities, and are responsible to:

Comply with all local, state, and federal safety standards;

Comply with project and owner safety requirements;

Actively participate in the project safety program and either hold or attend and participate in all required safety meetings;

Provide a qualified safety representative to interface with CH2M;

Maintain safety equipment and PPE for their employees;

Maintain and replace safety protection systems damaged or removed by the subcontractor's operations;

Notify the SC of any accident, injury, or incident (including spills or releases) immediately and submit reports to CH2M within 24 hours;

Install contractually required general conditions for safety (for example, handrail, fencing, fall protection systems, floor opening covers);

Conduct and document weekly safety inspections of project-specific tasks and associated work areas;

Conduct site-specific and job-specific training for all subcontractor employees, including review of the CH2M HSP, subcontractor HSPs, and subcontractor AHAs and sign appropriate sign-off forms; and

Determine and implement necessary controls and corrective actions to correct unsafe conditions.

The subcontractors listed above may be required to submit their own site-specific HSP and other plans such as lead or asbestos abatement compliance plans. Subcontractors are responsible for the health and safety procedures specific to their work, and are required to submit their plans to CH2M for review and acceptance before the start of field work.

Subcontractors are also required to prepare AHAs before beginning each activity posing hazards to their personnel. The AHA shall identify the principle steps of the activity, potential health and safety hazards for each step and recommended control measures for each identified hazard. In addition, a listing of the equipment to be used to perform the activity, inspection requirements, and training requirements for the safe operation of the equipment listed must be identified.

4.4 Employee Responsibilities

All personnel are assigned responsibility for safe and healthy operations. This concept is the foundation for involving all employees in identifying hazards and providing solutions. For any operation, individuals have full authority to stop work and initiate immediate corrective action or control. In addition, each worker has a right and responsibility to report unsafe conditions or practices. This right represents a significant facet of worker empowerment and program ownership. Through shared values and a belief that all accidents are preventable, our employees accept personal responsibility for working safely.

Each employee is responsible for the following performance objectives:

Understanding and abiding by CH2M and client HSE programs, rules, procedures, processes, and training, including any that are project-specific;

Completing all required HSE training made available and accessible within established timelines;

Always wearing any required personal protective equipment;

Intervening or stopping work for you or other CH2M employees when an unsafe condition or behavior is encountered or observed, and/or when an environmentally compromising condition exists;

Promptly notifying a supervisor, PM, SC, or RHSM when an unsafe condition or behavior is observed, and/or when an environmentally compromising condition exists;

Promptly reporting a supervisor, PM, SC, or RHSM all work-related health, safety , and environmental incidents or near misses;

Attending required project HSE pre-task briefings and meeting prior to performing work; and

Cooperating or assisting with HSE incident investigations.

4.4.1 Employee Authority

Each employee on the project has the obligation and authority to shut down any perceived unsafe work and during employee orientation, each employee will be informed of their authority to do so.

4.5 3rd-party Contractors

(Reference CH2M SOP HSE-215, *Contracts, Subcontracts and HSE Management Practices*)

Contractor: Gravity Consulting, LLC
Contractor Contact Name: Sean Hinz
Telephone: 425/281-1471
Contractor Tasks: Watercraft operations

Contractor: Columbia Navigation
Contractor Contact Name: Eric Weatherman
Telephone: 509/680-4335
Contractor Tasks: Watercraft operations

Contractor: AECOM

Contractor Contact Name: Telephone:	PM and shore-based coordinator – Dr. Jennifer Pretare, 510-681-6401 Field Supervisor #1 (RV Tieton) – Michelle Stegner, 503-310-0087 Field Supervisor #2 (RV Mazama) – Glen Mejia, 503-962-9007 Relief Field Supervisor #3 (RV Tieton) – Kim Anderson, 206-353-0414

Contractor Tasks: Biota, fish, sediment, soil, water, and plant sampling; watercraft operations

This HSP does not cover contractors that are contracted directly to the client or the owner. CH2M is not responsible for the health and safety or means and methods of the contractor's work, and we must never assume such responsibility through our actions (such as advising on health and safety issues). In addition to these instructions, CH2M team members should review contractor safety plans so that we remain aware of appropriate precautions that apply to us. Self-assessment checklists are to be used by the SC and CH2M team members to review the contractor's performance only as it pertains to evaluating CH2M exposure and safety. The RHSM is the only person who is authorized to comment on or approve contractor safety procedures.

Health and safety-related communications with contractors should be conducted as follows:

Request the contractor to brief CH2M team members on the precautions related to the contractor's work;

When an apparent contractor non-compliance or unsafe condition or practice poses a risk to CH2M team members:

- Notify the contractor safety representative;
- Request that the contractor determine and implement corrective actions;

- If necessary, stop affected CH2M work until contractor corrects the condition or practice; and
- Notify the client, PM, and RHSM as appropriate.

If apparent contractor non-compliance or unsafe conditions or practices are observed, inform the contractor safety representative (CH2M's obligation is limited strictly to informing the contractor of the observation; the contractor is solely responsible for determining and implementing necessary controls and corrective actions).

If an apparent imminent danger is observed, immediately warn the contractor employee(s) in danger and notify the contractor safety representative (CH2M's obligation is limited strictly to immediately warning the affected individual(s) and informing the contractor of the observation; the contractor is solely responsible for determining and implementing necessary controls and corrective actions).

All verbal health and safety-related communications will be documented in project field logbook, daily reports, or other records.

5.0 Standards of Conduct

All individuals associated with this project must work injury-free and drug-free and must comply with the following standards of conduct, the HSP, and the safety requirements of CH2M. Commonly accepted standards of conduct help maintain good relationships between people. They promote responsibility and self-development. Misunderstandings, frictions, and disciplinary action can be avoided by refraining from thoughtless or wrongful acts.

5.1 Standards of Conduct Violations

All individuals associated with this project are expected to behave in a professional manner. Violations of the standards of conduct would include, but not be limited to:

Failure to perform work;

Inefficient performance, incompetence, or neglect of work;

Willful refusal to perform work as directed (insubordination);

Negligence in observing safety regulations, poor housekeeping, or failure to report on-the-job injuries or unsafe conditions;

Unexcused or excessive absence or tardiness;

Unwillingness or inability to work in harmony with others;

Discourtesy, irritation, friction, or other conduct that creates disharmony;

Harassment or discrimination against another individual;

Failure to be prepared for work by wearing the appropriate construction clothing or bringing the necessary tools; or

Violation of any other commonly accepted reasonable rule of responsible personal conduct.

5.2 Disciplinary Actions

The Environmental Services (ES) business group employees, employees working on ES business group projects, and subcontractor employees are subject to disciplinary action for not following HSE rules and requirements. Potential disciplinary action is equally applicable to all employees including management and supervision. Disciplinary action may include denial of access to the worksite, warnings, reprimands, and other actions up to and including termination depending on the specific circumstances.

5.3 Subcontractor Safety Performance

CH2M should continuously endeavor to observe subcontractors' safety performance and adherence to their plans and AHAs. This endeavor should be reasonable, and include observing for hazards or unsafe practices that are both readily observable and occur in common work areas. CH2M is not responsible for exhaustive observation for hazards and unsafe practices. CH2M oversight does not relieve subcontractors of their responsibility for effective implementation and compliance with the established plan(s).

5.3.1 Observed Hazard Form

When apparent non-compliance or unsafe conditions or practices are observed, notify the subcontractor's supervisor or safety representative verbally, and document using the Observed Hazard Form, included as an attachment to this HSP, and require corrective action.

If necessary, stop subcontractor's work using the Stop Work Order Form until corrective actions is implemented for observed serious hazards or conditions. Update the Observed Hazard Form to document corrective actions have been taken. The subcontractor is responsible for determining and implementing necessary controls and corrective actions.

5.3.2 Stop Work Order

CH2M has the authority, as specified in the contract, and the responsibility to stop work in the event any CH2M employee observes unsafe conditions or failure of the subcontractor to adhere to its safe-work practices, or observes a condition or practice that may result in a release or violation of an environmental requirement. This authority and action does not in any way relieve the subcontractor of its responsibilities for the means and methods of the work or, therefore, of any corrective actions. Failure to comply with safe work practices can be the basis for restriction or removal of the subcontractor staff from the job site, termination of the subcontract, restriction from future work, or all three.

When an apparent imminent danger is observed, immediately stop work and alert all affected individuals. Remove all affected CH2M employees and subcontractor staff from the danger, notify the subcontractor's supervisor or safety representative, and do not allow work to resume until adequate corrective measures are implemented. Notify the PM, Contract Administrator (KA) and RHSM.

When repeated non-compliance or unsafe conditions are observed, notify the subcontractor's supervisor or safety representative and stop affected work by completing and delivering the Stop Work Order Form (attached to this HSP) until adequate corrective measures are implemented. Consult the KA to determine what the contract dictates for actions to pursue in event of subcontractor non-compliance including work stoppage, back charges, progress payments, removal of subcontractor manager, monetary penalties, or termination of subcontractor for cause.

5.4 Incentive Program

Each project is encouraged to implement a safety incentive program that rewards workers for exhibiting exemplary safety behaviors. Actions that qualify are those that go above and beyond what is expected. Actions that will be rewarded include spotting and correcting a hazard, bringing a hazard to the attention of your foreman, telling your foreman about an incident, coming up with a safer way to get the work done, or stopping a crew member from doing something unsafe. The program will operate throughout the project, covering all workers. The incentive program will be communicated to all employees during the project employee orientation and project safety meetings.

5.5 Reporting Unsafe Conditions/Practices

Responsibility for effective health and safety management extends to all levels of the project and requires good communication between employees, supervisors, and management. Accident prevention requires a pro-active policy on near misses, close calls, unsafe conditions, and unsafe practices. All personnel must report any situation, practice, or condition which might jeopardize the

safety of our projects. All unsafe conditions or unsafe practices will be corrected immediately. CH2M has zero tolerance of unsafe conditions or unsafe practices.

No employee or supervisor will be disciplined for reporting unsafe conditions or practices. Individuals involved in reporting the unsafe conditions or practices will remain anonymous.

The following reporting procedures will be followed by all project employees:

Upon detection of any unsafe condition or practice, the responsible employee will attempt to safely correct the condition;

The unsafe condition or practice will be brought to the attention of the worker's direct supervisor, unless the unsafe condition or practice involves the employee's direct supervisor. If so, the SC needs to be notified at once by the responsible employee;

Either the responsible employee or responsible employee's direct supervisor is responsible for immediately reporting the unsafe condition or practice to the SC;

The SC will act promptly to correct the unsafe condition or practice; and

Details of the incident or situation will be recorded by the SC in the field logbook or use the Observed Hazard Form if subcontractor was involved.

6.0 Safety Planning and Change Management

6.1 Daily Safety Meetings and Pre-Task Safety Plans

Daily safety meetings are to be held with all project personnel in attendance to review the hazards posed and required HSE procedures and AHAs that apply for each day's project activities. The Pre-Task Safety Plans (PTSPs) serve the same purpose as these general assembly safety meetings, but the PTSPs are held between the crew supervisor and their work crews to focus on those hazards posed to individual work crews.

At the start of each day's activities, the crew supervisor completes the PTSP, provided as an attachment to this HSP, with input from the work crew, during their daily safety meeting. The day's tasks, personnel, tools and equipment that will be used to perform these tasks are listed, along with the hazards posed and required HSE procedures, as identified in the HSP and AHA. The use of PTSPs promotes worker participation in the hazard recognition and control process while reinforcing the task-specific hazard and required HSE procedures with the crew each day.

6.2 Change Management

This HSP addresses all known activities and associated hazards. As work progresses, if significant changes are identified which could affect health and safety at the site, coordinate with the RHSM to determine whether a HSP update is necessary.

The following are examples of changes that may require a revision to the plan:

Change in CH2M staff;

New subcontractor to perform work;

New chemicals brought to site for use;

Change in scope or addition of new tasks;

Change in contaminants of concern (COCs) or change in concentrations of COCs; and

New hazards or hazards not previously identified that are not addressed in this HSP.

6.3 Agency Inspection Guidance

(Reference CH2M SOP HSE-201, *Agency Inspections and Communications*)

Agency inspections (e.g., OSHA, EPA, other regulatory agencies) are on the rise. CH2M implements safety and environmental programs in order to ensure safety to workers, the public, and the environment. This plan addresses things like labeling containers, completing the hazard communication training using the attachments to this HSP, listing training requirements and PPE requirements, and addressing project-specific hazards. Field personnel need to contact the RHSM to update this plan if hazards are encountered that are not addressed.

SOP HSE-201 addresses agency inspections in detail, and the attached **Target Zero Bulletin on Agency Inspections** provides a good summary of the inspection process and what to do if an agency such as OSHA or EPA shows up at the site. It is critical to make immediate notification to the RHSM if an inspector arrives (and EM if it is environmental-related); they can help facilitate and make additional notifications.

Review the Target Zero Bulletin and keep it with your Health and Safety Plan/Environmental Plan. Make it a topic at a safety meeting and keep it readily available in the event of an inspection.

7.0 Project Hazard Analysis

A health and safety risk analysis (Table 1) has been performed for each task. In the order listed below, the RHSM considers the various methods for mitigating the hazards. Employees are trained on this hierarchy of controls during their hazardous waste training and reminded of them throughout the execution of projects:

Elimination of the hazards (use remote sampling methodology to avoid going into a confined space);

Substitution (reduce exposure to vapors by using of a geoprobe instead of test pitting);

Engineering controls (ventilate a confined space to improve air quality);

Warnings (establish exclusion zones to keep untrained people away from hazardous waste work);

Administrative controls (implement a work-rest schedule to reduce chance of heat stress); or

Use of PPE (use of respirators when action levels are exceeded).

The hazard controls and safe work practices are summarized in the following sections of this HSP:

General hazards and controls;

Project-specific hazards and controls;

Physical hazards and controls;

Biological hazards and controls; and

Contaminants of concern.

7.1 Activity Hazard Analysis

An AHA must be developed for each CH2M job activity. The AHA shall define the work tasks required to perform each activity, along with potential HSE hazards and recommended control measures for each hazard. In addition, a listing of the equipment to be used to perform the activity, inspection requirements to be performed and training requirements for the safe operation of the equipment listed must be identified. Workers are briefed on the AHA before performing the work and their input is solicited prior, during, and after the performance of work to further identify the hazards posed and control measures required. The AHA shall identify the work tasks required to perform each activity, along with potential HSE hazards and recommended control measures for each hazard.

The following hazard controls and applicable CH2M core standards and SOPs should be used as a basis for preparing AHAs.

AHAs prepared for CH2M activities are included as an attachment to this HSP.

7.2 Subcontractor Activity Hazard Analysis

CH2M subcontractors are required to provide AHAs specific to their scope of work on the project for acceptance by CH2M. Each subcontractor shall submit AHAs for their field activities, as defined in their scope of work, along with their project-specific safety plan and procedures. Additions or changes in field activities, equipment, tools, or material used to perform work or hazards not addressed in existing AHAs requires either a new AHA to be prepared or an existing AHA to be revised.

Table 1 – General Activity Hazard Analysis

Project Activity / Potential Hazard	3rd-party Observation of Fish, Biota, Water, Sediment, Soil, and Plant Sampling	Surveying, Site Reconnaissance	Collection of Split Samples	Collection of Sub-Surface Soil Samples
Biological Hazards	X	X	X	X
Blood Borne Pathogens	X	X	X	X
Chemical Hazard	X		X	X
Driving	X	X	X	X
Electrical Safety	X	X	X	
Field Vehicles	X	X	X	X
Fire Prevention	X	X	X	
Hand & Power Tools	X	X	X	X
Hazard Communication	X		X	X
Ladder Safety	X	X	X	
Lighting	X	X	X	X
Manual Lifting	X	X	X	X
Noise	X	X	X	
Boating Safety	X	X	X	
Temperature Extremes	X	X	X	X
Ultraviolet Light exposure (sunburn)	X	X	X	X
Underground utilities				X

8.0 General Hazards and Controls

This section provides safe work practices and control measures used to reduce or eliminate potential hazards. It is a summarized list of requirements. Always consult the appropriate CH2M SOP to ensure all requirements are implemented.

8.1 Bloodborne Pathogens

(Reference CH2M SOP HSE-202, *Bloodborne Pathogens*)

Exposure to bloodborne pathogens may occur when rendering first aid or cardiopulmonary resuscitation (CPR), or when coming into contact with landfill waste or waste streams containing potentially infectious material (PIM).

Employees trained in first-aid/CPR or those exposed to PIM must complete CH2M's 1-hour bloodborne pathogens computer-based training module annually. When performing first-aid/CPR the following shall apply:

Observe universal precautions to prevent contact with blood or other PIMs. Where differentiation between body fluid types is difficult or impossible, consider all body fluids to be potentially infectious materials;

Always wash your hands and face with soap and running water after contacting PIMs. If washing facilities are unavailable, use an antiseptic cleanser with clean paper towels or moist towelettes; and

If necessary, decontaminate all potentially contaminated equipment and surfaces with chlorine bleach as soon as possible. Use one part chlorine bleach (5.25 percent sodium hypochlorite solution) diluted with 10 parts water for decontaminating equipment or surfaces after initially removing blood or other PIMs. Remove contaminated PPE as soon as possible before leaving a work area.

- CH2M will provide exposed employees with a confidential medical examination should an exposure to PIM occur. This examination includes the following procedures:

Documenting the exposure;

Testing the exposed employee's and the source individual's blood (with consent); and

Administering post-exposure prophylaxis.

8.2 Driving Safety

Refrain from using a cellular phone while driving. Pull off the road, put the vehicle in park and turn on flashers before talking on a cellular phone;

Never operate a personal digital assistant (PDA), or other device with e-mail, internet, or text messaging function while driving a vehicle;

Obey speed limits; be aware of blind spots or other hazards associated with low visibility. Practice defensive driving techniques, such as leaving plenty of room between your vehicle and the one ahead of you;

Do no drive while drowsy. Drowsiness can occur at any time, but is most likely after 18 hours or more without sleep;

Maintain focus on driving. Eating, drinking, smoking, adjusting controls can divert attention from the road. Take the time to park and perform these tasks when parked rather than while driving; and

Ensure vehicle drivers are familiar with the safe operation of vehicles of the type and size to be operated. Large vehicles such as full size vans and pick-ups have different vision challenges and handling characteristics than smaller vehicles.

8.3 Electrical Safety

(Reference CH2M SOP HSE-206, *Electrical Safety*)

Below are the hazard controls and safe work practices to follow when using electrical tools, extension cords, and/or other electrical-powered equipment or when exposed to electrical hazards. Ensure the requirements of the referenced SOP are followed:

Only qualified personnel are permitted to work on unprotected energized electrical systems;

Only authorized personnel are permitted to enter high-voltage areas;

CH2M employees who might from time to time work in an environment influenced by the presence of electrical energy must complete Awareness Level Electrical Safety Training located on the CH2M VO;

Do not tamper with electrical wiring and equipment unless qualified to do so. All electrical wiring and equipment must be considered energized until lockout/tagout procedures are implemented;

Inspect electrical equipment, power tools, and extension cords for damage prior to use. Do not use defective electrical equipment, remove from service;

CH2M has selected Ground Fault Circuit Interrupters (GFCIs) as the standard method for protecting employees from the hazards associated with electric shock;

- GFCIs shall be used on all 120-volt, single phase 15 and 20-amphere receptacle outlets which are not part of the permanent wiring of the building or structure.

An assured equipment grounding conductor program may be required under the following scenarios:

- GFCIs cannot be utilized;
- Client requires such a program to be implemented; or
- Business group decides to implement program in addition to GFCI protection.

Extension cords must be equipped with third-wire grounding. Cords passing through work areas must be covered, elevated or protected from damage. Cords should not be routed through doorways unless protected from pinching. Cords should not be fastened with staples, hung from nails, or hung with wire;

Electrical power tools and equipment must be effectively grounded or double-insulated and Underwriters Laboratory (UL) approved;

Operate and maintain electric power tools and equipment according to manufacturers' instructions;

Maintain safe clearance distances between overhead power lines and any electrical conducting material unless the power lines have been de-energized and grounded, or where insulating barriers have been installed to prevent physical contact. Maintain at least 10 feet (3 meters) from overhead power lines for voltages of 50 kV or less, and 10 feet (3 meters) plus 0.4 inches (1.0 cm) for every 1 kV over 50 kV;

Temporary lights shall not be suspended by their electric cord unless designed for suspension. Lights shall be protected from accidental contact or breakage; and

Protect all electrical equipment, tools, switches, and outlets from environmental elements.

8.4 Field Vehicles

Field vehicles may be personal vehicles, rental vehicles, fleet vehicles, or project vehicles.

Maintain a first aid kit, bloodborne pathogen kit, and fire extinguisher in the field vehicle at all times.

Utilize a rotary beacon on vehicle if working adjacent to active roadway.

Familiarize yourself with rental vehicle features prior to operating the vehicle:

- Vision Fields and Blind Spots
- Vehicle Size
- Mirror adjustments
- Seat adjustments
- Cruise control features, if offered
- Pre-program radio stations and Global Positioning System (GPS), if equipped

Always wear seatbelt while operating vehicle.

Adjust headrest to proper position.

Tie down loose items if utilizing a van or pick-up truck.

Close car doors slowly and carefully. Fingers can get pinched in doors.

Park vehicle in a location easily accessed in the event of an emergency. If not possible, carry a phone.

Have a designated place for storing the field vehicle keys when not in use.

Ensure back-up alarms are functioning, if equipped. Before backing a vehicle, take a walk around the vehicle to identify obstructions or hazards. Use a spotter when necessary to back into or out of an area.

See the Vehicle Accident Guidance attached to this HSP, if a vehicle incident is experienced in a rental or fleet vehicle.

8.5 Fire Prevention

(Reference CH2M SOP HSE-403, *Hazardous Material Handling*)

Follow the fire prevention and control procedures listed below.

8.5.1 Fire Extinguishers and General Fire Prevention Practices

Fire extinguishers shall be provided so that the travel distance from any work area to the nearest extinguisher is less than 100 feet (30.5 meters). When 5 gallons (19 liters) or more of a flammable or combustible liquid is being used, an extinguisher must be within 50 feet (15.2 meters). Extinguishers must:

- be maintained in a fully charged and operable condition;
- be visually inspected each month; and
- undergo a maintenance check each year.

The area in front of extinguishers must be kept clear.

Combustible materials stored outside should be at least 10 feet (3 meters) from any building.

Solvent waste and oily rags must be kept in a fire resistant, covered container until removed from the site.

Keep areas neat. Housekeeping is important.

8.5.2 Dispensing of Flammable/Combustible Liquids

Areas in which flammable or combustible liquids are dispensed in quantities greater than 5 gallons (22.7 liters) (shall be separated from other operations by at least 25 feet (7.6 meters).

Drainage away from storm drains or surface waters or other means of containment shall be provided to control spills.

Adequate natural or mechanical ventilation shall be provided to maintain the concentration of flammable vapor at or below 10 percent of the lower flammable limit.

Dispensing of flammable liquids from one container to another shall be done only when containers are electrically interconnected (bonded).

Dispensing flammable or combustible liquids by means of air pressure on the container or portable tanks is prohibited.

Dispensing devices and nozzles for flammable liquids shall be of an approved type.

8.6 General Practices and Housekeeping

The following are general requirements applicable to all portions of the work:

Site work should be performed during daylight hours whenever possible;

Good housekeeping must be maintained at all times in all project work areas;

Common paths of travel should be established and kept free from the accumulation of materials;

Keep access to aisles, exits, ladders, stairways, scaffolding, and emergency equipment free from obstructions;

Provide slip-resistant surfaces, ropes, or other devices to be used;

Specific areas should be designated for the proper storage of materials;

Tools, equipment, materials, and supplies shall be stored in an orderly manner;

As work progresses, scrap and unessential materials must be neatly stored or removed from the work area;

Containers provided for collecting trash and other debris and shall be removed at regular intervals;

All spills shall be quickly cleaned up; oil and grease shall be cleaned from walking and working surfaces;

Review the safety requirements of each job you are assigned to with your supervisor. You are not expected to perform a job that may result in injury or illness to yourself or to others;

Familiarize yourself with, understand, and follow jobsite emergency procedures;

Do not fight or horseplay while conducting the firm's business;

Do not use or possess firearms or other weapons while conducting the firm's business;

Report unsafe conditions or unsafe acts to your supervisor immediately;

Report emergencies, occupational illnesses, injuries, vehicle accidents, and near misses immediately;

Do not remove or make ineffective safeguards or safety devices attached to any piece of equipment;

Report unsafe equipment, defective or frayed electrical cords, and unguarded machinery to your supervisor;

Shut down and lock out machinery and equipment before cleaning, adjustment, or repair. Do not lubricate or repair moving parts of machinery while the parts are in motion;

Do not run in the workplace;

When ascending or descending stairways, use the handrail and take one step at a time;

Do not apply compressed air to any person or clothing;

Do not wear steel taps or shoes with metal exposed to the sole at any CH2M project location;

Do not wear finger rings, loose clothing, wristwatches, and other loose accessories when within arm's reach of moving machinery;

Remove waste and debris from workplace and dispose in accordance with federal, state or local regulations;

Note the correct way to lift heavy objects (secure footing, firm grip, straight back, lift with legs), and get help if needed. Use mechanical lifting devices whenever possible; and

Check the work area to determine what problems or hazards may exist.

8.7 Hazard Communication/GHS

(Reference CH2M SOPs HSE-107, *Hazard Communication* and HSE-403, *Hazardous Material Handling*)

The hazard communication coordinator is to perform the following:

Complete an inventory of chemicals brought on site by CH2M using the chemical inventory form included as an attachment to this HSP;

Confirm that an inventory of chemicals brought on site by CH2M subcontractors is available;

Request or confirm locations of material safety data sheets/safety data sheets (MSDS/SDSs) from the client, contractors, and subcontractors for chemicals to which CH2M employees potentially are exposed;

Before or as the chemicals arrive on site, obtain an MSDS/SDS for each hazardous chemical and include on the chemical inventory sheet (attached to this HSP) and add the MSDS/SDS to the MSDS/SDS attachment section of this HSP;

Label chemical containers with the identity of the chemical and with hazard warnings, and store properly;

Give employees required chemical-specific HAZCOM training using the chemical-specific training form included as an attachment to this HSP; and

Store all materials properly, giving consideration to compatibility, quantity limits, secondary containment, fire prevention, and environmental conditions.

8.8 Knife Use

Open-bladed knives (for example, box cutters, utility knives, pocket knives, machetes, and multi-purpose tools with fixed blades such as a Leatherman™) are prohibited at worksites except where the following three conditions are met:

The open-bladed knife is determined to be the best tool for the job;

An approved Activity Hazard Analysis (AHA) or written procedure is in place that covers the necessary safety precautions (work practices, PPE, and training); and

Knife users have been trained and follow the AHA.

8.9 Lighting

Lighting shall be evaluated when conducting work inside buildings, confined spaces, or other areas/instances where supplemental light may be needed (e.g., work before sunrise or after sunset). A light meter can be used to evaluate the adequacy of lighting. The following are common requirements for lighting and the conditions/type of work being performed:

While work is in progress outside construction areas shall have at least 33 lux (lx);

Construction work conducted inside buildings should be provided with at least 55 lux light;

The means of egress shall be illuminated with emergency and non-emergency lighting to provide a minimum 11 lx measured at the floor. Egress illumination shall be arranged so that the failure of any single lighting unit, including the burning out of an electric bulb will not leave any area in total darkness.

8.10 Personal Hygiene

Good hygiene is essential for personal health and to reduce the potential of cross-contamination when working on a hazardous waste site. Implement the following:

Keep hands away from nose, mouth, and eyes during work;

Keep areas of broken skin (chapped, burned, etc.) covered; and

Wash hands with soap and water prior to eating, smoking, or applying cosmetics.

8.11 Substance Abuse

(Reference CH2M SOP HSE-105, *Drug-Free Workplace)*

Employees who work under the influence of controlled substances, drugs, or alcohol may prove to be dangerous or otherwise harmful to themselves, other employees, clients, the company, the company's assets and interests, or the public. CH2M does not tolerate illegal drug use, or any use of drugs, controlled substances, or alcohol that impairs an employee's work performance or behavior.

Prohibitions onsite include:

Use or possession of intoxicating beverages while performing CH2M work;

Abuse of prescription or nonprescription drugs;

Use or possession of illegal drugs or drugs obtained illegally;

Sale, purchase, or transfer of legal, illegal or illegally obtained drugs; and

Arrival at work under the influence of legal or illegal drugs or alcohol.

- Drug and/or alcohol testing is applicable under CH2M Constructors, Inc. and munitions response projects performed in the United States. In addition, employees may be required to submit to drug and/or alcohol testing as required by clients. When required, this testing is performed in accordance

with SOP HSE-105, Drug-Free Workplace. Employees who are enrolled in drug or alcohol testing are required to complete annual training located on the CH2M Virtual Office (VO).

8.12 Unknown or Suspect Objects/Materials

If unknown or suspect objects/materials are encountered (i.e. exposed or partially buried drums, biological waste, cylinders, munitions of explosive concern, unexpected stained/discolored soil) are encountered during site operations, ongoing activities shall be immediately suspended. CH2M or subcontractor personnel encountering unknown or suspect objects/materials shall:

1) secure the area and identify the location of the object/material to the extent possible, without causing bodily injury to yourself or others and without disturbing the object,

2) evacuate the work area,

3) immediately notify the project manager/HSM of the encountered condition and

4) not provide additional disturbance or otherwise handle the suspect object/material.

The site supervisor or SC shall contact the Project Manager and the HSM to evaluate potential hazards associated with the specific situation encountered. The project team will then address the need for the use of special procedures, engineering controls, PPE or specialized subcontract personnel to safely mitigate the situation.

8.13 Field Ergonomics and Manual Lifting

(Reference CH2M SOP HSE-112, *Manual Lifting*)

Some of the most common injuries during field work are the result of performing work in an awkward body position (poor ergonomics) or pushing the body beyond its natural limits. Workers who have to lift, stoop, kneel, twist, grip, stretch, reach overhead, or work in other awkward positions regularly are at risk of developing discomfort or even an injury. Additionally, back injuries are one of the leading causes of work disability and most back injuries are the result of improper lifting techniques or overexertion.

Contact the RHSM to determine hazard control measures if your task involves:

Repetitive motions;

Lifting and carrying items over long distances or on steep or sloped terrain;

Heavy lifting;

Use of vibrating tools or equipment; or

Being in a static position for extended periods of time;

There are a variety of ergonomically designed tools and work practices that can reduce the potential for discomfort and injury. Following are requirements ("must" or "shall") and recommendations ("should") to aid in the prevention of discomfort or injuries while working in the field.

Fitness for Duty

If manual lifting and repetitive activities are not part of your normal work duties, contact your PM and/or RHSM to help determine if you have the physical capability to perform the work. In many cases adding lifting or repetitive tasks to a subcontractor's scope of work is desirable to prevent injury. If the work task causes any pain or discomfort stop and get assistance.

Manual Lifting

All CH2M workers must have training in proper manual lifting either through New Employee Orientation or through the Manual Lifting module located on the VO;

When possible, the task should be modified to minimize manual lifting hazards or awkward body positions;

Lifting loads weighing more than 40 pounds (18 kilograms) shall be evaluated by the SC using the Lifting Evaluation Form contained in SOP HSE-112;

Personnel shall seek assistance when performing manual lifting tasks that appear beyond physical capabilities.

Using mechanical lifting devices such as forklifts; cranes, hoists, and rigging; hand trucks; and trolleys; is the preferred means of lifting heavy objects;

Work in the Power Zone - The power zone for lifting or working is close to the body, between mid-thigh and mid-chest height. This zone is where arms and back can lift the most with the least amount of effort.

Work near elbow height to avoid bending excessive bending (avoid working above the shoulders and below the knees);

- Plan before carrying:
    - Wear appropriate shoes to avoid slips, trips or falls
    - If you wear gloves, wear gloves that fit. Tight-fitting gloves can put pressure on the hands, while loose-fitting gloves reduce grip strength and pose other safety hazards.
    - Avoid carrying large or bulky loads that limit or obstruct your vision
    - Slide, push, or roll instead of carrying when appropriate
    - When there is a choice, push instead of pull
    - Carry only as much as you can safely handle
    - Try to avoid slopes, stairs, or other obstacles that make carrying materials more difficult
    - Beware of and try to avoid slippery floors (e.g., liquids, ice, oil, and fine powders)
    - Use extra caution when moving loads that may be unstable
- In general, the following steps must be practiced when planning and performing manual lifts:
    - Examine the load and the surrounding area
    - Bend knees when lifting a load
    - Look forward to keep back straight
    - Position the load close to the body
    - Maintain a firm grip on the load
    - Test the load for stability and weight prior to lifting
    - Use smooth, controlled movements
    - Keep arms in front of body
    - Turn feet in direction of movement to avoid twisting

<u>Ergonomic Work Practices</u>

- Avoid repetitive motions, overhead reaching, and kneeling when possible;
- If prolonged awkward postures are unavoidable, use a "supported" posture to compensate; a supported posture uses part of your body to support the weight of another body segment that is in an awkward position;
- Watch your pace—attempting to do something faster can cause you to lose proper form;
- Use a table or move work to a location where you don't have to be in a bent-over position to do your work;
- Where awkward postures or repetitive motions are unavoidable, rotate with another worker, change tasks, stretch, and take short breaks frequently.

9.0 Project-Specific Hazard Controls

This section provides safe work practices and control measures used to reduce or eliminate potential hazards. These practices and controls are to be implemented by the party in control of either the work or the particular hazard. Each person onsite is required to abide by the hazard controls. Always consult the appropriate CH2M SOP to ensure all requirements are implemented. CH2M employees and subcontractors must remain aware of the hazards affecting them regardless of who is responsible for controlling the hazards. CH2M employees and subcontractors who do not understand any of these provisions should contact the RHSM for clarification.

9.1 Boat Safety

- Walk cautiously when wading in water. Always wear waders. Always check depth of water when wading. Avoid entering deep or fast moving water.
- When boating, always properly wear PFDs. Keep weight centered in boat. Avoid sudden shifts in position or weight. Enter and exit the boat cautiously and one at a time.
- When loading/unloading boat from vehicle, avoid carrying and loading in a way the might cause back strain. Walk slowly and carefully when carrying equipment or the canoe.
- Ensure all personnel entering area are briefed of potential hazards prior to entering work area (Safety Manager, Site Manager).
- Do not over-load the boat with personnel, equipment, and supplies.
- Plan path to avoid high angle entry and rock climbing; with the least amount of obstructions.
- Wear high traction safety footwear
- Plan steps before making them
- If stuck in mud, move slowly
- Ensure good grip on boat and balance. Do not stand in boat while boat is in motion.
- Vessel operations will be suspended if skippers judge that weather or current conditions become unsafe.
- Know obstructions and shallows, proceed slowly.
- Boats to be handled by experienced personnel only
- Moor or anchor boats securely when not in use
- Load small craft evenly to avoid listing.
- Counterbalance small craft when pulling equipment or debris out of the water. Keep the vessel as level as possible.
- Keep boat free from tripping hazards.
- Be aware of boat position and movement and communicate with the operator.
- Good Hygiene practices to be used at all times. No eating, drinking, smoking or chewing tobacco if contact with contaminated media is expected.

Boating Safety

Personnel who will operate a boat during the course of a project shall first demonstrate to the site manager that they are experienced in operating boats similar to those used for the project and that they are knowledgeable of the U.S. Coast Guard Boating Safety requirements (33 CFR Subchapter S). Project boats shall be operated by experienced boat operators only. Boat operators shall also possess basic mechanical knowledge necessary to troubleshoot common mechanical problems that can and do occur. The boat operator shall be responsible for the safety of all personnel on board the boat he or she is operating and for the integrity of all boat and safety equipment.

Each designated boat operator shall give a safety briefing to all occupants of the boat prior to leaving the shore. Boats are to be occupied during use by not less than one qualified operator plus one additional person.

The boat skipper has the final authority with regard to boat safety and navigational safety.

Use the attached boat safety checklist to evaluate and verify necessary equipment prior to leaving shore

9.1.1 Boat Requirements

All project boats will meet or exceed U.S. Coast Guard requirements for safety equipment, as applicable to the operation and type of boat. These requirements are summarized below for small craft (less than forty feet [12 meters] in length).

9.1.2 Flame Arresters

All gasoline engines, except outboard motors, installed in a boat must have an approved flame arrestor (backfire preventer) fitted to the carburetor.

9.1.3 Sound Signaling Devices

Boats shall carry at least one air horn or similar sound-signaling device. Radio or cell-phone communication must be in place as well.

9.1.4 Personal Flotation Devices

All personnel and passengers shall wear an approved personal flotation device (PFD) at all times when operating or being transported in a boat. A positively buoyant wet suit or dry suit may be substituted for a PFD. PFDs shall be Type II or higher (capable of turning its wearer in a vertical or slightly backward position in the water). In addition, each boat shall be equipped with at least one Type IV PFD, designed to be thrown to a person in the water and grasped and held by the user until rescued. A buoyant boat cushion equipped with straps and a float ring are two common examples of a Type IV PFD.

9.1.5 Fire Extinguishers

Each boat shall carry at least one Type B-I or B-II fire extinguisher (for use in gasoline, oil and grease fires) approved by Underwriters Laboratories (UL). Each fire extinguisher shall be inspected to ensure that it is sufficiently charged and that the nozzles are free and clear. Discharged fire extinguishers shall be replaced or recharged immediately.

9.1.6 Emergency Planning

As part of the project HSP and AHAs, emergencies and response actions must be addressed for potential emergencies such at fire, sinking, flooding, severe weather, man over-board, hazardous material incidents, etc.

9.1.7 Load Capacity

Boats shall not be loaded (passengers and gear) beyond the weight capacity printed on the U.S. Coast Guard information plate attached to the stern. In addition, several factors must be considered when loading a boat: distribute the load evenly, keep the load low, do not stand up in a small boat or canoe, and do not overload the boat.

9.1.8 Tool Kit

All motorized boats shall carry a tool kit sufficient for the boat operator to troubleshoot common mechanical problems such as fouled spark plugs, flooded carburetor, electrical shorts, etc. Boats operated in remote areas shall also carry appropriate spare parts (propellers, shear pins, patch kits, air pumps, etc). The tool kit shall be maintained by the boat operator and supplies used up shall be replaced immediately.

9.1.9 Communications

All boats operated shall carry a two-way radio or cellular telephone that enables communication back to the field camp or other pre-established location.

9.1.10 Good Housekeeping

Personnel using a boat shall properly stow and secure all gear and equipment against unexpected shifts when underway. Decks and open spaces must be kept clear and free from clutter and trash to minimize slip, trip, and fall hazards.

9.1.11 Fuel Management

Personnel shall utilize the "one-third rule" in boating fuel management. Use one-third of the fuel to get to the destination, one-third to return, and keep one-third in reserve.

No smoking is permitted on board vessels or during refueling operations.

9.1.12 Pollution Control

The Refuse Act of 1989 prohibits the throwing, discharging, or depositing of any refuse matter of any kind (including trash, garbage, oil, and other liquid pollutants) into the waters of the United States. The Federal Water Pollution Control Act prohibits the discharge of oil or hazardous substances in quantities that may be harmful into U.S. navigable waters. No person may intentionally drain oil or oily wastes from any source into the bilge of any vessel. Larger vessels equipped with toilet facilities must be equipped with a U.S. Coast Guard-approved marine sanitation device.

Employees shall report any significant oil spills to water to the _____ who must report the spill to the U.S. Coast Guard or other applicable regulatory agency. The procedure for incident reporting and investigation shall be followed when reporting the spill.

- Use the checklist below to evaluate vessel integrity.

Marine Vessel Checklist		
	Yes	**N/A**
Marine-band radio w/ Channel 16		
Satellite Phone		
Personal Flotation Devices (PFDs)		
Visual Distress Signals		
Anchor and Anchor Line		
Sound-Producing Devices		
Navigation Lights and Shapes		
Fire Extinguishers		
Alternative Propulsion (for example, paddles)		
Overall Vessel Condition Satisfactory		
Marine Sanitation Device		
Navigation Rules		
Ropes and Buoys		
First Aid Kit and Bloodborne Pathogen Kit		
Nonslip Deck		
Personnel Access Ladder		

9.2 Hand and Power Tools

(Reference CH2M, SOP HSE-210, *Hand and Power Tools*)

Below are the hazard controls and safe work practices to follow when personnel or subcontractors are using hand and power tools. Ensure the requirements in the referenced SOP are followed:

Tools shall be inspected prior to use and damaged tools will be tagged and removed from service;

Hand tools will be used for their intended use and operated in accordance with manufacturer's instructions and design limitations;

Maintain all hand and power tools in a safe condition;

Use PPE (such as gloves, safety glasses, earplugs, and face shields) when exposed to a hazard from a tool;

Do not carry or lower a power tool by its cord or hose;

Portable power tools will be plugged into GFCI protected outlets;

Portable power tools will be Underwriters Laboratories (UL) listed and have a three-wire grounded plug or be double insulated;

Disconnect tools from energy sources when they are not in use, before servicing and cleaning them, and when changing accessories (such as blades, bits, and cutters);

Safety guards on tools must remain installed while the tool is in use and must be promptly replaced after repair or maintenance has been performed;

Store tools properly in a place where they will not be damaged or come in contact with hazardous materials;

If a cordless tool is connected to its recharge unit, both pieces of equipment must conform strictly with electrical standards and manufacturer's specifications;

Tools used in an explosive environment must be rated for work in that environment (that is, intrinsically safe, spark-proof, etc.); and

Working with manual or pistol-grip hand tools may involve highly repetitive movement, extended elevation, constrained postures, and/or awkward positioning of body members (e.g., hand, wrist, arm, shoulder, neck, etc.). Consider alternative tool designs, improved posture, the selection of appropriate materials, changing work organization, and sequencing to prevent muscular, skeletal, repetitive motion, and cumulative trauma stressors.

Machine Guarding

Ensure that all machine guards are in place to prevent contact with drive lines, belts, chains, pinch points or any other sources of mechanical injury.

Unplugging jammed equipment will only be performed when equipment has been shut down, all sources of energy have been isolated and equipment has been locked/tagged and tested.

Maintenance and repair of equipment that results in the removal of guards or would otherwise put anyone at risk requires lockout of that equipment prior to work.

9.3 Inclement Weather

- This project may be conducted during months of the year in which severe storms occur at a higher frequency and develop rapidly; especially on the water. Personnel are to take heed of the weather forecast for the day and pay attention for signs of changing weather that indicate an impending storm. Signs include towering thunderheads, darkening skies, or a sudden increase in wind. If stormy

weather ensues, field personnel should discontinue work and seek shelter until the storm has passed.

- Protective measures during a lightning storm include seeking shelter; avoiding projecting above the surrounding landscape (don't stand on a hilltop or stand under a lone tree; seek low areas); staying away from open water, metal equipment, wire fences, and metal pipes; and positioning people several yards apart.
- Remember that lightning may strike several miles from the parent cloud, so work should be stopped/restarted accordingly. If you feel your hair stand on end or smell ozone, lightning may be about to strike you. Immediately drop to your knees and bend forward—**do not** lie flat on the ground.
- Flash floods are also a concern with the high mountains. Pay close attention to thunderstorms in the mountains and be aware of flash flood potential. Look for signs of floodplains.

9.4 Outdoor Safety Tips

- When scheduling daily sampling events, always inform someone as to where you are going, your route, and when you expect to return. **Stick to your plan**.
- Carry enough water for each person, each day of your sampling trips (plastic gallon jugs are handy and portable).
- If caught in a storm, find shelter as soon as possible and report your situation to the Project Manager.
- If your vehicle breaks down:
- Stay near the vehicle. Your emergency supplies are there. A vehicle can be seen for miles, but a person on foot is very difficult to find.
- Keep clothing on and dress in layers.
- If you have water, **drink it**. Do not ration it.
- If water is limited, keep your mouth shut. Do not talk, do not eat, do not smoke, do not drink alcohol, do not take salt.
- A roadway is a sign of civilization. If you find a road, **stay on it**.
- Report all incidents, no matter how minor, to your crew chief/lead, task manager, design manager, or Project Manager as appropriate.
- Incident reports are required for all incidents.
- Two-track roads are inherently difficult; use caution.
- Park the vehicle in a location where it can be accessed easily in the event of an emergency.
- Pay attention, constantly observe the work area for hazards, and implement every effort needed to protect CH2M personnel from onsite hazards.
- Field work will be done during the daylight hours.
- Wear high-visibility orange vests if in areas where hunters may be.

9.5 Traffic Hazards

The following precautions must be taken when working around traffic, and in or near an area where traffic controls have been established by a contractor.

- Exercise caution when exiting traveled way or parking along street – avoid sudden stops, use flashers, etc.
- Park in a manner that will allow for safe exit from vehicle, and where practicable, park vehicle so that it can serve as a barrier.
- All staff working adjacent to traveled way or within work area must wear reflective/high-visibility vests.
- Eye protection should be worn to protect from flying debris.
- Remain aware of factors that influence traffic related hazards and required controls – sun glare, rain, wind, flash flooding, limited sight-distance, hills, curves, guardrails, width of shoulder (i.e., breakdown lane), etc.
- Always remain aware of an escape route -- behind an established barrier, parked vehicle, guardrail, etc.
- Always pay attention to moving traffic – never assume drivers are looking out for you
- Work as far from traveled way as possible to avoid creating confusion for drivers.

- When workers must face away from traffic, a "buddy system" should be used, where one worker is looking towards traffic.
- When working on highway projects, obtain a copy of the contractor's traffic control plan.
- Work area should be protected by a physical barrier – such as a K-rail or Jersey barrier.
- Review traffic control devices to ensure that they are adequate to protect your work area. Traffic control devices should: 1) convey a clear meaning, 2) command respect of road users, and 3) give adequate time for proper traffic response. The adequacy of these devices are dependent on limited sight distance, proximity to ramps or intersections, restrictive width, duration of job, and traffic volume, speed, and proximity.
- Lookouts should be used when physical barriers are not available or practical. The lookout continually watches approaching traffic for signs of erratic driver behavior and warns workers. Vehicles should be parked at least 40 feet away from the work zone and traffic. Minimize the amount of time that you will have your back to oncoming traffic.

9.6 Uneven walking surfaces

- Employees walking in ditches, swales and other drainage structures adjacent to roads or across undeveloped land must use caution to prevent slips and falls which can result in twisted or sprained ankles, knees, and backs.
- Whenever possible observe the conditions from a flat surface and do not enter a steep ditch or side of a steep road bed.
- If steep terrain must be negotiated, sturdy shoes or boots that provide ankle support should be used. The need for ladders or ropes to provide stability should be evaluated.
- Wear sturdy footwear appropriate for site walk activities (i.e., hiking boots or work boots).
- Watch for icy conditions, and be aware of slips, trips and falls.

9.7 Soil Sampling

- Tie down loose items
- Utilize a spotter if backing vehicles or equipment towards the sampling location
- Inspect the sampling area for obstructions and poison ivy and poison oak, or other physical hazards
- If sample locations are located in dense tall grassy areas consider utilizing a "Bug-Out" suit or DuPont™ Tyvek® to mitigate the potential for tick bites
- If lifting heavy equipment from a vehicle, move items to the rear and get assistance when lifting
- Be alert for bees, wasps, and other insects when sampling
- Log calibration of the Direct Reading Instrument in either a field log book or on the attached form
- Notify others in the area that the task is going to be performed; delineate an exclusion zone, as applicable
- Don personal protective equipment (PPE) as specified in Section 4 of this site-specific HSP
- Position yourself upwind prior to sampling, if possible
- Do not handle sample jars without nitrile gloves

9.8 Utilities (Underground)

Name: One Call
Phone: 811

An assessment for underground utilities must be conducted where there is a potential to contact underground utilities or similar subsurface obstructions during intrusive activities. Intrusive activities include excavation, trenching, drilling, hand augering, soil sampling, or similar activities.

The assessment must be conducted before any intrusive subsurface activity and must include at least the following elements:

1. A background and records assessment of known utilities or other subsurface obstructions. ***Specifically ask the resident if they buried any lines on their property (e.g. water, gas, electric), and follow the avoidance techniques in 9.8.5 and 9.8.6.***

2. Contacting and using the designated local utility locating service (e.g. 811).

3. Field team will utilize a Pipehorn 800 HL to aid the clearing process of suspect underground utility locations prior to using sampling tools.

4. A visual survey of the area to validate the chosen location (Refer to Section 9.8.4).

5. Conducting an independent field survey to identify, locate, and mark potential underground utilities or subsurface obstructions. *Note: This is independent of, and in addition to, any utility survey conducted by the designated local utility locating service above.* ***NOTE: This requirement has been removed for this project only, if all of the other three provisions are followed, and the employee using the Terra Core instrument is wearing insulated "lineman" gloves when pushing the instrument into the ground (no exceptions)***

When any of these steps identifies an underground utility within 5 feet (1.5 meters) of intrusive work, then non-aggressive means must be used to physically locate the utility before a drill rig, backhoe, excavator or other aggressive method is used.

Aggressive methods are never allowed within 2 feet of an identified high risk utility (see paragraph below).

Any deviation from these requirements must be approved by the Responsible HS Manager and the PM.

9.8.1 Background and Records Assessment of Known Utilities

Identify any client- or location-specific permit and/or procedural requirements (e.g., dig permit or intrusive work permit) for subsurface activities. For military installations, contact the Base Civil Engineer and obtain the appropriate form to begin the clearance process.

Obtain available utility diagrams and/or as-built drawings for the facility.

Review locations of possible subsurface utilities including sanitary and storm sewers, electrical lines, water supply lines, natural gas lines, fuel tanks and lines, communication lines, lighting protection systems, etc. Note: Use caution in relying on as-built drawings as they are rarely 100 percent accurate.

Request that a facility contact with knowledge of utility locations review and approve proposed locations of intrusive work.

9.8.2 Designated Local Utility Locating Service

Contact your designated local utility locating service (e.g., Dig-Safe, Blue Stake, One Call) to identify and mark the location of utilities. Call 811 in the US or go to www.call811.com to identify the appropriate local service group. Contacting the local utility locating service is a legal requirement in most jurisdictions.

9.8.3 Independent Field Survey (Utility Locate)

The organization conducting the intrusive work (CH2M or subcontractor) shall arrange for an independent field survey to identify, locate, and mark any potential subsurface utilities in the work area. This survey is in addition to any utility survey conducted by the designated local utility locating service.

The independent field survey provider shall determine the most appropriate instrumentation/technique or combinations of instrumentation/techniques to identify subsurface utilities based on their experience and expertise, types of utilities anticipated to be present, and specific site conditions.

A CH2M or subcontractor representative must be present during the independent field survey to observe the utility locate and verify that the work area and utilities have been properly identified and marked. If there is any question that the survey was not performed adequately or the individual was not

qualified, then arrangements must be made to obtain a qualified utility locate service to re-survey the area. Obtain documentation of the survey and clearances in writing and signed by the party conducting the clearance. Maintain all documentation in the project file.

If the site owner (military installation or client) can provide the independent field survey, CH2M or the subcontractor shall ensure that the survey includes:

Physically walking the area to verify the work location and identify, locate, and mark underground utility locations:

Having qualified staff available and instrumentation to conduct the locate;

Agreeing to document the survey and clearances in writing.

Should any of the above criteria not be met, CH2M or subcontractor must arrange for an alternate independent utility locate service to perform the survey.

The markings from utility surveys must be protected and preserved until the markings are no longer required. If the utility location markings are destroyed or removed before intrusive work commences or is completed, the PM, SC, or designee must notify the independent utility locate service or the designated local utility locating service to resurvey and remark the area.

9.8.4 Visual Assessment before and during Intrusive Activities

Perform a "360 degree" assessment. Walk the area and inspect for utility-related items such as valve caps, previous linear cuts, patchwork in pavement, hydrants, manholes, utility vaults, drains, and vent risers in and around the dig area.

The visual survey shall include all surface landmarks; **sheds or shops with power running to them, partially day-lighted lines**, manholes, previous liner cuts, patchwork in pavement, pad-mounted transformers, utility poles with risers, storm sewer drains, utility vaults, and fire hydrants.

If any unanticipated items are found, conduct further research before initiating intrusive activities and implement any actions needed to avoid striking the utility or obstruction.

9.8.5 Subsurface Activities within 5 feet of an Underground Utility or if there is Uncertainty

When aggressive intrusive activities will be conducted within 5 feet (1.5 meters) of an underground utility or when there is uncertainty about utility locations, locations must be physically verified by non-aggressive means such as air or water knifing or hand digging. Non-conductive tools must be used if electrical hazards may be present. If intrusive activities are within 5 feet (1.5 meters) and parallel to a marked existing utility, the utility location must be exposed and verified by non-aggressive methods every 100 feet (30.5 meters). Check to see if the utility can be isolated during intrusive work.

9.8.6 Intrusive Activities within 2 feet of a "day-lighted" Underground Utility

Use non-aggressive methods (hand digging, vacuum excavation, etc.) to perform intrusive activities within 2 feet of a high risk utility (i.e., a utility that cannot be de-energized or would cause significant impacts to repair/replace). Hazardous utilities shall be de-energized whenever possible.

9.8.7 Spotter

A spotter shall be used to monitor for signs of utilities during advancement of intrusive work (e.g., sudden change in advancement of auger or split spoon, presence of pea gravel or sand in soils, presence of concrete or other debris in soils, refusal of auger or excavating equipment). If any suspicious conditions are encountered stop work immediately and contact the PM or RHSM to evaluate the situation. The spotter must have a method to alert an operator to stop the intrusive activity (e.g., air horn, hand signals).

10.0 Physical Hazards and Controls

Physical hazards include exposure to temperature extremes, sun, noise, and radiation. If you encounter a physical hazard that has not been identified in this plan, contact the RHSM so that a revision to this plan can be made.

10.1 Noise

(Reference CH2M SOP HSE-108, *Hearing Conservation*)

CH2M is required to control employee exposure to occupational noise levels of 85 decibels, A-weighted, (dBA) and above by implementing a hearing conservation program that meets the requirements of the OSHA Occupational Noise Exposure standard, 29 CFR 1910.95. A noise assessment may be conducted by the RHSM or designee based on potential to emit noise above 85 dBA and also considering the frequency and duration of the task.

Areas or equipment emitting noise at or above 90dBA shall be evaluated to determine feasible engineering controls. When engineering controls are not feasible, administrative controls can be developed and appropriate hearing protection will be provided.

Areas or equipment emitting noise levels at or above 85 dBA, hearing protection must be worn.

Employees exposed to 85 dBA or a noise dose of 50% must participate in the Hearing Conservation program including initial and annual (as required) audiograms.

The RHSM will evaluate appropriate controls measures and work practices for employees who have experienced a standard threshold shift (STS) in their hearing.

Employees who are exposed at or above the action level of 85 dBA are required to complete the online Noise Training Module located on CH2M's virtual office.

Hearing protection will be maintained in a clean and reliable condition, inspected prior to use and after any occurrence to identify any deterioration or damage, and damaged or deteriorated hearing protection repaired or discarded.

In work areas where actual or potential high noise levels are present at any time, hearing protection must be worn by employees working or walking through the area.

Areas where tasks requiring hearing protection are taking place may become hearing protection required areas as long as that specific task is taking place.

High noise areas requiring hearing protection should be posted or employees must be informed of the requirements in an equivalent manner and a copy of the OSHA standard 29 CFR 1910.95 shall be posted in the workplace.

10.2 Ultraviolet Radiation (sun exposure)

Health effects regarding ultraviolet (UV) radiation are confined to the skin and eyes. Overexposure can result in many skin conditions, including erythema (redness or sunburn), photoallergy (skin rash), phototoxicity (extreme sunburn acquired during short exposures to UV radiation while on certain medications), premature skin aging, and numerous types of skin cancer. Implement the following controls to avoid sunburn.

Limit Exposure Time

Rotate staff so the same personnel are not exposed all of the time.

Limit exposure time when UV radiation is at peak levels (approximately 2 hours before and after the sun is at its highest point in the sky).

Avoid exposure to the sun, or take extra precautions when the UV index rating is high.

Provide Shade

Take lunch and breaks in shaded areas.

Create shade or shelter through the use of umbrellas, tents, and canopies.

Fabrics such as canvas, sailcloth, awning material and synthetic shade cloth create good UV radiation protection.

Check the UV protection of the materials before buying them. Seek protection levels of 95 percent or greater, and check the protection levels for different colors.

Clothing

Reduce UV radiation damage by wearing proper clothing; for example, long sleeved shirts with collars, and long pants. The fabric should be closely woven and should not let light through.

Head protection should be worn to protect the face, ears, and neck. Wide-brimmed hats with a neck flap or "Foreign Legion" style caps offer added protection.

Wear UV-protective sunglasses or safety glasses. These should fit closely to the face. Wrap-around style glasses provide the best protection.

Sunscreen

Apply sunscreen generously to all exposed skin surfaces at least 20 minutes before exposure, allowing time for it to adhere to the skin.

Re-apply sunscreen at least every 2 hours, and more frequently when sweating or performing activities where sunscreen may be wiped off.

Choose a sunscreen with a high sun protection factor (SPF). Most dermatologists advocate SPF 30 or higher for significant sun exposure.

Waterproof sunscreens should be selected for use in or near water, and by those who perspire sufficiently to wash off non-waterproof products.

Check for expiration dates, because most sunscreens are only good for about 3 years. Store in a cool place out of the sun.

No sunscreen provides 100 percent protection against UV radiation. Other precautions must be taken to avoid overexposure.

10.3 Temperature Extremes

(Reference CH2M SOP HSE-211, *Heat and Cold Stress*)

Each employee is responsible for the following:

Recognizing the symptoms of heat or cold stress;

Taking appropriate precautionary measures to minimize their risk of exposure to temperature extremes (see following sections); and

Communicating any concerns regarding heat and cold stress to their supervisor or SC.

10.3.1 Heat

Heat-related illnesses are caused by more than just temperature and humidity factors.

Physical fitness influences a person's ability to perform work under heat loads. At a given level of work, the more fit a person is, the less the physiological strain, the lower the heart rate, the lower the

body temperature (indicates less retrained body heat—a rise in internal temperature precipitates heat injury), and the more efficient the sweating mechanism.

Acclimatization is a gradual physiological adaptation that improves an individual's ability to tolerate heat stress. Acclimatization requires physical activity under heat-stress conditions similar to those anticipated for the work. With a recent history of heat-stress exposures of at least two continuous hours per day for 5 of the last 7 days to 10 of the last 14 days, a worker can be considered acclimatized. Its loss begins when the activity under those heat-stress conditions is discontinued, and a noticeable loss occurs after 4 days and may be completely lost in three to four weeks. Because acclimatization is to the level of the heat-stress exposure, a person will not be fully acclimatized to a sudden higher level; such as during a heat wave.

Dehydration reduces body water volume. This reduces the body's sweating capacity and directly affects its ability to dissipate excess heat.

The ability of a body to dissipate heat depends on the ratio of its surface area to its mass (surface area/weight). **Heat dissipation** is a function of surface area, while heat production depends on body mass. Therefore, overweight individuals (those with a low ratio) are more susceptible to heat-related illnesses because they produce more heat per unit of surface area than if they were thinner. Monitor these persons carefully if heat stress is likely.

When wearing **impermeable clothing**, the weight of an individual is not as important in determining the ability to dissipate excess heat because the primary heat dissipation mechanism, evaporation of sweat, is ineffective.

SYMPTOMS AND TREATMENT OF HEAT STRESS

	Heat Syncope	Heat Rash	Heat Cramps	Heat Exhaustion	Heat Stroke
Signs and Symptoms	Sluggishness or fainting while standing erect or immobile in heat.	Profuse tiny raised red blister-like vesicles on affected areas, along with prickling sensations during heat exposure.	Painful spasms in muscles used during work (arms, legs, or abdomen); onset during or after work hours.	Fatigue, nausea, headache, giddiness; skin clammy and moist; complexion pale, muddy, or flushed; may faint on standing; rapid thready pulse and low blood pressure; oral temperature normal or low	Red, hot, dry skin; dizziness; confusion; rapid breathing and pulse; high oral temperature.
Treatment	Remove to cooler area. Rest lying down. Increase fluid intake. Recovery usually is prompt and complete.	Use mild drying lotions and powders, and keep skin clean for drying skin and preventing infection.	Remove to cooler area. Rest lying down. Increase fluid intake.	Remove to cooler area. Rest lying down, with head in low position. Administer fluids by mouth. Seek medical attention.	Cool rapidly by soaking in cool–but not cold–water. Call ambulance, and get medical attention immediately!

Precautions

Drink 16 ounces of water before beginning work. Disposable cups and water maintained at 50°Fahrenheit (10 degrees Celsius [C]) to 60°Fahrenheit (F) (15.6 degrees C) should be available. Under severe conditions, drink 1 to 2 cups every 20 minutes, for a total of 1 to 2 gallons (7.5 liters) per day. Do not use alcohol in place of water or other nonalcoholic fluids. Decrease your intake of coffee and caffeinated soft drinks during working hours.

Acclimate yourself by slowly increasing workloads (do not begin with extremely demanding activities).

Use cooling devices, such as cooling vests, to aid natural body ventilation. These devices add weight, so their use should be balanced against efficiency.

Use mobile showers or hose-down facilities to reduce body temperature and cool protective clothing.

Conduct field activities in the early morning or evening and rotate shifts of workers, if possible.

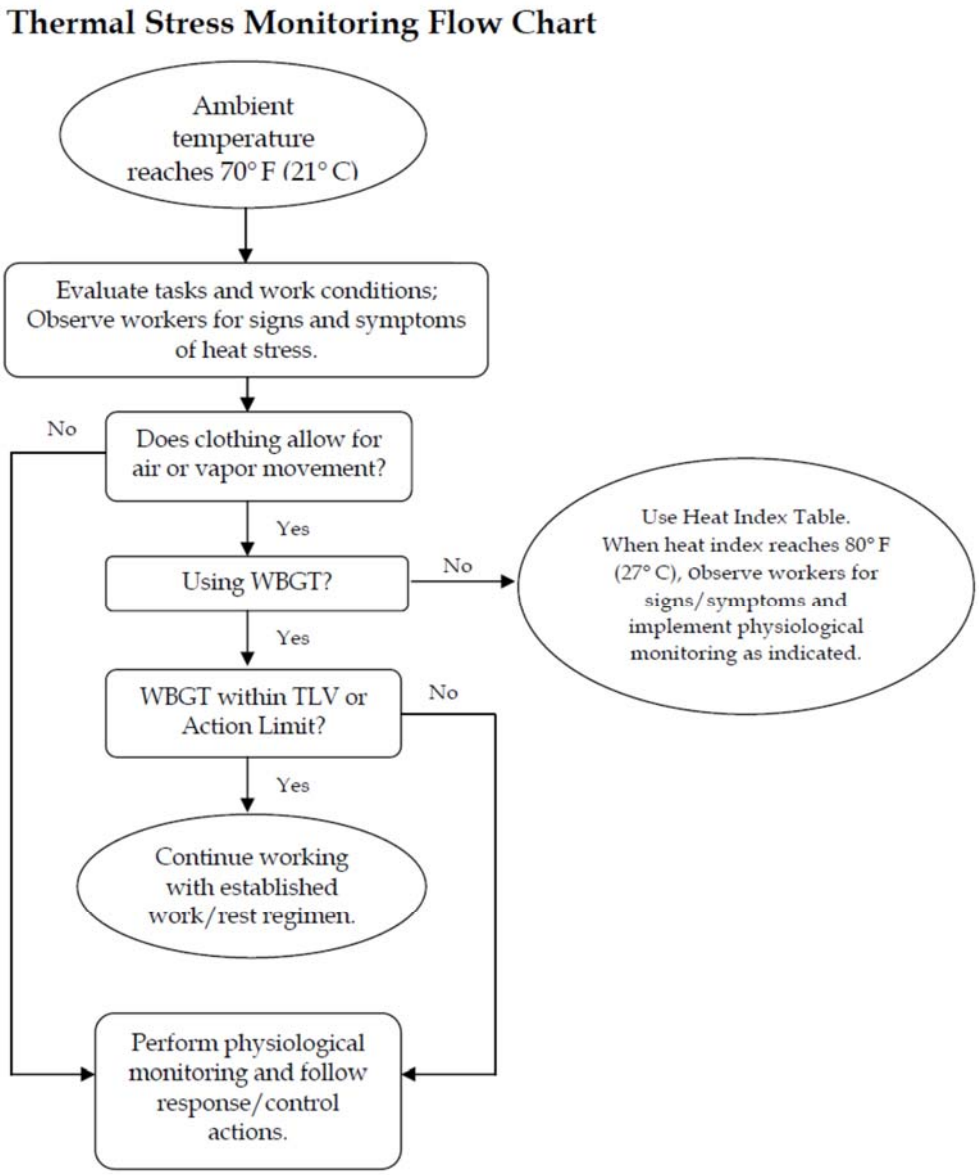
Avoid direct sun whenever possible, which can decrease physical efficiency and increase the probability of heat stress. Take regular breaks in a cool, shaded area. Use a wide-brim hat or an umbrella when working under direct sun for extended periods.

Provide adequate shade to protect personnel against radiant heat (sun, flames, hot metal).

Maintain good hygiene standards by frequently changing clothing and showering.

Observe one another for signs of heat stress. PREVENTION and communication is key.

Thermal Stress Monitoring

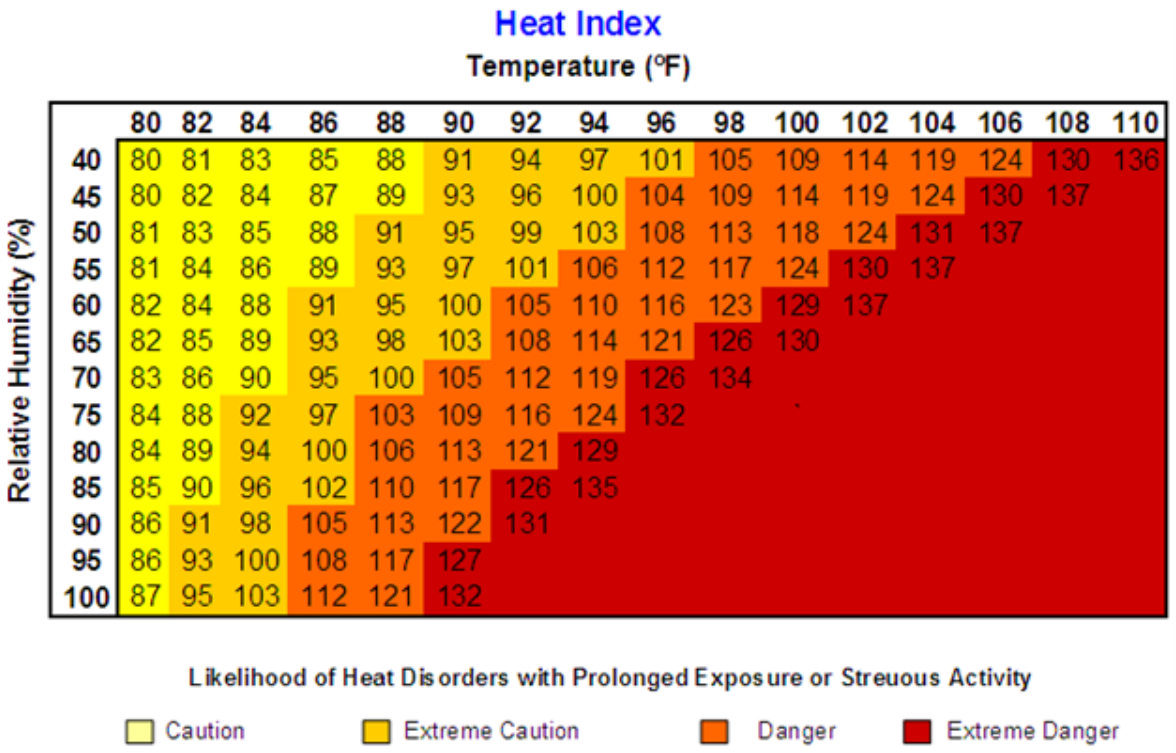


Thermal Stress Monitoring – Permeable or Impermeable Clothing

When permeable work clothes are worn (street clothes or clothing ensembles over street clothes), regularly observe workers for signs and symptoms of heat stress and implement physiological monitoring as indicated below. This should start when the heat index reaches 80° F (27° C) [see Heat Index Table below], or sooner if workers exhibit symptoms of heat stress indicated in the table above. These heat index values were devised for shady, light wind conditions; exposure to full sunshine can

increase the values by up to 15°F (8°C). Also, strong winds, particularly with very hot, dry air, can be extremely hazardous.

When wearing **impermeable clothing** (e.g., clothing doesn't allow for air or water vapor movement such as Tyvek), physiological monitoring as described below shall be conducted when the ambient temperature reaches 70° F (21° C) or at a lower temperature when workers begin to exhibit signs and symptoms of heat stress.



Heat Index	Possible Heat Disorders	Minimum Frequency of Physiological Monitoring
80°F - 90°F (27°C - 32°C)	Fatigue possible with prolonged exposure and/or physical activity	Observe Workers for signs of heat stress and implement physiological monitoring if warranted.
90°F - 105°F (32°C - 41°C)	Sunstroke, heat cramps, or heat exhaustion possible with prolonged exposure and/or physical activity	Every 2 hours, or sooner, if signs of heat stress are observed.
105°F - 130°F (41°C - 54°C)	Sunstroke, heat cramps, or heat exhaustion likely, and heat stroke possible with prolonged exposure and/or physical activity.	Every 60 minutes or sooner if signs of heat stress are observed.
130°F or Higher (54°C or Higher)	Heat/Sunstroke highly likely with continued exposure.	Every 30 minutes or sooner if signs of heat stress are observed.
Source: National Weather Service		

Physiological Monitoring and Associated Actions

The following physiological monitoring protocol below, using either radial pulse or aural temperature, will occur when the heat index is 80 degrees F or greater (or when personnel exhibit signs of heat stress), the following will be performed:

The sustained heart rate during the work cycle should remain below 180 beats per minute (bpm) minus the individual's age (e.g. 180 – 35 year old person = 145 bpm). The sustained heart rate can be estimated by measuring the heart rate at the radial pulse for 30 seconds as quickly as possible prior to starting the rest period.

The heart rate after one minute rest period should not exceed 120 beats per minute (bpm).

If the heart rate is higher than 120 bpm, the next work period should be shortened by 33 percent, while the length of the rest period stays the same.

If the pulse rate still exceeds 120 bpm at the beginning of the next rest period, the following work cycle should be further shortened by 33 percent.

Continue this procedure until the rate is maintained below 120 bpm.

Alternately, the body temperature can be measured, either oral or aural (ear), before the workers have something to drink.

If the oral or aural temperature exceeds 99.6° F (37.6 ° F) at the beginning of the rest period, the following work cycle should be shortened by 33 percent.

Continue this procedure until the oral or aural (ear) temperature is maintained below 99.6 ° F (37.6° C). While an accurate indication of heat stress, oral temperature is difficult to measure in the field, however, a digital aural (aural) thermometer is easy to obtain and inexpensive to purchase.

Procedures for when Heat Illness Symptoms are Experienced

Always contact the RHSM when any heat illness related symptom is experienced so that controls can be evaluated and modified, if needed.

In the case of cramps, reduce activity, increase fluid intake, move to shade until recovered.

In the case of all other heat-related symptoms (fainting, heat rash, heat exhaustion), and if the worker is a CH2M worker, contact the occupational physician at 1-855-328-6547 and immediate supervisor.

In the case of heat stroke symptoms, call 911, have a designee give location and directions to ambulance service if needed, follow precautions under the emergency medical treatment of this HSP.

10.3.2 Cold

General

Low ambient temperatures increase the heat lost from the body to the environment by radiation and convection. In cases where the worker is standing on frozen ground, the heat loss is also due to conduction.

Wet skin and clothing, whether because of water or perspiration, may conduct heat away from the body through evaporative heat loss and conduction. Thus, the body cools suddenly when chemical protective clothing is removed if the clothing underneath is perspiration soaked.

Movement of air across the skin reduces the insulating layer of still air just at the skin's surface. Reducing this insulating layer of air increases heat loss by convection.

Non-insulating materials in contact or near-contact with the skin, such as boots constructed with a metal toe or shank, conduct heat rapidly away from the body.

Certain common drugs, such as alcohol, caffeine, or nicotine, may exacerbate the effects of cold, especially on the extremities. These chemicals reduce the blood flow to peripheral parts of the body, which are already high-risk areas because of their large surface area to volume ratios. These substances may also aggravate an already hypothermic condition.

Precautions

Be aware of the symptoms of cold-related disorders, and wear proper, layered clothing for the anticipated fieldwork. Appropriate rain gear is a must in wet weather.

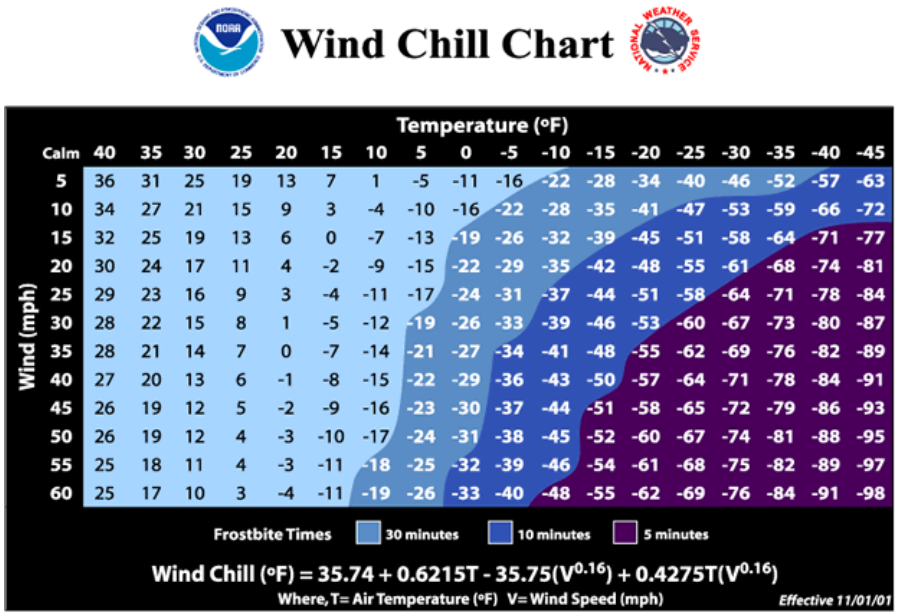
Wind-Chill Index (below) is used to estimate the combined effect of wind and low air temperatures on exposed skin. The wind-chill index does not take into account the body part that is exposed, the level of activity, or the amount or type of clothing worn. For those reasons, it should only be used as a guideline to warn workers when they are in a situation that can cause cold-related illnesses.

Persons who experience initial signs of immersion foot, frostbite, and/or hypothermia should report it immediately to their supervisor/PM to avoid progression of cold-related illness.

Observe one another for initial signs of cold-related disorders.

Obtain and review weather forecast – be aware of predicted weather systems along with sudden drops in temperature, increase in winds, and precipitation.

SYMPTOMS AND TREATMENT OF COLD STRESS			
	Immersion (Trench) Foot	**Frostbite**	**Hypothermia**
Signs and Symptoms	Feet discolored and painful; infection and swelling present.	Blanched, white, waxy skin, but tissue resilient; tissue cold and pale.	Shivering, apathy, sleepiness; rapid drop in body temperature; glassy stare; slow pulse; slow respiration.
Treatment	Seek medical treatment immediately.	Remove victim to a warm place. Re-warm area quickly in warm–but **not** hot–water. Have victim drink warm fluids, but **not** coffee or alcohol. Do not break blisters. Elevate the injured area, and get medical attention.	Remove victim to a warm place. Have victim drink warm fluids, but **not** coffee or alcohol. Get medical attention.



10.4 Radiological Hazards

Refer to CH2M's Core Standard, Radiological Control and Radiological Controls Manual for additional requirements.

Hazards	Controls
None Known	None Required

11.0 Biological Hazards and Controls

Biological hazards are everywhere and change with the region and season. If you encounter a biological hazard that has not been identified in this plan, contact the RHSM so that a revision to this plan can be made. Whether it is contact with a poisonous plant, a poisonous snake, or a bug bite, do not take bites or stings lightly. If there is a chance of an allergic reaction or infection, or to seek medical advice on how to properly care for the injury, contact the occupational nurse at 1-855-328-6547.

11.1 Bees and Other Stinging Insects

Bees and other stinging insects may be encountered almost anywhere and may present a serious hazard, particularly to people who are allergic. Watch for and avoid nests. Keep exposed skin to a minimum. Carry a kit if you have had allergic reactions in the past, and inform your supervisor and/or a buddy. If you are stung, contact the occupational nurse at 1-855-328-6547. If a stinger is present, remove it as soon as possible using something with a thin, hard edge (e.g., credit card) to scrape the stinger out. Be sure to sanitize the object first with hand sanitizer, alcohol or soap and water. Wash and disinfect the wound, cover it, and apply ice. Watch for an allergic reaction if you have never been stung before. Call 911 if the reaction is severe.

11.2 Bird Droppings

Large amounts of bird droppings may present a disease risk. The best way to prevent exposure to fungus spores in bird droppings is to avoid disturbing it. A brief inhalation exposure to highly contaminated dust may be all that is needed to cause infection and subsequent development of fungal disease.

If disturbing the droppings or if removal is necessary to perform work, follow these controls:

Use dust control measures (wetting with water or HEPA vacuuming) for all activities that may generate dust from the accumulated droppings.

Wear Tyvek with hoods, disposable gloves and booties, and air-purifying respirators with a minimum N95 rating.

Put droppings into plastic/poly bags and preferably into a 55-gallon drum to prevent bag from ripping.

11.3 Hantavirus

Hantavirus pulmonary syndrome (HPS) is a disease caused by a virus which can be transmitted from certain rodents to humans and is prevalent throughout the United States. Avoid disturbing rodent nests. Contact is most likely to occur when there is a current rodent infestation in things like control boxes, storage sheds, wellheads, remediation equipment, or trailers. Once excreted into the environment by the rodent, hantaviruses can survive in the environment and remain infectious for a period of 2-3 days. Ultraviolet rays in sunlight inactivate hantaviruses. Nesting material and droppings must be removed if work is necessary in a rodent-infested area. PPE for removal shall include:

Tyvek coveralls;

Rubber boots or disposable shoe covers;

Rubber, latex, or vinyl gloves;

Respiratory protection such as a full face or half-mask air-purifying respirator with a high-efficiency particulate air (HEPA) filter; and

Protective goggles if wearing a half-mask respirator.

Spray any urine, droppings, and nesting materials with either a bleach and water solution (1 parts bleach to 9 parts water) or a household disinfectant prepared according to the label instructions for

dilution and disinfection time. Soak well and let stand for 15 minutes. Use a paper towel or rag to pick up the materials and dispose of them.

Mop floors after spraying them using bleach and water solution or a disinfectant. Dirt floors can be sprayed with either bleach and water solution or a disinfectant. Personal protective gear shall be decontaminated upon removal at the end of the day. All potentially infective waste material (including respirator filters) from clean-up operations shall be double-bagged in plastic bags.

Symptoms of HPS

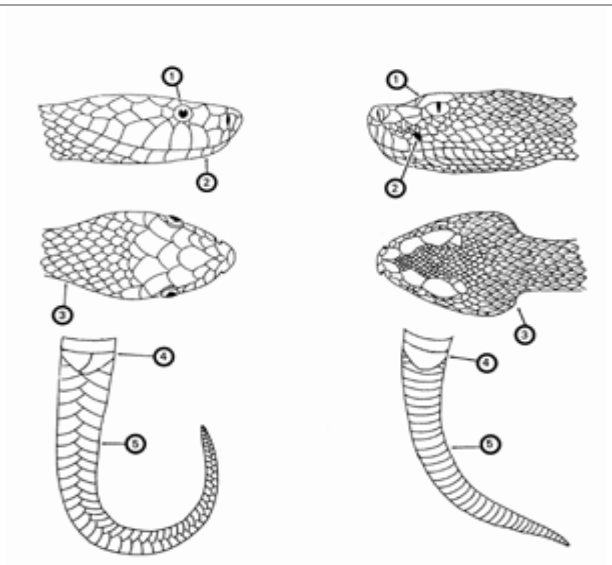
Symptoms develop between 14 and 31 days after exposure to infected rodents and include fatigue, fever, and muscle aches, especially the large muscle groups--thighs, hips, back and sometimes shoulders. About half of all HPS patients also experience headaches, dizziness, chills and/or abdominal pain. Four to 10 days after the initial phase of the illness, late symptoms of HPS may appear. These include coughing and shortness of breath. If you develop symptoms suggestive of HPS, call the occupational nurse at 1-855-328-6547.

11.4 Snakes

Snakes typically are found in underbrush and tall grassy areas. If you encounter a snake, stay calm and look around; there may be other snakes. Turn around and walk away on the same path you used to approach the area. If bitten by a snake, wash and immobilize the injured area, keeping it lower than the heart if possible. Call the occupational nurse at 1-855-328-6547 immediately. Do not apply ice, cut the wound, or apply a tourniquet. Try to identify the type of snake: note color, size, patterns, and markings. Below is a guide to identifying poisonous snakes from non-poisonous snakes.

Identification of Poisonous Snakes

Major Identification Features Non-venomous Snake	Major Identification Features Venomous Snake
1. Round pupils 2. No sensing pit 3. Head slightly wider than neck 4. Divided anal plate 5. Double row of scales on the underside of the tail	1. Elliptical pupils 2. Sensing pit between eye and nostril 3. Head much wider than neck 4. Single anal plate 5. Single scales on the underside of the tail



11.5 Spiders - Brown Recluse and Widow

The Brown Recluse spider can be found most anywhere in the United States. It varies in size in shape, but the distinguishing mark is the violin shape on its body. They are typically non-aggressive. Keep an eye out for irregular, pattern-less webs that sometimes appear almost tubular built in a protected area such as in a crevice or between two rocks. The spider will retreat to this area of the web when threatened.

The Black Widow, Red Widow and the Brown Widow are all poisonous. Most have globose, shiny abdomens that are predominantly black with red markings (although some may be pale or have lateral stripes), with moderately long, slender legs. These spiders are nocturnal and build a three-dimensional tangled web, often with a conical tent of dense silk in a corner where the spider hides during the day.

Hazard Controls

Inspect or shake out any clothing, shoes, towels, or equipment before use.

Wear protective clothing such as a long-sleeved shirt and long pants, hat, gloves, and boots when handling stacked or undisturbed piles of materials.

Minimize the empty spaces between stacked materials.

Remove and reduce debris and rubble from around the outdoor work areas.

Trim or eliminate tall grasses from around outdoor work areas.

Store apparel and outdoor equipment in tightly closed plastic bags.

Keep your tetanus boosters up-to-date (every 10 years). Spider bites can become infected with tetanus spores.

If you think you have been bit by a poisonous spider, immediately call the occupational nurse at 1-855-328-6547 and follow the guidance below:

Remain calm. Too much excitement or movement will increase the flow of venom into the blood;

Apply a cool, wet cloth to the bite or cover the bite with a cloth and apply an ice bag to the bite;

Elevate the bitten area, if possible;

Do not apply a tourniquet, do not try to remove venom; and

Try to positively identify the spider to confirm its type. If the spider has been killed, collect it in a plastic bag or jar for identification purposes. Do not try to capture a live spider—especially if you think it is a poisonous spider.

Black Widow

Red Widow

Brown Widow

Brown Recluse

If you are stung by a scorpion, call the occupational nurse 1-855-328-6547 and try to note the description of the scorpion. Cleanse the sting area and apply ice.

11.6 Black Bears

Bears may inhabit wooded areas where there is scarce continuous human presence. Make your presence known-especially when vegetation and terrain make it hard to see. Make noise, sing, or talk loudly. Avoid thick brush. Try to walk with the wind at your back so your scent will warn bears of your presence.

Give bears plenty of room. Every bear has a "personal space" - the distance within which a bear feels threatened – that can be from a few feet to a few hundred feet. If you stray within that zone, a bear may act aggressively. Never approach bears, even if only out of curiosity, and never attempt to feed bears.

If a bear cannot recognize you, he may come closer or stand on his hind legs for a better view. You may try to back away slowly diagonally, but if the bear follows, stop and stand your ground. If the bear moves closer or acts aggressively, stay close together and wave your arms and shout.

Do not climb a tree – black bears are good climbers.

Do not run. Bears have been clocked at speeds of up to 35 mph, and like dogs, will chase fleeing animals. Bears often make bluff charges, sometimes up to 10 feet away without making contact. Continue waving your arms and shouting. Never imitate bears sounds or use high-pitched squeals.

If attacked, do not run. Clasp your hands tightly over the back of your neck or if you are carrying a backpack use it to protect your head and neck and remain still. For Black bears, if the attack lasts for more than a few seconds, respond aggressively - use sticks, rocks, your fists or noise. Black bears will sometimes back off if they are challenged.

11.7 Ticks

Every year employees are exposed to tick bites at work and at home putting them at risk of illness. Ticks typically are in wooded areas, bushes, tall grass, and brush. Ticks are black, black and red, or brown and can be up to one-quarter inch (6.4 mm) in size. In some geographic areas exposure is not easily avoided. Wear tightly woven light-colored clothing with long sleeves and pant legs tucked into boots; spray only outside of clothing with permethrin or permanone and spray skin with only DEET; and check yourself frequently for ticks.

Where site conditions (vegetation above knee height, tick endemic area) or when tasks (having to sit or kneel in vegetation) diminish the effectiveness of the other controls mentioned above, bug-out suits (check with your local or regional warehouse) or Tyvek shall be used. Bug-out suits are more breathable than Tyvek.

Take precautions to avoid exposure by including pre-planning measures for biological hazards prior to starting field work. Avoid habitats where possible, reduce the abundance through habitat disruption or application of acracide. If these controls aren't feasible, contact your local or regional warehouse for preventative equipment such as repellants, protective clothing and tick removal kits. Use the buddy system and perform tick inspections prior to entering the field vehicle. If ticks were not planned to be encountered and are observed, do not continue field work until these controls can be implemented.

See Tick Fact Sheet (Attachment 5) for further precautions and controls to implement when ticks are present. If bitten by a tick, follow the removal procedures found in the tick fact sheet, and call the occupational nurse at 1-855-328-6547.

Be aware of the symptoms of Lyme disease or Rocky Mountain spotted fever (RMSF). Lyme disease is a rash that might appear that looks like a bull's eye with a small welt in the center. RMSF is a rash of red spots under the skin 3 to 10 days after the tick bite. In both RMSF and Lyme disease, chills, fever, headache, fatigue, stiff neck, and bone pain may develop. If symptoms appear, again contact the occupational nurse at 1-855-328-6547.

Be sure to complete an Incident Report (either use the Hours and Incident Tracking System [HITS] system on the VO) if you do come in contact with a tick.

11.8 Feral Dogs

Avoid all dogs – both leashed and stray. Do not disturb a dog while it is sleeping, eating, or caring for puppies. If a dog approaches to sniff you, stay still. An aggressive dog has a tight mouth, flattened ears and a direct stare. If you are threatened by a dog, remain calm, do not scream and avoid eye contact. If you say anything, speak calmly and firmly. Do not turn and run, try to stay still until the dog leaves, or back away slowly until the dog is out of sight or you have reached safety (e.g. vehicle). If attacked, retreat to vehicle or attempt to place something between you and the dog. If you fall or are knocked to the ground, curl into a ball with your hands over your head and neck and protect your face. If bitten, wash the wound vigorously with soap and water, and contact the occupational nurse at 1-855-328-6547. Report the incident to the local authorities, and try to get as much information about the dog as possible (e.g. breed, size, color, owner, location, signs of sickness, erratic behavior other than the aggressiveness of the attack) .

12.0 Contaminants of Concern

The table below summarizes the potential contaminants of concern (COC) and their occupational exposure limit and signs and symptoms of exposure.

Contaminants of Concern					
Contaminant	**Location and Maximum[a] Concentration**	**Exposure Limit[b]**	**IDLH[c]**	**Symptoms and Effects of Exposure**	**PIP[d] (eV)**
Arsenic	Present in slag material; or as a result upland deposition	0.01 mg/m^3	5 Ca	Ulceration of nasal septum, respiratory irritation, dermatitis, gastrointestinal disturbances, peripheral neuropathy, hyper-pigmentation	NA
Barium		0.5 mg/m^3	50	Irritation to eyes, skin, upper resp; skin burns; gastroenteritis; slow pulse	NA
Cadmium		0.005 mg/m^3	9 Ca	Pulmonary edema, coughing, chest tightness/pain, headache; chills, muscle aches, nausea, vomiting, diarrhea; difficulty breathing; loss of sense of smell; emphysema; mild anemia	NA
Cobalt (Metal Dusts)		0.05 mg/m^3	20	Coughing; difficulty breathing; wheezing; decreased pulmonary function; diffuse nodule fibroses; dermatitis; respiratory hypersensitivity; asthma	NA
Copper		1 mg/m^3	100	Irritation to eyes, skin, nose, and pharynx; metallic taste; dermatitis	NA
Lead		0.05 mg/m^3	100	Weakness lassitude, facial pallor, pal eye, weight loss, malnutrition, abdominal pain, constipation, anemia, gingival lead line, tremors, paralysis of wrist and ankles, encephalopathy, kidney disease, irritated eyes, hypertension	NA
Manganese		1 mg/m^3	500	Insomnia; mental confusion; meta fume fever; dry throat; cough; flu-like fever; vomit; malaise	NA
Zinc		5 mg/m^3	500	Chills; aches; nausea; fever; cough; dry throat; headache; blurred vision; vomit; fatigue	NA

Footnotes:

[a] Specify sample-designation and media: SB (Soil Boring), A (Air), D (Drums), GW (Groundwater), L (Lagoon), TK (Tank), SS (Surface Soil), SL (Sludge), SW (Surface Water).
[b] Appropriate value of permissible exposure limit (PEL), recommended exposure limit (REL), or threshold limit value (TLV) listed.
[c] IDLH = immediately dangerous to life and health (units are the same as specified "Exposure Limit" units for that contaminant); NL = No limit found in reference materials; CA = Potential occupational carcinogen.
[d] PIP = photoionization potential; NA = Not applicable; UK = Unknown.

eV = electron volt; mg/kg = milligram per kilogram; mg/m^3 = milligrams per cubic meter

Potential Routes of Exposure		
Dermal: Contact with contaminated media. This route of exposure is minimized through use of engineering controls, administrative controls and proper use of PPE.	**Inhalation:** Vapors and contaminated particulates. This route of exposure is minimized through use of engineering controls, administrative controls and proper use of respiratory protection when other forms of control do not reduce the potential for exposure.	**Other:** Inadvertent ingestion of contaminated media. This route should not present a concern if good hygiene practices are followed (e.g., wash hands and face before drinking or smoking).

13.0 Site Monitoring

(Reference CH2M SOP HSE-207, *Exposure Monitoring for Airborne Chemical Hazards*)

When performing site monitoring, record all the information, such as in a field logbook. Note date and time, describe monitoring location (for example, in breathing zone, at source and site location), and what the reading is. If any action levels are reached, note it in the field logbook and note the action taken.

Exposure records (air sampling) must be preserved for the duration of employment plus thirty years. Ensure that copies of the field log book are maintained in the project file.

Copies of all project exposure records (e.g., copies of field logbook pages where air monitoring readings are recorded and associated calibration) shall be sent to the regional SPA for retention and maintained in the project files.

13.1 Air Monitoring Specifications

Instrument	Tasks	Action Levels[a]	Frequency [b]	Calibration
Visual Dust Monitor	• 3rd-party observation of fish, biota, water, sediment, soil, and/or plant sampling • Collection of upland surface soil samples • Split sample collection	No Visual Dust → Level D Visual Dust → Implement dust control measures	Initially and continuously during tasks	None

[a] Action levels apply to **sustained** breathing-zone measurements above background **for more than 5 minutes**.

[b] The exact frequency of monitoring depends on field conditions and is to be determined by the SC-HW; generally, every 5 to 15 minutes if acceptable; it may be appropriate to do so more frequently. Monitoring results should be recorded. Documentation should include instrument and calibration information, time, measurement results, personnel monitored, and place/location where measurement is taken (for example, "Breathing Zone/MW-3," "at surface/SB-2," etc.).

Note: Based on the COCs and scope of work, at this time, there does not appear to be an inhalation exposure hazard. Employees should still use good personal hygiene, wash hands before meals, and wear chemical resistant gloves when conducting field activities listed in Section 3.3.1 and handling any potential contaminated media. If analytical data indicates an increase in contamination, or the scope of work changes, notify the Health and Safety Manager to reevaluate air monitoring for future tasks onsite.

13.2 Calibration Specifications

(Refer to the respective manufacturer's instructions for proper instrument-maintenance procedures)

Instrument	Gas	Span	Reading	Method
Not Applicable at this time				

13.3 Air Sampling

Method Description: Based on current site conditions, recent analytical data, and the tasks planned in this work order, air sampling will not be required at this time. If site conditions or tasks change, notify the Health and Safety Manager to reevaluate the need for air sampling.

14.0 Personal Protective Equipment

(Reference CH2M- SOP HSE-117, *Personal Protective Equipment*)

14.1 Required Personal Protective Equipment

PPE must be worn by employees when actual or potential hazards exist and engineering controls or administrative practices cannot adequately control those hazards. A PPE assessment has been conducted by the RHSM based on project tasks (see PPE specifications below). Verification and certification of assigned PPE by task is completed by the RHSM that approved this plan. Below are items that need to be followed when using any form of PPE:

Employees must be trained to properly wear, limitations, and maintain of the PPE;

In work areas where actual or potential hazards are present at any time, PPE must be worn by employees working or walking through the area;

PPE inspected prior to use to identify any deterioration or damage; maintained in a clean and reliable condition; discarded if damaged; not modified, tampered with, or repaired beyond routine maintenance.

Project-Specific Personal Protective Equipment Requirements[a]

Task	Level	Body	Head	Respirator [b]
• Site reconnaissance • Surveying	N/A	**Coveralls:** Standard field attire (i.e. long pants and shirts w/ sleeves) **Boots:** Steel-toe, chemical-resistant boots OR steel-toe, leather work boots **Gloves:** Leather gloves (if necessary based on hazards). **Personal Flotation Device**: A coast guard approved PFD required when onboard a boat, tumbling into swift-moving or deep water, or wading in water exceeding 3 feet in depth. **Waders**: Waders will be used when wading in water above the boot line.	Hardhat [c] Safety glasses Ear protection [d]	None required.
• 3rd-party observation of fish, biota, water, sediment, soil, and/or plant sampling • Collection of upland surface soil samples • Split sample collection	Modified D	**Coveralls:** Cotton coveralls or rain gear, or uncoated Tyvek® if cotton coveralls cannot be kept clean. **Boots:** Steel-toe, chemical-resistant boots OR steel-toe, leather work boots **Gloves:** Nitrile gloves when sampling. **Gloves:** Insulated "line-man" gloves when using the Terra-Core instrument **Personal Flotation Device**: A coast guard approved PFD required when onboard a boat, tumbling into swift-moving or deep water, or wading in water exceeding 3 feet in depth. **Waders**: Waders will be used when wading in water above the boot line.	Hardhat [c] Splash shield [c] Safety glasses Ear protection [d]	None required.

Reasons for Upgrading or Downgrading Level of Protection (with RHSM approval)

Upgrade[c]	Downgrade
• Request from individual performing tasks. • Change in work tasks that will increase contact or potential contact with hazardous materials. • Occurrence or likely occurrence of gas or vapor emission. • Known or suspected presence of dermal hazards. • Instrument action levels in the "Site Monitoring" section exceeded.	• New information indicating that situation is less hazardous than originally thought. • Change in site conditions that decrease the hazard. • Change in work task that will reduce contact with hazardous materials.

[a] Modifications are as indicated. CH2M will provide PPE only to CH2M employees.

[b] No facial hair that would interfere with respirator fit is permitted.

[c] Performing a task that requires an upgrade to a higher level of protection (e.g., Level D to Level C) is permitted only when the PPE requirements have been approved by the RHSM, and an SC qualified at that level is present.

15.0 Worker Training and Qualification

15.1 CH2M Worker Training

(Reference CH2M SOP HSE-110, *Training*)

15.1.1 Hazardous Waste Operations Training

All employees engaging in hazardous waste operations or emergency response shall receive appropriate training as required by 29 CFR 1910.120 and 29 CFR 1926.65. At a minimum, the training shall have consisted of instruction in the topics outlined in 29 CFR 1910.120 and 29 CFR 1926.65. Personnel who have not met these training requirements shall not be allowed to engage in hazardous waste operations or emergency response activities.

15.1.1.1 Initial Training

General site workers engaged in hazardous waste operations shall, at the time of job assignment, have received a minimum of 40 hours of initial health and safety training for hazardous waste site operations, unless otherwise noted in the above-referenced standards.

Employees who may be exposed to health hazards or hazardous substances at treatment, storage, and disposal (TSD) operations shall receive a minimum of 24 hours of initial training to enable the employee to perform their assigned duties and functions in a safe and healthful manner.

Employees engaged in emergency response operations shall be trained to the level of required competence in accordance with 29 CFR 1910.120.

15.1.1.2 Three-Day Actual Field Experience

General site workers for hazardous waste operations shall have received three days of actual experience (on-the-job training) under the direct supervision of a trained, qualified supervisor and shall be documented. If the field experience has not already been received and documented at a similar site, this supervised experience shall be accomplished and documented at the beginning of the assignment of the project.

15.1.1.3 Refresher Training

General site workers and TSD workers shall receive 8-hours of refresher training annually (within the previous 12-month period) to maintain qualifications for fieldwork. Employees engaged in emergency response operations shall receive annual refresher training of sufficient content and duration to maintain their competencies or shall demonstrate competency in those areas at least annually.

15.1.1.4 Eight-Hour Supervisory Training

On site management or supervisors who will be directly responsible for, or supervise employees engaged in hazardous waste site operations, will have received at least 8 hours of additional specialized training on managing such operations. Employees designated as Safety Coordinator – Hazardous Waste are considered 8-hour HAZWOPER Site Safety Supervisor trained.

15.1.2 First Aid/Cardiopulmonary Resuscitation

First aid and CPR training consistent with the requirements of a nationally recognized organization such as the American Red Cross Association or National Safety Council shall be administered by a certified trainer. A minimum of two personnel per active field operation will have first aid and CPR training. Bloodborne pathogen training located on CH2M's Virtual Office is also required for those designated as first aid/CPR trained.

15.1.3 Safety Coordinator Training

SCs are trained to implement the HSE program on CH2M field projects. A qualified SC is required to be identified in the site-specific HSP for CH2M field projects. SCs must also meet the requirements of the worker category appropriate to the type of field project (construction or hazardous waste). In addition, the SCs shall have completed additional safety training required by the specific work activity on the project that qualifies them to implement the HSE program (for example, fall protection, excavation).

15.1.4 Site-Specific Training

Prior to commencement of field activities, all field personnel assigned to the project will have completed site-specific training that will address the contents of applicable HSPs, including the activities, procedures, monitoring, and equipment used in the site operations. Site-specific training will also include site and facility layout, potential hazards, risks associated with identified emergency response actions, and available emergency services. This training allows field workers to clarify anything they do not understand and to reinforce their responsibilities regarding safety and work operations for their particular activity.

15.1.5 Project-Specific Training Requirements

Project-specific training for this project includes:

- Safety Coordinator Training – CH2M SC-HW must have current SC- Haz Waste
- FA/CPR - The assigned SC-HW onsite must have current FA/CPR training.
- Fire Extinguisher - The assigned SC-HW onsite must take the on-line fire extinguisher training course.
- Waste Management - The assigned SC-HW onsite must take the on-line waste management training course.
- Blood-borne Pathogen - The assigned SC-HW must take the CH2M on-line BBP training course.
- Dangerous Goods Shipping Training - The SC-HW onsite must take the on-line DG training course

16.0 Medical Surveillance and Qualification

(Reference CH2M SOP HSE-113, *Medical Surveillance*

All site workers participating in hazardous waste operations or emergency response (HAZWOPER) will maintain an adequate medical surveillance program in accordance with 29 CFR 1910.120 or 29 CFR 1926.65 and other applicable OSHA standards. Documentation of employee medical qualification (e.g., physician's written opinion) will be maintained in the project files and made available for inspection.

16.1 Hazardous Waste Operations and Emergency Response

CH2M personnel expected to participate in on site HAZWOPER tasks are required to have a current medical qualification for performing this work. Medical qualification shall consist of a qualified physician's written opinion regarding fitness for duty at a hazardous waste site, including any recommended limitations on the employee's assigned work. The physician's written opinion shall state whether the employee has any detected medical conditions that would place the employee at increased risk of material impairment of the employee's health from work in hazardous waste operations or emergency response, or from respirator use.

16.2 Job or Site-Specific Medical Surveillance

Due to the nature of hazards for a particular job or work site, specialized medical surveillance may be necessary. This surveillance could include biological monitoring for specific compounds, or specialized medical examinations.

16.3 Respirator User Qualification

Personnel required to wear respirators must have a current medical qualification to wear respirators. Medical qualification shall consist of a qualified physician's written opinion regarding the employee's ability to safely wear a respirator in accordance with 29 CFR 1910.134.

16.4 Hearing Conservation

Personnel working in hazardous waste operations or operations that fall under 29 CFR 1910.95 and exposed to noise levels in excess of the 85dBA time-weighted average shall be included in a hearing conservation program that includes annual audiometric testing.

17.0 Site-Control Plan

17.1 Site-Control Procedures

(Reference CH2M SOP HSE-218, *Hazardous Waste Operations)*

Site control is established to prevent the spread of contamination throughout the site and to ensure that only authorized individuals are permitted into potentially hazardous areas.

The SC will implement site control procedures including the following bulleted items.

Establish support, contamination reduction, and exclusion zones. Delineate with flags or cones as appropriate. Support zone should be upwind of the site. Use access control at entry and exit from each work zone.

Establish onsite communication consisting of the following:

- Line-of-sight and hand signals;
- Air horn; and
- Two-way radio or cellular telephone if available.

Establish offsite communication.

Establish and maintain the "buddy system."

17.2 Remediation Work Area Zones

(Reference CH2M SOP HSE-218 Hazardous Waste Operations)

A three-zone approach will be used to control areas where site contaminants exist. Access will be allowed only after verification of appropriate training and medical qualification. The three-zone approach shall include an EZ, Contamination Reduction Zone (CRZ) and a Support Zone (SZ). The three-zone approach is not required for construction work performed outside contaminated areas where control of site contamination is not a concern.

Specific work control zones shall be established as necessary during task planning. Site work zones should be modified in the field as necessary, based on such factors as equipment used, air monitoring results, environmental conditions, or alteration of work plans. The following guidelines shall be used for establishing and revising these preliminary zone designations.

17.2.1 Support Zone

The SZ is an uncontaminated area (trailers, offices, field vehicles, etc.) that will serve as the field support area for most operations. The SZ provides field team communications and staging for emergency response. Appropriate sanitary facilities and safety and emergency response equipment will be located in this zone. Potentially contaminated personnel/materials are not allowed in this zone. The only exception will be appropriately packaged and decontaminated materials, or personnel with medical emergencies that cannot be decontaminated.

17.2.2 Contamination Reduction Zone

The CRZ is established between the EZ and the SZ, upwind of the contaminated area where possible. The CRZ provides an area for decontamination of personnel, portable handheld equipment and tools, and heavy equipment. In addition, the CRZ serves as access for heavy equipment and emergency support services.

17.2.3 Exclusion Zone

The EZ is where activities take place that may involve exposure to site contaminants and/or hazardous materials or conditions. This zone shall be demarcated to prevent unauthorized entry. More than one EZ may be established if there are different levels of protection to be employed or different hazards that exist in the same work area. The EZ shall be large enough to allow adequate space for the activity to be completed, including field personnel and equipment, as well as necessary emergency equipment.

The EZ shall be demarcated with some form of physical barrier or signage. The physical barrier or signage shall be placed so that they are visible to personnel approaching or working in the area. Barriers and boundary markers shall be removed when no longer needed.

17.2.4 Other Controlled Areas

Other work areas may need to be controlled due to the presence of an uncontrolled hazard, to warn workers of requirements, or to prevent unauthorized entry. Examples include general construction work areas, open excavations, high noise areas, vehicle access areas, and similar activities or limited access locations. These areas shall be clearly demarcated with physical barriers (fencing, cones, reinforced caution tape or rope) as necessary and posted with appropriate signage.

18.0 Decontamination

(Reference CH2M SOP HSE-218, *Hazardous Waste Operations*)

Decontamination areas will be established for work in potentially contaminated areas to prevent the spread of contamination. Decontamination areas should be located upwind of the exclusion zone where possible and should consider any adjacent or nearby projects and personnel. The SC must establish and monitor the decontamination procedures and their effectiveness. Decontamination procedures found to be ineffective will be modified by the SC. The SC must ensure that procedures are established for disposing of materials generated on the site.

No eating, drinking, or smoking is permitted in contaminated areas and in exclusion or decontamination zones. The SC should establish areas for eating, drinking, and smoking.

18.1 Contamination Prevention

Preventing or avoiding contamination of personnel, tools, and equipment will be considered in planning work activities at all field locations. Good contamination prevention and avoidance practices will assist in preventing worker exposure and result in a more efficient decontamination process. Procedures for contamination prevention and avoidance include the following:

Do not walk through areas of obvious or known contamination;

Do not directly handle or touch contaminated materials;

Make sure there are no cuts or tears in PPE;

Fasten all closures in suits and cover them with duct tape, if appropriate;

Take particular care to protect any skin injuries;

Stay upwind of airborne contamination, where possible;

Do not eat or drink in contaminated work areas;

Do not carry food, beverages, tobacco, or flame-producing equipment into contaminated work areas;

Minimize the number of personnel and amount of equipment in contaminated areas to that necessary for accomplishing the work;

Choose tools and equipment with nonporous exterior surfaces that can be easily cleaned and decontaminated;

Cover monitoring and sampling equipment with clear plastic, leaving openings for the sampling ports, as necessary; and

Minimize the amount of tools and equipment necessary in contaminated areas.

18.2 Personnel and Equipment Decontamination

Personnel exiting an EZ must ensure that they are not spreading potential contamination into clean areas or increasing their potential for ingesting or inhaling potential contaminants. Personal decontamination may range from removing outer gloves as exiting the EZ, to proceeding through an outer layer doffing station including a boot and glove wash and rinse, washing equipment, etc. Equipment that has come into contact with contaminated media must also be cleaned/decontaminated when it is brought out of the EZ.

18.3 Decontamination During Medical Emergencies

Standard personnel decontamination practices will be followed whenever possible. For emergency life saving first aid and/or medical treatment, normal decontamination procedures may need to be abbreviated or omitted. In this situation, site personnel shall accompany contaminated victims to advise

emergency response personnel on potential contamination present and proper decontamination procedures.

Outer garments may be removed if they do not cause delays, interfere with treatment, or aggravate the problem. Protective clothing can be cut away. If the outer garments cannot be safely removed, a plastic barrier between the individual and clean surfaces should be used to help prevent contaminating the inside of ambulances or medical personnel. Outer garments can then be removed at the medical facility.

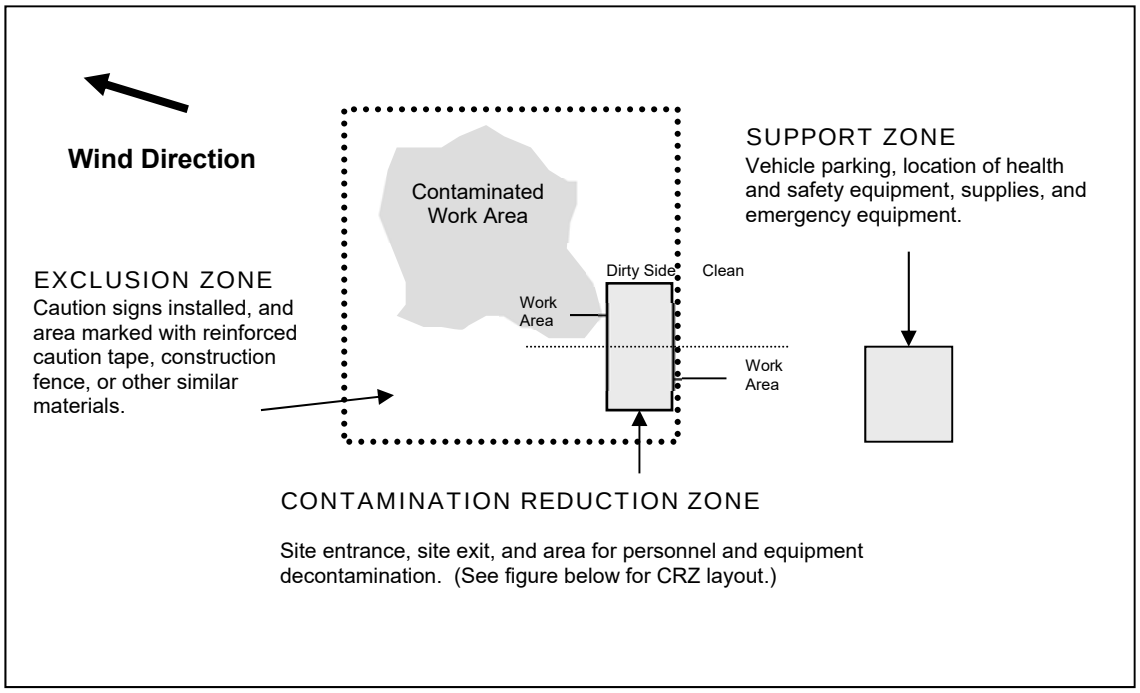
18.4 Waste Collection and Disposal

All contaminated material generated through the personnel and equipment decontamination processes (e.g., contaminated disposable items, gross debris, liquids, sludges) will be properly containerized and labeled, stored at a secure location, and disposed in accordance with the project plans.

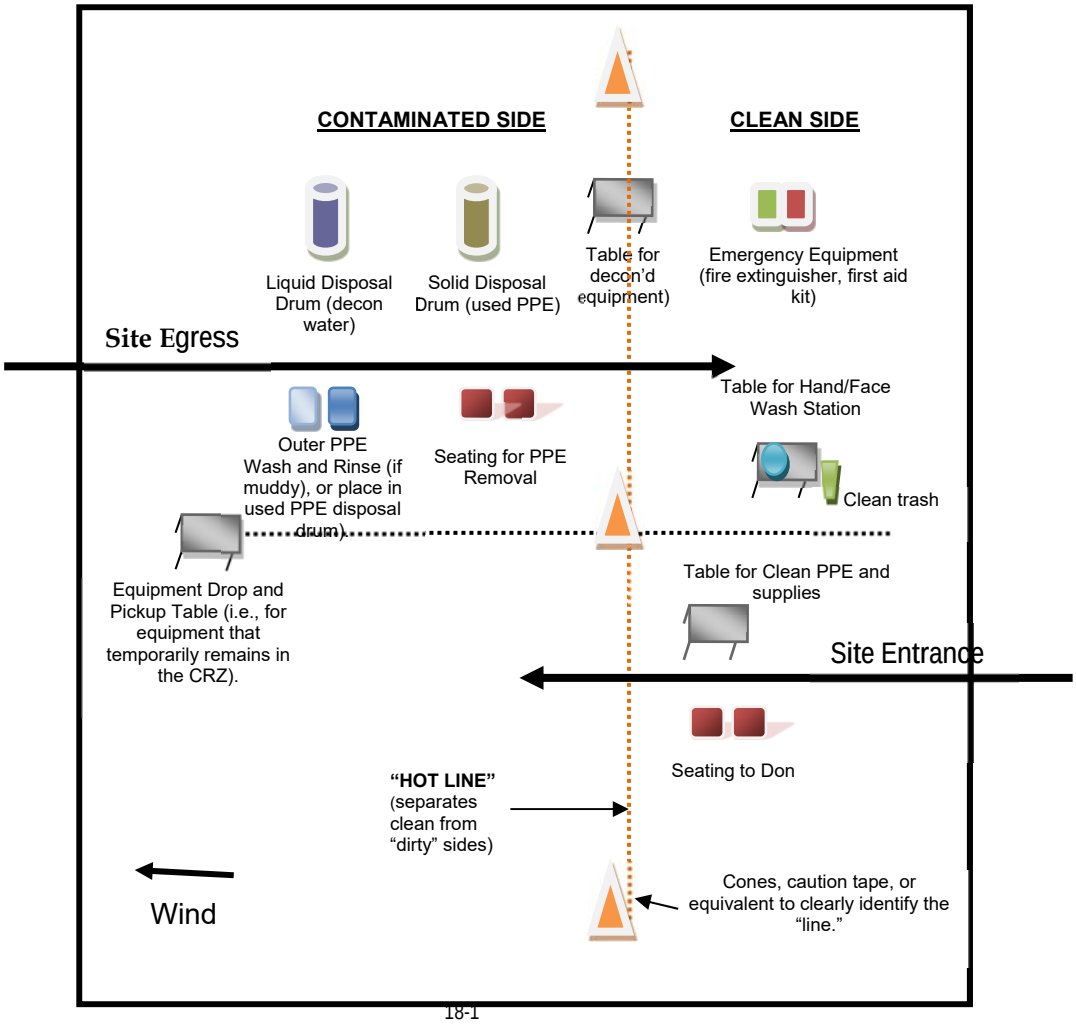
18.5 Diagram of Personnel-Decontamination Line

The following figure illustrates a conceptual establishment of work zones, including the decontamination line. Work zones are to be modified by the SC to accommodate task-specific requirements.

Work Area - Set up appropriately based on wind direction



Typical Contamination Reduction Zone



19.0 Emergency Response Plan

(Reference CH2M SOP HSE-106, *Emergency Planning*)

19.1 Pre-Emergency Planning

The Emergency Response Coordinator (ERC), typically the SC or designee, performs the applicable pre-emergency planning tasks before starting field activities and coordinates emergency response with CH2M onsite parties, the facility, and local emergency-service providers as appropriate. Pre-Emergency Planning activities performed by the ERC include:

Review the facility emergency and contingency plans where applicable;

Determine what onsite communication equipment is available (two-way radio, air horn);

Determine what offsite communication equipment is needed (nearest telephone, cell phone);

Confirm and post the "Emergency Contacts" page and route to the hospital located in this section in project trailer(s) and keep a copy in field vehicles along with evacuation routes and assembly areas. Communicate the information to onsite personnel and keep it updated;

Field Trailers: Post "Exit" signs above exit doors, and post "Fire Extinguisher" signs above locations of extinguishers. Keep areas near exits and extinguishers clear;

Review changed site conditions, onsite operations, and personnel availability in relation to emergency response procedures;

Where appropriate and acceptable to the client, inform emergency room and ambulance and emergency response teams of anticipated types of site emergencies;

Inventory and check site emergency equipment, supplies, and potable water;

Communicate emergency procedures for personnel injury, exposures, fires, explosions, and releases;

Rehearse the emergency response plan before site activities begin. This may include a "tabletop" exercise or an actual drill depending on the nature and complexity of the project. Drills should take place periodically but no less than once a year;

Brief new workers on the emergency response plan; and

The ERC will evaluate emergency response actions and initiate appropriate follow-up actions.

19.2 Emergency Equipment and Supplies

The ERC shall ensure the following emergency equipment is on the site. Verify and update the locations of this equipment as needed. The equipment will be inspected in accordance with manufacturer's recommendations. The inspection shall be documented in a field logbook or similar means to be kept in the project files.

Emergency Equipment and Supplies	Location
20 (or two 10) class A,B,C fire extinguisher	Field vehicle/Boat
First aid kit	Field vehicle/Boat
Potable water	Field vehicle/Boat
Bloodborne-pathogen kit	Field vehicle/Boat
Marine-band Radio	Boat
Satellite phone	Field Vehicle/Boat (if cell coverage is not expected); AECOM boats will be equipped with marine-band radios and satellite phones based on discussions with them
Additional equipment (specify): Cellular phone	Field vehicle/Boat

19.3 Incident Response

In fires, explosions, or chemical releases, actions to be taken include the following:

Notify appropriate response personnel;

Shut down CH2M operations and evacuate the immediate work area;

Account for personnel at the designated assembly area(s);

Assess the need for site evacuation, and evacuate the site as warranted;

Implement HSE-111, Incident Notification, Reporting and Investigation; and

Notify and submit reports to clients as required in contract.

- Small fires or spills posing minimal safety or health hazards may be controlled with onsite spill kits or fire extinguishers without evacuating the site. When in doubt evacuate. Follow the incident reporting procedures in the "Incident Notification, Reporting, and Investigation" section of this HSP.

19.4 Emergency Medical Treatment

Emergency medical treatment is needed when there is a life-threatening injury (such as severe bleeding, loss of consciousness, breathing or heart has stopped). When in doubt if an injury is life-threatening or not, treat it as needing emergency medical treatment.

Notify 911 or other appropriate emergency response authorities as listed in the "Emergency Contacts" page located in this section.

The ERC will assume charge during a medical emergency until the ambulance arrives or until the injured person is admitted to the emergency room.

Prevent further injury, perform decontamination (if applicable) where feasible; lifesaving and first aid or medical treatment takes priority.

Initiate first aid and CPR where feasible.

Notify supervisor and if the injured person is a CH2M employee, the supervisor will call the occupational nurse at 1-855-328-6547 and make other notifications as required by HSE SOP-111, *Incident Notification, Reporting and Investigation*.

Make certain that the injured person is accompanied to the emergency room.

Follow the Serious Incident Reporting process in HSE SOP-111, Incident Notification, Reporting and Investigation, and complete incident report using the HITS system on the VO or if not feasible, use the hard copy forms provided as an attachment to this HSP.

Notify and submit reports to client as required in contract.

19.5 Evacuation

Evacuation routes, assembly areas, and severe weather shelters (and alternative routes and assembly areas) are to be specified on the site map.

Evacuation route(s) and assembly area(s) will be designated by the ERC or designee before work begins.

Personnel will assemble at the assembly area(s) upon hearing the emergency signal for evacuation.

The ERC and a "buddy" will remain on the site after the site has been evacuated (if safe) to assist local responders and advise them of the nature and location of the incident.

The ERC will account for all personnel in the onsite assembly area.

A designated person will account for personnel at alternate assembly area(s).

The ERC will follow the incident reporting procedures in the "Incident Notification, Reporting and Investigation" section of this HSP.

19.6 Evacuation Signals

Signal	Meaning
Grasping throat with hand	Emergency-help me.
Thumbs up	OK; understood.
Grasping buddy's wrist	Leave area now.
Continuous sounding of horn	Emergency; leave site now.

20.0 Spill Containment Procedures

CH2M and subcontractor personnel working at the project site shall be knowledgeable of the potential health, safety and environmental concerns associated with petroleum and other substances that could potentially be released at the project site.

The following is a list of criteria that must be addressed in CH2M's or the subcontractor's plans in the event of a spill or release. In the event of a large quantity spill notify emergency services. Personnel discovering a spill shall (only if safe to do so):

Stop or contain the spill immediately (if possible) or note source. Shut off the source (e.g., pump, treatment system) if possible. If unsafe conditions exist, then leave the area, call emergency services, inform nearby personnel, notify the site supervisors, and initiate incident reporting process. The SC shall be notified immediately;

Extinguish sources of ignition (flames, sparks, hot surfaces, cigarettes);

Clear personnel from the spill location and barricade the area;

Use available spill control equipment in an effort to ensure that fires, explosions, and releases do not occur, recur, or spread;

Use sorbent materials to control the spill at the source;

Construct a temporary containment dike of sorbent materials, cinder blocks, bricks or other suitable materials to help contain the spill;

Attempt to identify the character, exact source, amount, and extent of the released materials. Identification of the spilled material should be made as soon as possible so that the appropriate cleanup procedure can be identified;

Assess possible hazards to human health or the environment as a result of the release, fire or explosion; and

Follow incident notification, reporting, and investigation section of this plan.

21.0 Inspections

21.1 Safe Behavior Observations

Safe Behavior Observations (SBOs) are a tool to be used by supervisors to provide positive reinforcement for work practices performed correctly, while also identifying and eliminating deviations from safe work procedures that could result in a loss.

The SC or designee shall perform at least one SBO each week for any field work performed by subcontractors or when there are at least two CH2M personnel performing field work.

The SC or designee shall complete the SBO form (attached to this HSP) for the task/operation being observed and submit them weekly.

For commercial projects, SBOs may be submitted electronically by e-mailing them to the address, "CH2MHILL ES COM Safe Behavior Observations" when connected to the network or at SafeBehaviorObservations@ch2m.com. For Federal projects, SBOs may be submitted electronically by e-mailing them to the address, "CH2M ES FED Safe Behavior Observations" when connected to the network or at CH2MHILLESFEDSafeBehaviorObservation@ch2m.com.

22.0 Incident Notification, Reporting, and Investigation

(Reference CH2M SOP HSE-111, *Incident Notification, Reporting and Investigation*)

22.1 General Information

This section applies to the following:

All injuries involving employees, third parties, or members of the public;

Damage to property or equipment;

Interruptions to work or public service (hitting a utility);

Incidents which attract negative media coverage;

Near misses;

Spills, leaks, or regulatory violations; and

Motor vehicle accidents.

Documentation, including incident reports, investigation, analysis and corrective measure taken, shall be kept by the SC and maintained onsite for the duration of the project.

22.2 Section Definitions

Incident: An incident is an event that causes or could have caused undesired consequences. An incident may be caused by natural forces, employees, subcontractors, or third parties in any location associated with CH2M operations, including offices, warehouses, project sites, private property, or public spaces. Incidents include:

Injury or illness to a CH2M employee or subcontractor employee, or member of the public;

Property damage;

Spill or release;

Environmental requirement or permit violation;

A "near-miss"; or

Other (e.g., fire, explosion, bomb threat, workplace violence, threats)

Accident: an incident involving actual loss through injury, damage to assets, or environmental harm.

Near Miss: A near-miss occurs when an intervening factor prevented an injury or illness, property damage, spill or release, permit violation or other event from occurring. Examples of near-miss situations include: a hard hat or other personal protective equipment (PPE) prevented an injury; secondary containment or emergency shutoff prevented a spill; or an alert co-worker prevented an incident.

Serious Incident:

A Serious Incident must be immediately reported to senior management includes:

- Work related death, or life threatening injury or illness of a CH2M employee;
- subcontractor, or member of the public;
- Kidnap/missing person;
- Acts or threats of terrorism;
- Event that involves a fire, explosion, or property damage that requires a site evacuation or is estimated to result in greater than $ 500,000 in damage; or

- Spill or release of hazardous materials or substances that involves a significant threat of imminent harm to site workers, neighboring facilities, the community or the environment.

22.3 Reporting Requirements

All employees and subcontractors' employees shall immediately report any incident (including "near misses," as defined in the section above) in which they are involved or witness to their supervisor.

The CH2M or Subcontractor supervisor, upon receiving an incident report, shall inform his immediate superior and the CH2M SC.

The SC shall immediately report the following information to the RHSM and PM by phone and e-mail:

Project Name and Site Manager;

Date and time of incident;

Description of incident;

Extent of known injuries or damage;

Level of medical attention; and

Preliminary root cause/corrective actions

The RHSM shall immediately inform the EM (or available alternate) of spills, potential environmental permit compliance, or any environmental situation that could result in a notice of violation from an agency.

The CH2M team shall comply with all applicable statutory incident reporting requirements such as those to OSHA, the police, or state or Federal environmental agency.

22.4 HITS System and Incident Report Form

CH2M maintains a HITS entry and/or Incident Report Form (IRF) for all work-related injuries and illnesses sustained by its employees in accordance with recordkeeping and insurance requirements. A HITS entry and/or IRF will also be maintained for other incidents (property damage, fire or explosion, spill, release, potential violation, and near misses) as part of our loss prevention and risk reduction initiative.

The SC shall complete an entry into the Hours and Incident Tracking System (HITS) database system located on CH2M's Virtual Office (or if VO not available, use the hard copy Incident Report Form and Root Cause Analysis Form and forward it to the RHSM) within 24 hours and finalize those forms within 3 calendar days.

22.5 Injury Management/Return-to-Work (for US/Puerto Rico based CH2M Staff Only)

(Reference CH2M, SOP HSSE-124, Injury Management/Return-to-Work)

22.5.1 Background

The Injury Management Program has been established to provide orderly, effective and timely medical treatment and return-to-work transition for an employee who sustains a work-related injury or illness. It also provides guidance and assistance with obtaining appropriate treatment to aid recovery, keep supervisors informed of employee status, and to quickly report and investigate work-related injury/illnesses to prevent recurrence.

To implement the Injury Management/Return-to-Work Program successfully, supervisors and/or SC should:

Ensure employees are informed of the Injury Management/Return-to-Work Program;

Become familiar with the Notification Process (detailed below); and

Post the Injury Management/Return-to-Work Notification Poster.

22.5.2 The Injury Management/Return-to-Work Notification Process:

Employee informs their supervisor.

Employee calls the Injury Management Program toll free number 1-855-328-6547 immediately and speaks with the Occupational Injury Nurse. This number is operable 24 hours per day, 7 days a week.

Supervisor ensures employee immediately calls the Injury Management Program number. Supervisor makes the call with the injured worker or for the injured worker, if needed.

Nurse assists employee with obtaining appropriate medical treatment, as necessary schedules clinic visit for employee (calls ahead, and assists with any necessary follow up treatment). The supervisor or SC accompanies the employee if a clinic visit is necessary to ensure that employees receive appropriate and timely care.

Supervisor or SC completes the HITS entry or Incident Report Form immediately (within 24 hours) and forwards it to the Project Manager and RHSM.

Nurse notifies appropriate CH2M staff by e-mail (supervisor, Health & Safety, Human Resources, Workers' Compensation).

Nurse communicates and coordinates with and for employee on treatment through recovery.

Supervisor ensures suitable duties are identified and available for injured or ill workers who are determined to be medically fit to return to work on transitional duty (temporary and progressive).

Supervisor ensures medical limitations prescribed (if any) by physician are followed until the worker is released to full duty.

22.6 Serious Incident Reporting Requirements

(Reference CH2M SOP HSE-111, *Incident Reporting, Notification and Investigation*)

The serious incident reporting requirements ensures timely notification and allows for positive control over flow of information so that the incident is handled effectively, efficiently, and in conjunction with appropriate corporate entities. This standard notification process integrates Health, Safety, Security and Environment and Firm Wide Security Operations requirements for the consistent reporting of and managing of serious events throughout our operations.

22.6.1 Serious Incident Determination

The following are general criteria for determining whether an incident on CH2M owned or managed facilities or program sites is considered serious and must be immediately reported up to Group President level through the reporting/notification process:

Work related death, or life threatening injury or illness of a CH2M employee, subcontractor, or member of the public;

Kidnap or missing person;

Acts or threats of terrorism;

Event that involves a fire, explosion, or property damage that requires a site evacuation or is estimated to result in greater than $ 500,000 in damage; or

Spill or release of hazardous materials or substances that involves a significant threat of imminent harm to site workers, neighboring facilities, the community or the environment.

22.6.2 Serious Incident Reporting

If an incident meets the "Serious Incident" criteria, the Project Manager is to immediately contact the Crisis Manager at 720-286-4911, then follow the standard incident reporting procedure.

For all serious incidents this standard reporting process is implemented immediately so as to ultimately achieve notification to the Business Group President within 2 hours of incident onset or discovery, and notification to appropriate corporate Crisis Management Support Team.

22.7 Incident Root Cause Analysis

The accident analysis is essential if all causes of the incident are to be identified for the correct remedial actions to be taken to prevent the same and similar type of incident from recurring. Root Cause Analysis (RCA) shall be completed for all recordable injuries, property damage incidents in excess of $5000.00 (US), environmental permit violations, spills and releases which are required to be reported to regulatory agencies, and any other incident, including near misses where they RHSM or PM determines an RCA is appropriate. The RHSM/REM is responsible for ensuring it is completed and results entered in the incident report form in HITS. RCA's must be completed using a Team that includes, at least the RHSM or designee, the involved party(ies), a responsible operations representative (e.g. PM, construction manager, crew supervisor, etc.) and an independent management representative not associated with the incident.

The Root Cause Analysis Form must be completed for all Loss Incidents and Near Loss Incidents. This form must be submitted to the investigation team for review.

For minor losses or near losses, the information may be gathered by the supervisor or other personnel immediately following the loss. Based on the complexity of the situation, this information may be all that is necessary to enable the investigation team to analyze the loss, determine the root cause, and develop recommendations. More complex situations may require the investigation team to revisit the loss site or re-interview key witnesses to obtain answers to questions that may arise during the investigation process.

Photographs or videotapes of the scene and damaged equipment should be taken from all sides and from various distances. This point is especially important when the investigation team will not be able to review the loss scene.

The investigation team must follow the Root Cause Analysis Flow Chart (see Attachment 4 of the SOP) to assist in identifying the root cause(s) of a loss. Any loss may have one or more root causes and contributing factors. The root cause is the primary or immediate cause of the incident, while a contributing factor is a condition or event that contributes to the incident happening, but is not the primary cause of the incident. Root causes and contributing factors that relate to the person involved in the loss, his or her peers, or the supervisor should be referred to as "personal factors." Causes that pertain to the system within which the loss or injury occurred should be referred to as "job factors."

Personal factors include:

Lack of skill or knowledge;

Correct way takes more time and/or requires more effort;

Short-cutting standard procedures is positively reinforced or tolerated; or

Person thinks there is no personal benefit to always doing the job according to standards.

Job Factors include:

Lack of or inadequate operational procedures or work standards;

Inadequate communication of expectations regarding procedures or standards; or

Inadequate tools or equipment.

The root cause(s) could be any one or a combination of these seven possibilities or some other uncontrollable factor. In the vast majority of losses, the root cause is very much related to one or more of these seven factors. Uncontrollable factors should be used rarely and only after a thorough review eliminates all seven other factors.

22.7.1 Corrective Actions

Include all corrective actions taken or those that should be taken to prevent recurrence of the incident. Include the specific actions to be taken, the employer and personnel responsible for implementing the actions, and a timeframe for completion. Be sure the corrective actions address the causes.

Once the investigation report has been completed, the PM shall hold a review meeting to discuss the incident and provide recommendations. The responsible supervisors shall be assigned to carry out the recommendations, and shall inform the SC upon successful implementation of all recommended actions.

Evaluation and follow-up of the IRF will be completed by the type of incident by the RHSM, EM, or FWSO.

Incident investigations must be initiated and completed as soon as possible but no later than 72 hours after the incident.

23.0 Records and Reports

An organized project filing system is essential for good documentation and recordkeeping. There are many benefits to an organized filing system:

Other CH2M employees can easily and quickly find documents;

Records are readily available for review;

Records may be needed during OSHA investigations, audits, or other legal matters;

Records may be needed on short notice in case of an accident, illness or other emergency; and

Systematic recordkeeping aids in overall project organization.

The project filing system shall be established at the beginning of the project and maintained throughout all phases of construction and archived in accordance with CH2M's Records Retention Policy. The information contained in the filing system shall be updated regularly and/or as specified in this document. The PM and SC are responsible for collecting documentation, including subcontractor documentation, and maintaining a complete and organized filing system.

Below are examples of records that must be maintained as the project progresses:

Exposure records includes air monitoring data (including calibration records), MSDSs, exposure modeling results;

Physical hazard exposure records include noise, ionizing radiation, non-ionizing radiation, vibration, and lasers exposure assessments and measurements;

Respiratory fit test records;

Training records;

Incident reports, investigations and associated back-up information such as agency notifications, calculations, and corrective actions taken;

Federal or state agency inspection records;

Other Records:

- HSE audits and assessments;
- Project-specific HSE plans;
- SBOs;

The RHSM shall coordinate with the PM or designee to ensure that final project-specific HSE records described in this section, including negative exposure determinations, are maintained with the project files in accordance with the CH2M records retention schedule, or forwarded to the Medical Surveillance Program Administrator, as appropriate. Records retention requirements are detailed in the Recordkeeping and Access to Records SOP, HSE-119.

CH2M Health and Safety Plan

Attachment 1

Health and Safety Plan Employee Sign-off Form

EMPLOYEE SIGNOFF FORM

Health and Safety Plan

The CH2M project employees and subcontractors listed below have been provided with a copy of this HSP, have read and understood it, and agree to abide by its provisions.

Project Name: **Project Number:**

EMPLOYEE NAME (Please print)	**EMPLOYEE SIGNATURE**	**COMPANY**	**DATE**

CH2M Health and Safety Plan

Attachment 2

Chemical Inventory/Register Form

CHEMICAL INVENTORY/REGISTER FORM

Refer to SOP HSE-107, Attachment 1, for instructions on completing this form.

Location:

HCC:

☐ Office ☐ Warehouse ☐ Laboratory ☐ Project:

Project No.:

Regulated Product	Location	Container labeled (✓if yes)	MSDS available (✓if yes)

MSDS for the listed products will be maintained at:

CH2M Health and Safety Plan

Attachment 3

Chemical-Specific Training Form

CHEMICAL-SPECIFIC TRAINING FORM

Refer to SOP HSE-107 Attachment 1 for instructions on completing this form.

Location:	Project # :
HCC:	Trainer:

TRAINING PARTICIPANTS:

NAME	SIGNATURE	NAME	SIGNATURE

REGULATED PRODUCTS/TASKS COVERED BY THIS TRAINING:

The HCC shall use the product MSDS to provide the following information concerning each of the products listed above.

☐ Physical and health hazards

☐ Control measures that can be used to provide protection (including appropriate work practices, emergency procedures, and personal protective equipment to be used)

☐ Methods and observations used to detect the presence or release of the regulated product in the workplace (including periodic monitoring, continuous monitoring devices, visual appearance or odor of regulated product when being released, etc.)

Training participants shall have the opportunity to ask questions concerning these products and, upon completion of this training, will understand the product hazards and appropriate control measures available for their protection.

Copies of MSDSs, chemical inventories, and CH2M's written hazard communication program shall be made available for employee review in the facility/project hazard communication file.

CH2M Health and Safety Plan

Attachment 4

Key Target Zero Program Elements

(blank forms for field use)

Activity Hazard Analysis

Pre-Task Safety Plans

Safe Behavior Observation

ACTIVITY HAZARD ANALYSIS

Activity:	**Date**:
	Project Name:
Description of the work:	**Site Supervisor**:
	Site Safety Officer:
	Review for latest use: Before the job is performed

Work Activity Sequence (Identify the principal steps involved and the sequence of work activities)	Potential Health and Safety Hazards (Analyze each principal step for potential hazards)	Hazard Controls (Develop specific controls for each potential hazard)

ACTIVITY HAZARD ANALYSIS

Work Activity Sequence (Identify the principal steps involved and the sequence of work activities)	Potential Health and Safety Hazards (Analyze each principal step for potential hazards)	Hazard Controls (Develop specific controls for each potential hazard)

Equipment to be used (List equipment to be used in the work activity)	**Inspection Requirements** (List inspection requirements for the work activity)	**Training Requirements** (List training requirements including hazard communication)

ACTIVITY HAZARD ANALYSIS

	PRINT NAME	SIGNATURE	
Supervisor Name:	_____	_____	**Date/Time:** _____
Safety Officer Name:	_____	_____	**Date/Time:** _____
Employee Name(s):	_____	_____	**Date/Time:** _____
	_____	_____	**Date/Time:** _____
	_____	_____	**Date/Time:** _____
	_____	_____	**Date/Time:** _____
	_____	_____	**Date/Time:** _____
	_____	_____	**Date/Time:** _____
	_____	_____	**Date/Time:** _____
	_____	_____	**Date/Time:** _____
	_____	_____	**Date/Time:** _____

Pre-Task Safety Plan (PTSP) and Safety Meeting Sign-in Sheet

Project:_____ Location: _____ Date:_____

Supervisor: _____ Job Activity:_____

_____

Attendees: Print Name Sign Name

_____

_____

_____

_____

_____

_____

_____

List Tasks and verify that applicable AHAs have been reviewed:

_____

_____

_____

Tools/Equipment Required for Tasks (ladders, scaffolds, fall protection, cranes/rigging, heavy equipment, power tools):

_____

_____

_____

Potential H&S Hazards, including chemical, physical, safety, biological and environmental (check all that apply):

__ Chemical burns/contact	__ Trench, excavations, cave-ins	__ Ergonomics
__ Pressurized lines/equipment	__ Overexertion	__ Chemical splash
__ Thermal burns	__ Pinch points	__ Poisonous plants/insects
__ Electrical	__ Cuts/abrasions	__ Eye hazards/flying projectile
__ Weather conditions	__ Spills	__ Inhalation hazard
__ Heights/fall > 6 feet	__ Overhead Electrical hazards	__ Heat/cold stress
__ Noise	__ Elevated loads	__ Water/drowning hazard
__ Explosion/fire	__ Slips, trip and falls	__ Heavy equipment
__ Radiation	__ Manual lifting	__ Aerial lifts/platforms
__ Confined space entry	__ Welding/cutting	__ Demolition
__Underground Utilities	__ Security	__ Poor communications

Other Potential Hazards (Describe):

_____

_____

_____

Hazard Control Measures (Check All That Apply):			
PPE __ Thermal/lined __ Eye __ Dermal/hand __ Hearing __ Respiratory __ Reflective vests __ Flotation device __ Hard Hat	Protective Systems __ Sloping __ Shoring __ Trench box __ Barricades __ Competent person __ Locate buried utilities __ Daily inspections __ Entry Permits/notification	Fire Protection __ Fire extinguishers __ Fire watch __ Non-spark tools __ Grounding/bonding __ Intrinsically safe equipment	Electrical __ Lockout/tagout __ Grounded __ Panels covered __ GFCI/extension cords __ Power tools/cord inspected __ Overhead line clearance __ Underground utils ID'd
Fall Protection __ Harness/lanyards __ Adequate anchorage __ Guardrail system __ Covered opening __ Fixed barricades __ Warning system	Air Monitoring __ PID/FID __ Detector tubes __ Radiation __ Personnel sampling __ LEL/O2 __ No visible dust __ Other	Proper Equipment __ Aerial lift/ladders/scaffolds __ Forklift/heavy equipment __ Backup alarms __ Hand/power tools __ Crane with current inspection __ Proper rigging __ Operator qualified	Welding & Cutting __ Cylinders secured/capped __ Cylinders separated/upright __ Flash-back arrestors __ No cylinders in CSE __ Flame retardant clothing __ Appropriate goggles
Confined Space Entry __ Isolation __ Air monitoring __ Trained personnel __ Permit completed __ Rescue	Medical/ER __ First-aid kit __ Eye wash __ FA-CPR trained personnel __ Route to hospital	Heat/Cold Stress __ Work/rest regime __ Rest area __ Liquids available __ Monitoring __ Training	Vehicle/Traffic __ Traffic control __ Barricades __ Flags __ Signs
Permits __ Hot work __ Confined space __ Lockout/tagout __ Excavation __ Demolition __ Energized work	Demolition __ Pre-demolition survey __ Structure condition __ Isolate area/utilities __ Competent person __ Hazmat present	Inspections: __ Ladders/aerial lifts __ Lanyards/harness __ Scaffolds __ Heavy equipment __ Drill rigs/geoprobe rigs __ Cranes and rigging __ Utilities marked	Training: __ Hazwaste (current) __ Construction __ Competent person __ Task-specific __ FA/CPR __ Confined Space __ Hazcom
Underground Utilities __Dig alert called __3rd Party locater __As-builts reviewed __Interview site staff __Client review __soft locate necessary?	Incident Communications __Work stops until cleared by TM/CM __Immediate calls to TM/CM __Client notification __24 hour notification setup __Clear communications	AHA' s __reviewed and approved by HSM __on site and current __applicable for this day's work __Communication and incident processes included?	
Field Notes (including observations from prior day, etc.): _____ _____ _____			

Name (Print): _____
Signature:_____ Date:_____

Safe Behavior Observation Form			
☐Federal or ☐Commercial Sector (check one)		☐Construction or ☐Consulting (check one)	
Project Number:	Client/Program:		
Project Name:	Observer:		Date:
Position/Title of worker observed:	Background Information/ comments:		
Task/Observation Observed:			

- ❖ Identify and reinforce safe work practices/behaviors
- ❖ Identify and improve on at-risk practices/acts
- ❖ Identify and improve on practices, conditions, controls, and compliance that eliminate or reduce hazards
- ❖ Proactive PM support facilitates eliminating/reducing hazards (do you have what you need?)
- ❖ Positive, corrective, cooperative, collaborative feedback/recommendations

Actions & Behaviors	Safe	At-Risk	Observations/Comments
Current & accurate Pre-Task Planning/Briefing (Project safety plan, STAC, AHA, PTSP, tailgate briefing, etc., as needed)			**Positive Observations/Safe Work Practices:**
Properly trained/qualified/experienced			
Tools/equipment available and adequate			
Proper use of tools			**Questionable Activity/Unsafe Condition Observed:**
Barricades/work zone control			
Housekeeping			
Communication			
Work Approach/Habits			
Attitude			
Focus/attentiveness			**Observer's Corrective Actions/Comments:**
Pace			
Uncomfortable/unsafe position			
Inconvenient/unsafe location			
Position/Line of fire			
Apparel (hair, loose clothing, jewelry)			
Repetitive motion			**Observed Worker's Corrective Actions/Comments:**
Other…			

For National Government Sector projects please email completed forms to: CH2M ES FED Safe Behavior Observation

CH2M Health and Safety Plan

Attachment 5

Fact Sheets

Vehicle Accident Guidance

Ticks

2018 Vehicle Accident Guidance

Definitions

Auto Liability: Injury or damage caused by a vehicle a CH2M employee is driving

Auto Physical Damage: Damage to the vehicle the CH2M employee is driving

NOTE: When driving your personal vehicle on company business, your personal auto insurance will respond to any automobile accident.

Insurance Cards

Please print and place in your vehicle

Fleet Vehicles: VO – Corporate Functions/Insurance & Bonding, Additional Resources, Auto ID Cards, Fleet: 2017-2018 Auto ID Cards FLEET (choose the state where the vehicle is garaged)

Rental Vehicles: VO – Corporate Functions/Insurance & Bonding, Additional Resources, Auto ID Cards, 2017-2018 Auto ID Cards Hired & Non-Owned (choose the state your driver's license issued)

NOTE: ALL Rental Vehicles should be rented through **Travel and Transport** or by using the **Corporate Code** to obtain the corporate rental rate as well as the Loss Damage Waiver. If the vehicle is not rented through Travel and Transport with the appropriate Company Code, the **entire cost of the auto accident could be charged to your Project.**

Rental Company	Company Code
Enterprise	XZ12139 (cars)
Enterprise	TK00442 (trucks)
National	XZ12139
Hertz	71499
Budget	T694100
Avis	A679700

When an Incident Occurs

In case of emergency – call 911

Notify your supervisor, Project Manager, and Project Health and Safety Manager

At the scene of the accident:

- ✓ Call the Police
- ✓ Take precautions to protect the scene of the accident from further accidents
- ✓ Provide emergency care for injured persons
- ✓ Request medical assistance
- ✓ Do not provide transportation
- ✓ Gather as much information as possible
- ✓ Take pictures
- ✓ Obtain witness names and addresses

Never admit liability. If asked, state that the claim will be or has been reported to your insurance carrier and an adjuster will contact them.

Complete a HITS Report – VO – Policies & Resources/Health, Safety & Environment/Program, HITS

Claim Reporting

Rental Vehicle (through Travel & Transport or rented using the CH2M Corporate Code):
Contact the rental company and report the claim; and
Send an email with all pertinent information to CH2MGlobalTravel@ch2m.com **AND** AutoClaims@jacobs.com

Leased Vehicle:
Damage to Leased Vehicle Only:
Report the claim to ARI, 1-800-221-1645
Damage to Leased Vehicle and/or damage to other property, vehicles and/or injuries:
Report the claim to ARI and to AutoClaims@jacobs.com; and
Notify Michelle Garcia/DEN, 720-286-4273

Rental Vehicles not rented through Travel and Transport (or not rented using the CH2M Corporate Code but rented with Corporate Visa):

Rented with Corporate VISA:

1. Report claim to the rental company
2. Report claim to VISA **immediately** (coverage is void if not reported within 30 days) – 800 847-2911
3. Notify AutoClaims@jacobs.com and CH2MGlobalTravel@ch2m.com

Not Rented with Corporate VISA:

1. Report claim to rental company
2. Send an email with pertinent information to CH2MGlobalTravel@ch2m.com **AND** AutoClaims@jacobs.com

If You are Injured in the Accident

- ✓ **Notify your supervisor, Project Manager, and Project Health and Safety Manager**
- ✓ **Call JacobsCare (Continental U.S. including Hawaii and Anchorage, AK) at 1-855-328-6547**
  Other locations:
  - North Slope and Anchorage Fab employees continue to call +1 888 297-2725
  - Canada, contact your supervisor and your HSE representative and call the Nurse Triage number at 1-877-424-5256
  - Puerto Rico will contact your supervisor, HSE representative and HR

For International, contact your supervisor, HSE representative and HR

Tick-Borne Pathogens — A Fact Sheet

Most of us have heard of Lyme disease or Rocky Mountain Spotted Fever (RMSF), but there are actually six notifiable tick-borne pathogens that present a significant field hazard. In some areas, these account for more than half of our serious field incidents. The following procedures should be applied during any field activity—even in places that are predominantly paved with bordering vegetation.

Hazard Recognition

An important step in controlling tick related hazards is understanding how to identify ticks, their habitats, their geographical locations, and signs and symptoms of tick-borne illnesses.

Tick Identification

There are five varieties of hard-bodied ticks that have been associated with tick-borne pathogens. These include:

Deer (Black Legged) Tick (eastern and pacific varieties)

Lone Star Tick

Dog Tick

Rocky Mountain Wood Tick

These varieties and their geographical locations are illustrated on the following page.

Tick Habitat

In eastern states, ticks are associated with deciduous forest and habitat containing leaf litter. Leaf litter provides a moist cover from wind, snow, and other elements. In the north-central states, is generally found in heavily wooded areas often surrounded by broad tracts of land cleared for agriculture.

On the Pacific Coast, the bacteria are transmitted to humans by the western black-legged (deer) tick and habitats are more diverse. For this region, ticks have been found in habitats with forest, north coastal scrub, high brush, and open grasslands. Coastal tick populations thrive in areas of high rainfall, but ticks are also found at inland locations.

Illnesses and Signs & Symptoms

There are six notifiable tick-borne pathogens that cause human illness in the United States. These pathogens may be transmitted during a tick bite—normally hours after attachment. The illnesses, presented in approximate order of most common to least, include:

Lyme (bacteria)

RMSF (bacteria)

Ehrlichiosis (bacteria)

STARI (Southern Tick-Associated Rash Illness) (bacteria)

Tularemia (Rabbit Fever) (bacteria)

Babesia (protozoan parasite)

Symptoms will vary based on the illness, and may develop in infected individuals typically between 3 and 30 days after transmission. Some infected individuals will not become ill or may develop only mild symptoms. These illnesses present with some or all of the following signs & symptoms: fever, headache, muscle aches, stiff neck, joint aches, nausea, vomiting, abdominal pain, diarrhea, malaise, weakness, small solid, ring-like, or spotted rashes. The bite site may be red, swollen, or develop ulceration or lesions. For Lyme disease, the bite area will sometimes resemble a target pattern. A variety of long-term symptoms may result if the illness is left untreated, including debilitating effects and death.

Deer Tick

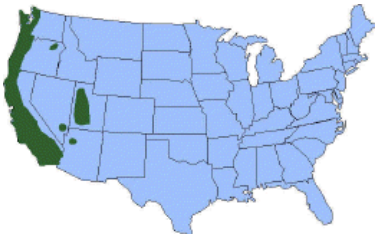
From Left: adult female, adult male, nymph, and larvae Deer Tick (cm scale)

Lone Star Tick

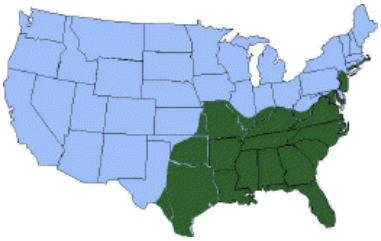
Dog Tick

Rocky Mountain Wood Tick

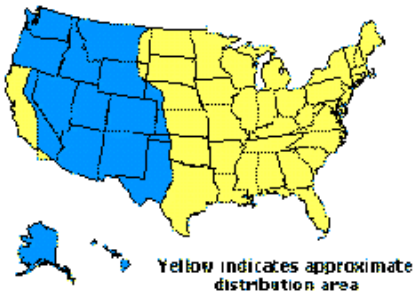
Distribution of Deer Tick (dark green)

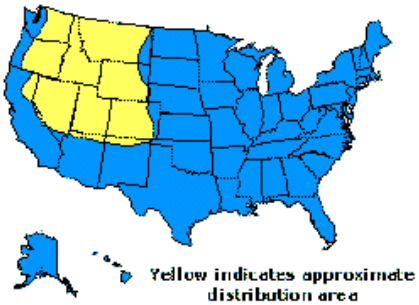


Distribution of Pacific Deer Tick (dark green)



Distribution of Lone Star Tick (Green)





Hazard Control

The methods for controlling exposure to ticks include, in order of most- to least-preferred:

Avoiding tick habitats and ceasing operations in heavily infested areas

Reducing tick abundance through habitat disruption or application of acracide

Personal protection through use of repellants and protective clothing

Frequent tick inspections and proper hygiene

Vaccinations are not available and preventative antibiotic treatment after a bite is generally not recommended.

Avoidance and Reduction of Ticks

To the extent practical, tick habitats should be avoided. In areas with significant tick infestation, consider stopping work and withdrawing from area until adequate tick population control can be achieved. Stopping and withdrawing should be considered as seriously as entering an area without proper energy control or with elevated airborne contaminants—tick-borne pathogens present risk of serious illness!

In areas where significant population density or infestation exists, tick reduction should be considered. Tick reduction can be achieved by disrupting tick habitats and/or direct population reduction through the use of tick-toxic pesticides (Damminix, Dursban, Sevin, etc.).

Habitat disruption may include only simple vegetative maintenance such as removing leaf litter and trimming grass and brush. Tick populations can be reduced by between 72 and 100 percent when leaf litter alone is removed. In more heavily infested areas, habitat disruption may include grubbing, tree trimming or removal, and pesticide application (Damminix, Dursban, Sevin, etc.). This approach is practical in smaller, localized areas or perimeter areas that require occasional access. Habitat controls are to be implemented with appropriate health and safety controls, in compliance with applicable environmental requirements, and may be best left to the property owner or tenant or to a licensed pesticide vendor. Caution should be exercised when using chemical repellents or pesticides in or around areas where environmental or industrial media samples will be collected for analysis.

Personal Protection

After other prevention and controls are implemented, personal protection is still necessary to control exposure to ticks. Personal protection must include all of the following steps:

So that ticks may be easily seen, wear light-colored clothing. Full-body New Tyvek (paper-like disposable coveralls) may also be used

To prevent ticks from getting underneath clothing tuck pant legs into socks or tape to boots

Wear long-sleeved shirts, a hat, and high boots

Apply DEET repellent to exposed skin or clothing per product label

Apply permethrin repellent to the outside of boots and clothing before wearing, per product label

Frequently check for ticks and remove from clothing

At the end of the day, search your entire body for ticks (particularly groin, armpits, neck, and head) and shower

To prevent pathogen transmission through mucous membranes or broken/cut skin, wash or disinfect hands and/or wear surgical-style nitrile gloves any time ticks are handled

Pregnant individuals and individuals using prescription medications should consult with their physician and/or pharmacists before using chemical repellents. Because human health effects may not be fully known, use of chemical repellents should be kept to a minimum frequency and quantity. Always follow manufacturers' use instructions and precautions. Wash hands after handling, applying, or removing protective gear and clothing. Avoid situations such as hand-to-face contact, eating, drinking, and smoking when applying or using repellents.

Remove and wash clothes per repellent product label. Chemical repellents should not be used on infants and children.

Vaccinations are generally not available for tick-borne pathogens. Although production of the LYMErix™ Lyme disease vaccination has been ceased, vaccination may still be considered under specific circumstances and with concurrence from the consulting physician.

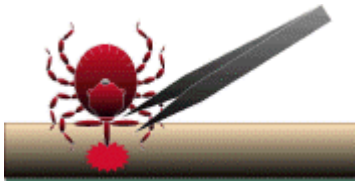
Tick Check

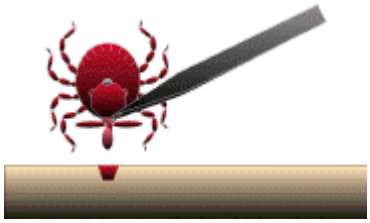
A tick check should be performed after field survey before entering the field vehicle (you do not want to infest your field vehicle with ticks). Have your field partner check your back; the backs of your legs, arms, and neck; and your hairline. Shake off clothing as thorough as possible before entering the vehicle. Once the field day is complete, repeat this procedure and perform a thorough self check.

If a tick has embedded itself into the skin, remove the tick as described below.

Tick Removal

1. Use the tick removal kit obtained through the CH2M Milwaukee warehouse, or a fine-tipped tweezers or shield your fingers with a tissue, paper towel, or nitrile gloves.
Error! Objects cannot be created from editing field codes.
2. Grasp the tick as close to the skin surface as possible and pull upward with steady, even pressure. Do not twist or jerk the tick; this may cause the mouthparts to break off and remain in the skin. If this happens, remove mouthparts with tweezers. Consult your healthcare provider if infection occurs.





3. Avoid squeezing, crushing or puncturing the body of the tick because its fluids (saliva, hemolymph, gut contents) may contain infectious organisms. Releasing these organisms to the outside of the tick's body or into the bite area may increase the chance of infectious organism transmission.

4. Do not handle the tick with bare hands because infectious agents may enter through mucous membranes or breaks in the skin. This precaution is particularly directed to individuals who remove ticks from domestic animals with unprotected fingers. Children, elderly persons, and immunocompromised persons may be at greater risk of infection and should avoid this procedure.

5. After removing the tick, thoroughly disinfect the bite site and wash your hands with soap and water.

6. Should you wish to save the tick for identification, place it in a plastic bag, with the date of the tick bite, and place in your freezer. It may be used at a later date to assist a physician with making an accurate diagnosis (if you become ill).

Note: Folklore remedies such as petroleum jelly or hot matches do little to encourage a tick to detach from skin. In fact, they may make matters worse by irritating the tick and stimulating it to release additional saliva, increasing the chances of transmitting the pathogen. These methods of tick removal should be avoided. In addition, a number of tick removal devices have been marketed, but none are better than a plain set of fine tipped tweezers.

First-Aid and Medical Treatment

Tick bites should always be treated with first-aid. Clean and wash hands and disinfect the bite site after removing embedded tick. Individuals previously infected with Lyme disease does not confer immunity—re-infection from future tick bites can occur even after a person has contracted a tick-borne disease.

The employee should contact the Injury Management/Return To Work provider (IMRTW), WorkCare using the toll-free number 855-328-6547 to report the tick bite. WorkCare will follow-up with each CH2M employee

who reports a tick bite and is at risk of developing Lyme disease by monitoring for symptoms up to 45 days, and will refer the employee to a medical provider for evaluation and treatment as necessary.

CH2M HEALTH AND SAFETY PLAN

Attachment 6

Agency Inspection Target Zero Bulletin

Environmental Services Business Group

TARGET ZERO BULLETIN

Subject: HSSE Agency Inspections (OSHA, EPA, DOT, State Health Department)

Do you know what YOU would do if an agency inspector arrived at your site unannounced?

Recently, a State Occupational Safety and Health Administration (OSHA) inspector made an unannounced visit to one of our Federal project sites. OSHA, U.S. Environmental Protection Agency (EPA), and authorized state or local agencies have authority to inspect any facility that is subject to health, safety, and environmental legislation. Inspections may be announced or unannounced. This particular inspector indicated that the project was targeted for an inspection because the work was funded by the American Recovery and Reinvestment Act (ARRA).

Enterprise Standard Operating Procedure (SOP) HSE-201, *Agency Inspections and Communications,* describes the responsibilities, procedures, and requirements associated with inspections conducted by external regulatory agencies, as well as the methods for communicating information to key individuals. This Target Zero Bulletin is a brief summary of what to do in the event of an agency inspection at your site. Refer to the SOP for more specific guidance.

Notification of Inspections

- If the inspection is an announced regulatory agency inspection, the Project Manager (PM) should notify the Responsible Health and Safety Manager (RHSM) and Responsible Environmental Manager (REM) well in advance of the inspection.
- If an unannounced agency inspector visits one of our projects, Field personnel must immediately notify the project Emergency Response Coordinator (ERC). Typically the ERC is the Safety Coordinator (SC).
- The ERC must immediately notify the RHSM/REM, as appropriate, of unannounced inspections, or designate someone to call the RHSM/REM. The RHSM/REMs can provide guidance to the field staff and PM.

Inspector Credential Verification

- Upon arrival, the ERC must request the inspector to provide official credentials. Record the inspector's name and office phone number or obtain the inspector's business card.
- The inspector shall sign the visitors log and be given a site-specific health, safety, and environmental protection briefing.
- The inspector shall meet any site access requirements associated with security clearances, specialized training, and medical monitoring. The CH2M representative shall verify that the inspector possesses these requirements; access will only be granted to those areas where appropriate access requirements are met. Some inspectors have the authority to gain access to any work area at any time, such as an inspector with a search warrant. In these cases, we can stop work operations as necessary to protect the safety of the inspector(s).

Opening Conference

- The CH2M Project Manager, ERC, RHSM, or REM, and the inspector shall determine attendees for the opening conference. The RHSM (for OSHA and other worker health and safety inspections) or REM (for environmental inspections) shall join the opening conference via conference call.
- The inspector shall inform CH2M of the purpose of the inspection and provide a copy of the complaint, if applicable.
- The inspector shall outline the scope of the inspection, including employee interviews conducted in private, physical inspection of the workplace and records, possible referrals, discrimination complaints, and the closing conference(s).

Requests for OSHA Logs

- An OSHA inspector may request to review the project OSHA Injury/Illness log, better known as the OSHA 300 Log. Contact your RHSM for assistance in obtaining the OSHA 300 Log.

- Field projects with a continuous duration of one year or longer are considered to be separate establishments and are required to maintain an OSHA 300 log specific to the project. The project OSHA 300 log should be maintained onsite and kept current.
- Recordable injuries and illnesses sustained on field projects less than one year in duration are maintained on the CH2M office log where the injured employee is based.

The Inspection

- The scope of the inspection shall be limited to that indicated by the inspector in the opening conference. The inspector shall be escorted to relevant areas only. The ERC or other designated by the RHSM or REM must accompany the inspector during the inspection.
- Ensure that the inspection is limited to the scope that the inspector disclosed during the opening conference. The ERC should always take notes which identify: areas inspected, machinery or equipment and materials examined, employees or other persons interviewed, and photographs taken by the inspector.
- The inspector will observe safety, health, and environmental conditions and practices and document the inspection process. The inspector may also take photos and instrument readings, examine records, collect air samples, measure noise levels, survey existing engineering controls, and monitor employee exposure to toxic vapors, gases, and dusts.
- CH2M should gather duplicate information (photographs, readings, samples) in the same manner and condition as the inspector. If the equipment needed to take duplicate samples is not onsite, ask the inspector if the sampling can wait until the equipment is available. If samples are taken, request a description of the tests that the agency intends to perform on the samples and request results as soon as they are available.
- Employees may be questioned during the inspection tour. The employee can refuse to speak to an inspector, can speak to the inspector with a company representative (including management) present, or can speak to the inspector privately. It is CH2M policy that employees who wish to speak to the inspector are not discriminated against, intimidated, or otherwise mistreated for exercising their rights during compliance inspections.
- Copies of documents should not be provided to the inspector without the approval of the RHSM or REM or Legal Insurance Department (LID). **DO NOT** voluntarily release documents. Respond only to inspection team requests.
- During the course of the inspection, the inspector may point out violations. For each violation, the CH2M representative should ask the inspector to discuss possible corrective action. Where possible, violations detected by the inspector should be corrected immediately and noted by the inspector as corrected.
- For those items which cannot be corrected immediately, an action plan shall be formulated for timely correction. In any instance, employees exposed to hazards shall be removed from the area.

Closing Conference

After the inspection, a closing conference is normally held as follows:

- The CH2M PM, ERC, RHSM or REM shall be involved via conference call in the closing conference, at a minimum;
- The inspector shall describe the apparent violations found during the inspection and other pertinent issues as deemed necessary by the inspector. CH2M shall be advised of their rights to participate in any subsequent conferences, meetings or discussions. Any unusual circumstances noted during the closing conference shall be documented by the ERC;
- The inspector shall discuss violations observed during the inspection and indicate for which violations a citation and a proposed penalty may be issued or recommended;
- The ERC shall request receipts for all samples and approved documents photocopied by the inspector, request a photocopy of the inspector's photograph log, and request a copy of the final inspection report; and
- Any documentation from an agency inspection must be transmitted immediately to the RHSM or REM, and LID.

Unannounced regulatory agency inspections may happen at any time on our projects -

Get your RHSM/REM and PM involved immediately if an Inspector arrives.

CH2M HEALTH AND SAFETY PLAN

Attachment 7

Completed CH2M AHAs

CH2M HEALTH AND SAFETY PLAN

Attachment 8

Material Safety Data Sheets

Attachment A2
Standard Operating Procedures

STANDARD OPERATING PROCEDURE SOP-1

Sample Labeling

Scope and Applicability

This standard operating procedure (SOP) describes the general CH2M procedure for sample labeling that will be used on the 2018 UCR Northern Pike Tissue Study.

Sample Identifier Labels

Sample identifiers will be established before field sampling begins and assigned to each sample as it is collected. Sample identifiers consist of codes designed to fulfill three purposes: 1) to identify related samples (i.e., composites) to ensure proper data analysis and interpretation; to obscure the relationships between samples so that laboratory analysis will be unbiased by presumptive similarities between samples; and, 3) to track individual sample containers to ensure that the laboratory receives all the material associated with a single sample. These codes and their uses are described below.

Individual Fish Sample Numbering

Individual fish will be identified with the letters “EPA”, a species abbreviation, length group and a sequential number (e.g., EPA-NP-01-001). The codes will include the following information:

Species abbreviation for the Northern Pike will be NP:

- Northern Pike = NP

Length group will be:

- 01 = 300 – 499 mm total length
- 02 = 450 mm and greater total length

Sequential fish numbers will be expressed sequentially as three digits starting with 001 (e.g., 001 or 002).

Therefore, the example EPA-NP-01-001 would be a northern pike that is 300-499 mm in length and the first fish that was processed.

STANDARD OPERATING PROCEDURE SOP-2

SAMPLE PROCESSING FOR TARGET FISH SPECIES

Purpose

The purpose of this standard operating procedure (SOP) is to describe the procedures used for filleting, measuring fish fillet weights, subsampling and preparing samples for shipment to the analytical laboratory during the Upper Columbia River (UCR) Northern Pike Tissue Study during Summer 2018.

Scope and Applicability

This SOP applies to all northern pike collected during the summer 2018 sampling.

Equipment and Materials

- Coolers, dry ice, thermometers
- Balance and calibration weight
- Examination board (such as a plastic cutting board or stainless-steel pan tray)
- Nitrile gloves
- Heavy-duty aluminum foil
- Various sizes of resealable plastic bags
- Spray bottle (containing lake water for rinsing equipment)[1]
- Processing forms
- Secondary field tags
- Roll of plastic sheeting (for processing area)
- Scalpel with replaceable stainless steel blades
- Stainless steel, ceramic, or titanium fillet knives
- Cut proof gloves
- Forceps
- Field notebook
- Marine band radio and cell phone
- Digital camera
- Alconox soap and brushes
- Kim wipes™

Procedures

The filleting, measurements, and sorting of fish will be performed on the National Park Service boat following transfer of capture fish from the Lake Roosevelt Fisheries Co-Managers (CCT, Spokane Tribe of Indians, and WDFW).

Fish length and weight provided by the Lake Roosevelt Fisheries Co-Managers will be documented on the fish processing form and the sample ID provided on the fish tag will be confirmed prior to processing. Filleting will follow general EPA guidelines for assessing chemical contaminant data for use in fish advisories (USEPA 2000). Fish will be filleted with the skin removed.

[1] Lake water used in processing will come from the same reach where the fish were collected

The following general procedures will be used:

1. Prior to resection, hands will be washed with soap and rinsed thoroughly in tap water, followed by distilled water, and a clean pair of nitrile gloves will be worn over cut-proof gloves.
2. All cutting boards and utensils will be cleaned prior to use by washing with laboratory detergent and distilled water and allowed to air dry before use.
3. Care will be taken to ensure that specimens come into contact only with decontaminated cutting boards and utensils.
4. Individual fish will be placed on decontaminated glass or Teflon® cutting board or on one that has been covered with clean heavy-duty aluminum foil.
5. A clean, high-quality stainless-steel, ceramic, or titanium filleting knife will be used to remove both fillets.
6. Once the fillets have been removed from the fish, the top section of the fillet containing the Y-bone will be removed from the remaining fillet and disposed of.
7. Any dark muscle tissue in the vicinity of the lateral line will not be separated from the light muscle tissue that constitutes the rest of the muscle tissue mass.
8. Fillets will be weighed to the nearest gram and recorded on the fish processing form.
9. Care will also be taken to avoid contaminating fillet tissues with material released by the inadvertent puncture of internal organs. If the fillet is inadvertently contaminated, the fillet tissue will be rinsed in contaminant-free, distilled water and blotted dry with Kim Wipes™. In addition, documentation of the potential contamination will be completed on the fish processing form.
10. Following resection, fillet tissue will be individually wrapped in aluminum foil and placed in a resealable plastic bag. The bagged fillets will then be placed inside a second bag with the fish ID so that this label is between the 2 resealable plastic bags. This will facilitate identification and sample organization at the laboratory without unwrapping the fish.
11. Bagged and labelled fillets will be stored in a cooler on wet ice while on the sampling boat. These tissues will then be transferred to a cooler with dry ice for shipment.
12. The remaining fish carcass will be sunk in the reservoir.
13. All cutting boards and utensils will be cleaned between samples with detergent and distilled water between samples.

References

USEPA. 2000. Guidance for assessing chemical contaminant data for use in fish advisories, Volume 1, Fish sampling and analysis, Third Edition. USEPA Office of Water. EPA 823-B-00-007.

STANDARD OPERATING PROCEDURE SOP-3

SAMPLE STORAGE, PACKING, AND SHIPPING

Scope and Applicability

Specific requirements for sample storage on-site, packaging of sample coolers, and shipment to the off-site analytical laboratory are addressed in this Standard Operating Procedure (SOP) for the UCR Northern Pike Tissue Study during Summer 2018.

Equipment and Materials

Specific equipment or supplies necessary to properly pack and ship fish tissue samples include the following:

- Quality Assurance Project Plan for 2009 Fish Tissue Study
- Thermometers
- Resealable plastic bags (assorted sizes)
- Dry ice or, if dry ice is not available, wet ice in doubled, sealable bags
- Coolers
- Bubble wrap
- Fiber-reinforced packing tape and clear plastic packing tape
- Scissors or knife
- Chain-of-custody (COC) forms
- COC seals
- Large plastic garbage bags (preferably 3 mil thick) for cooler lining
- Paper towels
- ‘‘Fragile,’’ ‘‘This End Up,’’ or ‘‘Handle with Care’’ labels

Procedures

All shipping will utilize a commercial courier.

As a courier service will be used, CH2M field personnel will need to be aware of any potentially limiting factors to timely shipping (e.g., availability of overnight service and weekend deliveries to specific areas of the country, shipping regulations “restricted articles” [e.g., dry ice]) prior to shipping the samples.

On-Site Sample Storage

Samples will be placed in secure storage (i.e., locked room or vehicle) or remain in the possession of CH2M sampling personnel before shipment. Any sample storage areas will be locked and secured to maintain sample integrity and COC requirements.

Packing and Preparation

The following steps should be followed to ensure the proper transfer of samples from the field to the analytical laboratory.

1. Check sample containers against the COC form to ensure all samples intended for shipment are accounted for.
2. Choose the appropriate size cooler (or coolers) and make sure that the outside and inside of the cooler is clean of gross contamination. If the cooler has a drain on the outside at the bottom of the cooler, the drain should be capped and thoroughly taped shut with duct tape.

3. The cooler should be lined with a large plastic bag (preferably a bag with a thickness of 3 mil). The bag should be opened and placed inside the cooler.
4. Place the individual fish tissue samples (which during the sample processing step have already been placed in plastic bags) into the large plastic bag in the cooler, leaving sufficient room for dry ice to keep the samples frozen.
5. Check sample containers against the COC form to ensure all the samples that were collected are in the cooler.
6. As the samples have a required storage temperature, add enough dry ice to keep the samples refrigerated during overnight shipping (i.e., <0°C). Always over-estimate the amount of ice that you think will be required. After all samples and ice have been added to the cooler, use bubble wrap (or other available clean packing material) to fill any empty space to keep the samples from shifting during transport.
7. Sign and date the completed COC form and retain a copy or scan for project files. Place the signed COC form in a resealable bag and tape the bag containing the form to the inside of the cooler lid. Each cooler should contain an individual COC form for the samples contained in each respective cooler. If time constraints impact sample shipping and it becomes necessary to combine all samples onto a single set of COC forms and the shipment contains multiple coolers, indicate on the outside of the respective cooler "Chain of Custody Inside".
8. After the cooler is sufficiently packed to prevent shifting of the containers, close the lid and seal the cooler shut with fiber-reinforced packing tape. The cooler should be taped shut around the opening between the lid and the bottom of the cooler and around the circumference of the cooler at both hinges.
9. As security against unauthorized handling of the samples, apply two COC seals across the opening of the cooler lid. One seal should be placed on the front right portion of the cooler and one seal should be placed on the back left portion of the cooler. Be sure the seals are properly affixed to the cooler so they are not removed during shipment. Additional clear packing tape across the seal may be necessary if the outside of the cooler is wet.

The sample processing coordinator (SPC) should notify the laboratory contact will be shipped and the estimated arrival time. The SPC should also send copies of all COC forms to CH2M's project manager, as appropriate.

Shipping

Fish samples will usually be driven to the lab by a courier at the end of the sampling event. Add other appropriate stickers, such as "This End Up," "Fragile," and "Handle With Care." If the shipment contains multiple coolers, indicate on the mailing label the number of coolers that the testing laboratory should expect to receive (e.g., 1 of 2; 2 of 2).

STANDARD OPERATING PROCEDURE SOP-4

FIELD DOCUMENTATION

Scope and Applicability

The integrity of each sample from the time of collection to the point of data reporting must be maintained throughout the study. Proper record keeping will be implemented in the field to allow samples to be traced from collection to final disposition.

All information pertaining to field operations during sample collection must be properly documented to ensure transparency (and reproducibility) of methods and procedures. Several types of field documents will be used for this purpose by field personnel.

Field Logbooks

During field sampling events, field logbooks are used to record all daily field activities on each vessel used for fish tissue collection. The purpose of the field logbook is to document events that occur during field activities and to record data measured in the field to ensure transparency and reproducibility.

The field logbook is the responsibility of, and maintained by the Field Team Lead (FTL). The site logbook will be kept current by the FTL during field activities and will be placed in the project files at the conclusion of field activities.

The field logbook will be bound and waterproof with consecutively numbered pages. All entries will be made using indelible ink and no erasures will be made. Any necessary corrections in the logbook should consist of a single line-out deletion, followed by the author's initials and the date. The author will initial and date each page of the field logbook, sign and date the last page at the end of each day, and draw a line through the remainder (unused portion) of that page.

The project name, dates of the field work, site name, and location (city and state) should be written on the cover of the field logbook. If more than one logbook is used during a single sampling event, then the upper right hand corner of the logbook will be annotated (e.g., Volume 1 of 2, 2 of 2) to indicate the number of logbooks used during the field event. Field logbooks will be stored in a secure manner when not in use in the field.

At a minimum, the following information will be recorded in the field logbook:

- Project name and location.
- Purpose and description of the field task.
- Project start date and end date.
- Date and time of entry (24-hour clock).
- Time and duration of daily sampling activities.
- Weather conditions at the beginning of the field work and any changes that occur throughout the day, including the approximate time of the change (e.g., wind speed and direction, rain, thunder, wave action, vessel traffic, temperature of both the air and water). Name and affiliation of person making entries and other field personnel and their duties, including the times that they are present.
- The location and description of the work area, including sketches, map references, and photograph log, if appropriate.
- Level of personal protection being used.

- Onsite visitors (names and affiliations), if any, including the times that they are present (e.g., cultural resource personnel, agency observers, etc.).
- The name, affiliation, and telephone number(s) of any key field contacts.
- Notation of the coordinate system used to determine the station location information.
- The sample identifier and analysis code for each sample to be submitted for laboratory analysis, if not included on separate field data sheets (cross reference provided).
- All field measurements made (or reference to specific field data sheets used for this purpose), including the time that the measurement was collected and the date of calibration, if appropriate.
- The sampling location name, date, gear, water depth (if applicable), and sampling location coordinates, if not included on separate field data sheets.
- The type of vessel used (e.g., size, power, type of engine) (for aquatic sampling only).
- Specific information on each type of sampling activity.
- The sample type (e.g., fish tissue, surface sediment), sample number, sample tag number, and preservatives used (if any), if not included on separate field data sheets.
- Sample storage methods.
- Cross-references of numbers for duplicate samples.
- A description of the sample [for fish sampling this would include approximate number of target/non- target fish by species caught for each gear set or whether gear was unsuccessful; any debris caught in sample gear; unusual odors, etc.].
- Photographs (uniquely identified) taken at the sampling location, if any.
- Details of the work performed.
- Variations, if any, from the project-specific Quality Assurance Project Plan (QAPP) or standard operating protocols and reasons for deviation.
- Details pertaining to unusual events which might have occurred during sample collection (e.g., possible sources of sample contamination, equipment failure, unusual appearance of sample integrity).
- References to other logbooks or field forms used to record information (e.g., field data sheets, health and safety log).
- Sample shipment information (e.g., shipping manifests, COC form numbers, carrier, air bill numbers, time addresses).
- A record of quantity of investigation derived wastes (if any) and storage and handling procedures.

During the field day, as listed above, a summary of all site activities should be recorded in the logbook. The information need not duplicate anything recorded in other field logbooks or field forms (e.g., Site Health and Safety Officer's logbook, calibration logbook, field data sheets), but should summarize the contents of the other logbooks and refer to the page locations in these logbooks for detailed information.

If measurements are made at any location, the measurements and equipment used must either be recorded in the field logbook or reference must be made to the logbook and page number(s) on which they are recorded. All maintenance and calibration records for equipment should be traceable through field records to the person using the instrument and to the specific piece of instrumentation itself.

Upon completion of the field sampling event, the FTL will be responsible for submitting all field logbooks to be copied.

Sample Processing and Field Data Forms

Sample processing and field data forms will be generated during this field sampling event (e.g., fish external examination form) to record the relevant sample information collected during a sampling event. Upon completion of the field sampling event, the FTL will be responsible for submitting all field data forms to be copied.

Photographs

In certain instances, photographs (print or digital) of sampling events. Photographs should include a measured scale in the picture, when practical (e.g., pencil, coin, ruler, etc.). Photographs may also be taken of sample characteristics and routine sampling activities. Telephoto or wide-angle shots will not be used because they cannot be used in enforcement proceedings. The following items should be recorded in the field logbook for each photograph taken:

1. The photographer's name or initials, the date, the time of the photograph, and the general direction faced (orientation).
2. A brief description of the subject and the field work portrayed in the picture.
3. For digital photographs, the sequential number of the photograph, the file name, and the file location.

Upon completion of the field sampling event, the FTL will be responsible for submitting all photographic materials to be copied, as appropriate. The files will be placed in the project files (at the CH2M Project Manager's location). Photo logs and any supporting documentation from the field logbooks will be photocopied and placed in the project files.

STANDARD OPERATING PROCEDURE SOP-5

SAMPLE CUSTODY

Scope and Applicability

This SOP describes CH2M procedures for custody management of environmental samples during the 2018 Northern Pike Tissue Study.

Chain-of-custody (COC) forms ensure that samples are traceable from the time of collection through processing and analysis until final disposition. A sample is considered to be in a person's custody if any of the following criteria are met:

1. The sample is in the person's possession
2. The sample is in the person's view after being in possession
3. The sample is in the person's possession and is being transferred to a designated secure area
4. The sample has been locked up to prevent tampering after it was in the person's possession.

At no time is it acceptable for samples to be outside of CH2M personnel's custody unless the samples have been transferred to a secure area (i.e., locked up and custody sealed). If the samples cannot be placed in a secure area, then a CH2M field team member must physically remain with the samples (e.g., at lunch time one team member must remain with the samples).

Chain-of-Custody Forms

The COC form is critical because it documents sample possession from the time of collection through the final disposition of the sample. The form also provides information to the laboratory regarding what analyses are to be performed on the samples that are shipped.

The COC form will be completed after each field collection activity and before the samples are shipped to the laboratory. Sampling personnel are responsible for the care and custody of the samples until they are shipped. When transferring possession of the samples, the individuals relinquishing and receiving the samples must sign the COC form(s), indicating the time and date that the transfer occurs.

The COC forms are generated using Scribe sample management software. The COC form is then signed and scanned. The signed copy accompanies the shipment to the laboratory and the scan is retained on file at the CH2M Project Manager's location.

The individual fish sample labels will be recorded on the COC form. The COC form will also identify the sample collection date and time, the type of sample, the project, and the sampling personnel. In addition, the COC form provides information on the preservative or other sample pretreatment applied in the field and the analyses to be conducted by referencing a list of specific analyses or the statement of work for the laboratory. The COC form will be sent to the laboratory along with the sample(s).

Procedures

The following guidelines will be followed to ensure the integrity of the samples:

1. At the end of each sampling day and prior to shipping or storage, COC entries will be made for all samples and COCs will be filled out for all samples. Information on the COCs will be checked against field logbook entries.
2. At the bottom of each COC form is a space for the signatures of the persons relinquishing and receiving the samples and the time and date that the transfer occurred. The time that the samples were relinquished should match. Each COC form must be appropriately signed and dated by the sampling personnel. The person who relinquishes custody of the samples must sign this form.

3. The COC form should not be signed until the information has been checked for inaccuracies by the FTL. All changes should be made by drawing a single line through the incorrect entry and initialing and dating it. Revised entries should be made in the space below the entries. Any blank lines remaining on the COC form after corrections are made should be marked out with single lines that are initialed and dated. This procedure will preclude any unauthorized additions.
4. At the bottom of each COC form is a space for the signatures of the persons relinquishing and receiving the samples and the time and date that the transfer occurred. The time that the samples were relinquished should match exactly the time they were received by another party. Under no circumstances should there be any time when custody of the samples is undocumented.
5. If samples are sent by a commercial carrier not affiliated with the laboratory, such as Federal Express (FedEx) or United Parcel Service (UPS), the name of the carrier should be recorded on the COC form. Any tracking numbers supplied by the carrier should be also entered on the COC form. The time of transfer should be as close to the actual drop-off time as possible. After the COC forms are signed, they should be sealed inside the transfer container.
6. If errors are found after the shipment has left the custody of sampling personnel, a corrected version of the forms must be made and sent to all relevant parties. Minor errors can be rectified by making the change on a copy of the original with a brief explanation and signature. Errors in the signature block may require a letter of explanation.
7. Upon completion of the field sampling event, the FTL will be responsible for submitting all COC forms to be copied.

Custody Seals

As security against unauthorized handling of the samples during shipping, two custody seals will be affixed to each sample cooler. The custody seals will be placed across the opening of the cooler (front right and back left) prior to shipping. Be sure the seals are properly affixed to the cooler so they cannot be removed during shipping. Additional tape across the seal may be prudent.

Shipping Air Bills

When samples are shipped from the field to the testing laboratory via a commercial carrier (e.g., Federal Express, UPS), an air bill or receipt is provided by the shipper. Upon completion of the field sampling event, the FTL will be responsible for submitting the sender's copy of all shipping air bills to be copied.

The air bill number (or tracking number) should be noted on the applicable COC forms or alternatively the applicable COC form number should be noted on the air bill to enable the tracking of samples if a cooler becomes lost.

Acknowledgement of Sample Receipt Forms

In most cases, when samples are sent to a testing laboratory, an Acknowledgment of Sample Receipt form is sent to the project QA/QC coordinator the day the samples are received by the laboratory. It is the responsibility of the person receiving this form (designated by Project Manager) to review the form and make sure that all the samples that were sent to the laboratory were received by the laboratory and that the correct analyses were requested. If an error is found, the laboratory must be called immediately. Decisions made during the telephone conversation should be documented in writing on the Acknowledgment of Sample Receipt Form. In addition, corrections should be made to the COC form and the corrected version of the COC form should be faxed to the laboratory. The Acknowledgment of Sample Receipt form (and any modified COC forms) will then be submitted to be copied for inclusion with the field sampling records.

Attachment A3
Example Field Forms

2018 FISH EXTERNAL EXAMINATION FORM
Upper Columbia River (UCR) Northern Pike Tissue Study

Date (MM/DD/YYYY): _____ Reach: _____ Indiv. Fish Sample No. _____

Time: _____ Weight (g): _____ Length (cm): _____

EXTERNAL EXAMINATION: (check all that apply)

BODY SURFACE:
- ☐ normal
- ☐ raised growth(s)
- ☐ reddened lesion(s)
- ☐ spinal deformities
- ☐ hemorrhagic body
- ☐ focul discoloration
- ☐ body fungus
- ☐ parasites(s) (specify):
  - white spots ☐
  - leech(es) ☐
  - black spot(s) ☐
  - Anchor worm(s) ☐
  - other (specify): ☐

_____
_____

HEAD & ORAL CAVITY:
- ☐ normal head
- ☐ deformed head
- ☐ upper lip growth
- ☐ lower lip growth
- ☐ swollen nare

BARBELS:
- ☐ normal
- ☐ missing
- ☐ stubbed
- ☐ deformed
- ☐ other (specify):

_____
_____

EYES:

Left	Right
☐ normal	☐ normal
☐ exophalmic	☐ exophalmic
☐ opaque	☐ opaque
☐ missing	☐ missing
☐ hemmorrhagic	☐ hemmorrhagic
☐ emboli	☐ emboli
☐ other(specify):	☐ other(specify):
_____	_____
_____	_____
_____	_____

OPERCULA:
- ☐ normal
- ☐ slight shortening
- ☐ severe shortening
- ☐ Other (specify): _____
  _____
  _____

GILLS:

Left:	Right:
☐ normal	☐ normal
☐ frayed	☐ frayed
☐ marginate	☐ marginate
☐ pale	☐ pale
☐ other (specify): _____	☐ other (specify): _____

DELTS:
- ☐ Deformities
- ☐ Erosion
- ☐ Lesions
- ☐ Tumors

FINS:
- ☐ normal
- ☐ mild erosion
- ☐ severe erosion
- ☐ frayed
- ☐ hemorrhagic
- ☐ emboli
- ☐ other (specify): _____

2018 Fish Collection Form **Date:**_____

Upper Columbia River (UCR) Northern Pike Tissue Study

Individual Fish ID	Time	Abnormalities (√)	Photo ID	Weight of Fillets (g)	Collectors Initials	Notes:

UCR 2018 Northern Pike Tissue Sampling

Fish ID:___________________________

Date:______________ **Time:**______________

Sampler:______________

Site: UCR

Matrix: tissue **Lab**: ALS, Kelso, WA

Container: foil**,** plastic bag

Preservative: frozen

Containers: 1 of 1

Analyses: TAL metals, mercury, inorganic arsenic

UCR 2018 Northern Pike Tissue Sampling

Fish ID:___________________________

Date:______________ **Time:**______________

Sampler:______________

Site: UCR

Matrix: tissue **Lab**: ALS, Kelso

Container: foil**,** plastic bag

Preservative: frozen

Containers: 1 of 1

Analyses: TAL metals, mercury, inorganic arsenic

UCR 2018 Northern Pike Tissue Sampling

Fish ID:___________________________

Date:______________ **Time:**______________

Sampler:______________

Site: UCR

Matrix: tissue **Lab**: ALS, Kelso

Container: foil**,** plastic bag

Preservative: frozen

Containers: 1 of 1

Analyses: TAL metals, mercury, inorganic arsenic

UCR 2018 Northern Pike Tissue Sampling

Fish ID:___________________________

Date:______________ **Time:**______________

Sampler:______________

Site: UCR

Matrix: tissue **Lab**: ALS, Kelso

Container: foil**,** plastic bag

Preservative: frozen

Containers: 1 of 1

Analyses: TAL metals, mercury, inorganic arsenic

UCR 2018 Northern Pike Tissue Sampling

Fish ID:___________________________

Date:______________ **Time:**______________

Sampler:______________

Site: UCR

Matrix: tissue **Lab**: ALS, Kelso

Container: foil**,** plastic bag

Preservative: frozen

Containers: 1 of 1

Analyses: TAL metals, mercury, inorganic arsenic

UCR 2018 Northern Pike Tissue Sampling

Fish ID:___________________________

Date:______________ **Time:**______________

Sampler:______________

Site: UCR

Matrix: tissue **Lab**: ALS, Kelso

Container: foil**,** plastic bag

Preservative: frozen

Containers: 1 of 1

Analyses: TAL metals, mercury, inorganic arsenic

UCR 2018 Northern Pike Tissue Sampling

Fish ID:___________________________

Date:______________ **Time:**______________

Sampler:______________

Site: UCR

Matrix: tissue **Lab**: ALS, Kelso

Container: foil**,** plastic bag

Preservative: frozen

Containers: 1 of 1

Analyses: TAL metals, mercury, inorganic arsenic

UCR 2018 Northern Pike Tissue Sampling

Fish ID:___________________________

Date:______________ **Time:**______________

Sampler:______________

Site: UCR

Matrix: tissue **Lab**: ALS, Kelso

Container: foil**,** plastic bag

Preservative: frozen

Containers: 1 of 1

Analyses: TAL metals, mercury, inorganic arsenic

UCR 2018 Northern Pike Tissue Sampling

Fish ID:___________________________

Date:______________ **Time:**______________

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Matrix: tissue **Lab**: ALS, Kelso

Container: foil**,** plastic bag

Preservative: frozen

Containers: 1 of 1

Analyses: TAL metals, mercury, inorganic arsenic

UCR 2018 Northern Pike Tissue Sampling

Fish ID:___________________________

Date:______________ **Time:**______________

Sampler:______________

Site: UCR

Matrix: tissue **Lab**: ALS, Kelso

Container: foil**,** plastic bag

Preservative: frozen

Containers: 1 of 1

Analyses: TAL metals, mercury, inorganic arsenic

APPENDIX E-1
HUMAN HEALTH RISK-BASED CONCENTRATIONS FOR FISH TISSUE IN SUPPORT OF SAMPLING AND ANALYSIS PLAN DEVELOPMENT

HUMAN HEALTH RISK-BASED CONCENTRATIONS FOR FISH TISSUE IN SUPPORT OF SAMPLING AND ANALYSIS PLAN DEVELOPMENT

Risk-based concentrations (RBCs) are based on the maximally exposed receptor population (traditional subsistence scenario) from the human health risk assessment (HHRA) work plan for the Upper Columbia River (UCR) (Appendix F, Human Intake Factor for Ingestion of Fish; United States Environmental Protection Agency [USEPA] 2009). RBCs were back- calculated based on a target hazard quotient (THQ) of 0.1 for non-cancer and a target cancer risk (TR) of 1E-06 using the November 2017 version of the Regional Screening Levels (RSL) Calculator. The RSL Calculator states that "wet or dry weight is not an inherent assumption of the SL numbers. …users of the Table should consider whether the population of interest is more likely to consume the fish using a preparation method that is better simulated by a wet or dry weight." Consumption of raw or cooked fish would be represented by wet weight, while smoked fish would be dry weight. For arsenic, the fish tissue RBC was calculated based on an assumption that 10% of arsenic in fish tissue is in a biologically available form. The RBC for methylmercury is a fish tissue residue criterion (TRC) that adjusts the oral reference dose (RfD) by a relative source contribution (RSC) that accounts for methylmercury in marine fish consumed (USEPA 2010).

The equations used to calculate the RBCs for non-cancer hazard and cancer risk are:

$$RBC_{non-cancer} = \frac{THQ \times AT \times ED \times BW}{EF \times ED \times \frac{1}{RfD} \times IR \times CF}$$

and

$$RBC_{cancer} = \frac{TR \times AT \times LT}{CSF \times CF \times \left[\left(EF \times ED_{child} \times \frac{IR_{child}}{BW_{child}}\right) + \left(EF \times ED_{adult} \times \frac{IR_{adult}}{BW_{adult}}\right)\right]}$$

where:

THQ = total hazard quotient (0.1)

AT = averaging time (365 days/year, USEPA 2011)

ED = exposure duration (64 years for adults; 4 years for children[1]; Harper et al. 2002)

BW = body weight ((80 kg for adults; 17.2 kg for children; USEPA 2014b, USEPA 2005)

EF = exposure frequency (365 days/year; Harper et al. 2002 and professional judgement

RfD = oral reference dose (see table)

IR = fish ingestion rate (1060 g/day for adults; 530 g/day for children 2-6 years old; Harper et al.2002)

CF = conversion factor (1E-3 kg/g)

[1] The four year exposure duration for children assumes that they will be breastfed for the first two years of life.

TR = total cancer risk (1E-6)
LT = lifetime (70 years; U.S. EPA 2011), and
CSF = oral cancer slope factor (see table).

Oral RfDs and CSFs for the contaminants of potential concern were obtained from the U.S. EPA Regional Screening Level (RSL) calculator (www.epa.gov/risk/regional-screening-levels-rsls-equations-November-2017) except for uranium, which has a site-specific RfD of 0.0006 mg/kg-day.[11] The calculated RBSLs for fish tissue COPCs are listed in in Table E-1.

Table E-1. Risk Based Screening Levels for Fish Tissue COPCs

Analyte	N	N Detect	Site-wide Detection Frequency (%)	Max Reach Detection Frequency (%)	Maximum Detected Concentration (mg/kg ww)	RBSL (mg/kg ww)	RBSL (mg/kg dw)	FreqDet > 5%?	Max> RBSL?
4,4'-DDE	81	73	90.1	100.0	5.20E-02	1.49E-02	5.96E-02	yes	yes
Aluminum	261	170	65.1	74.3	2.80E+02	2.39E+02	9.56E+02	yes	yes
Antimony	261	132	50.6	61.0	1.09E-01	9.55E-02	3.82E-01	yes	yes
Arsenic	261	233	89.3	94.9	3.98E-01	3.38E-03	1.35E-02	yes	yes
bis(2-Ethylhexyl)phthalate	81	3	3.7	11.1	4.90E-01	3.62E-01	1.45E+00	yes	yes
Chromium	261	206	78.9	86.8	9.00E-01	1.01E-02	4.04E-02	yes	yes
Dieldrin	81	11	13.6	30.8	4.40E-04	3.17E-04	1.27E-03	yes	yes
Heptachlor epoxide	81	6	7.4	14.3	7.70E-04	5.57E-04	2.23E-03	yes	yes
Hexachlorobenzene	81	48	59.3	71.4	3.63E-03	3.17E-03	1.27E-02	yes	yes
Lead	261	179	68.6	82.9	7.75E-01	NA	NA	yes	no RBSL
Mercury	539	539	100.0	100.0	5.84E-01	2.39E-02	9.56E-02	yes	yes
PBDE_cong_47	89	89	100.0	100.0	5.01E-02	2.39E-02	9.56E-02	yes	yes
Selenium	261	255	97.7	100.0	1.23E+00	1.19E+00	4.76E+00	yes	yes
TEQ - dioxin-like PCBs (ND=0)	239	239	100.0	100.0	2.38E-06	3.90E-08	1.56E-07	yes	yes
TEQ - dioxin-like PCBs (ND=1/2DL)	239	239	100.0	100.0	2.38E-06	3.90E-08	1.56E-07	yes	yes
TEQ - Dioxins/Furans (ND=0)	261	245	93.9	97.1	9.86E-07	3.90E-08	1.56E-07	yes	yes
TEQ - Dioxins/Furans (ND=1/2DL)	261	245	93.9	97.1	1.06E-06	3.90E-08	1.56E-07	yes	yes
Thallium	261	208	79.7	95.8	7.39E-02	2.39E-03	9.56E-03	yes	yes
Total PCBs (aroclors;ND=0)	30	30	100.0	100.0	3.66E-02	2.53E-03	1.01E-02	yes	yes

Table E-1. Risk Based Screening Levels for Fish Tissue COPCs

Analyte	N	N Detect	Site-wide Detection Frequency (%)	Max Reach Detection Frequency (%)	Maximum Detected Concentration (mg/kg ww)	RBSL (mg/kg ww)	RBSL (mg/kg dw)	FreqDet > 5%?	Max> RBSL?
Total PCBs (non-dioxin-like congeners;ND=0)	239	239	100.0	100.0	2.17E-01	2.53E-03	1.01E-02	yes	yes
Zirconium	79	28	35.4	77.8	1.91E-01	1.91E-02	7.64E-02	yes	yes

[a] Chemicals with no toxicity value (i.e., "no RBSL") will not be evaluated quantitatively as COPCs in the baseline HHRA. Rather, this will be discussed in the uncertainty section of the baseline HHRA.

[b] As described in the text of the memorandum, lead is considered a COPC in exposure media where it is found at concentrations above the detection limit.

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