APPENDIX C

CULTURAL RESOURCES COORDINATION PLAN

CONTENTS

LIST OF MAPS

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

ACHP	Advisory Council on Historic Preservation
APE	area of potential effects
ARPA	Archeological Resources Protection Act of 1979
CCT	Confederated Tribes of the Colville Reservation
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CRCP	cultural resources coordination plan
EPA	U.S. Environmental Protection Agency
FOIA	Freedom of Information Act
Lake Roosevelt	Franklin D. Roosevelt Lake
MOA	Memorandum of Agreement
NAGPRA	Native American Graves Protection and Repatriation Act
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NPS	National Park Service
QAPP	quality assurance project plan
RCW	Revised Code of Washington
RI/FS	remedial investigation and feasibility study
RM	river mile
SHPO	State Historic Preservation Officer
Site	Upper Columbia River site
STI	Spokane Tribe of Indians
TAI	Teck American Incorporated
THPO	Tribal Historic Preservation Officer
UCR	Upper Columbia River
USBR	U.S. Bureau of Reclamation
WAC	Washington Administrative Code

UNITS OF MEASURE

cm	centimeter(s)
cm/sec	centimeter(s) per second
ft	feet/foot
ft/sec	feet per second
gal	gallon(s)
in.	inch(es)
L	liter(s)
m	meter(s)

1 INTRODUCTION

This document presents the cultural resources coordination plan (CRCP) for the Upper Columbia River (UCR) site (herein the 'Site') remedial investigation and feasibility study (RI/FS) with emphasis placed for sampling activities associated with the Phase 2 sediment study.

1.1 BACKGROUND

As specified in the Statement of Work associated with the June 2, 2006 Settlement Agreement (USEPA 2006), "For all RI/FS activities at the Site involving sediment collection or ground penetration/disturbance, the Company shall work with the potentially affected parties to assess the effects of the planned work and seek ways to avoid, minimize or mitigate any adverse effects on historic properties." The purpose of this CRCP is to describe known or likely physical impacts of proposed sediment sampling, provide relevant background information, define measures for protecting resources, and define procedures for consulting with the appropriate state, federal, and Tribal parties with interests in the cultural resources of the Site.

The Site is located wholly within Washington State and includes approximately 150 river miles of the Columbia River extending from the U.S.-Canada border to the Grand Coulee Dam. The Colville Indian Reservation borders the UCR from approximately river mile (RM) 690 to the Grand Coulee Dam. The Spokane Indian Reservation borders the UCR to the east from approximately RM 650 to RM 640. Franklin D. Roosevelt Lake (Lake Roosevelt) and associated lands are administered by the U.S. Bureau of Reclamation (USBR) and the National Park Service (NPS) of the U.S. Department of the Interior.

The U.S. Environmental Protection Agency (EPA) has responsibilities under the National Historic Preservation Act (NHPA) to consider how its undertakings would affect historic properties. As defined in the NHPA, "historic properties" include archaeological resources, historic-period buildings and structures, and traditional cultural places listed in or determined eligible for listing in the National Register of Historic Places. To meet the NHPA requirements, EPA must ensure that sampling and other activities would avoid, minimize, or mitigate any adverse effects to any historic properties.

The CRCP is organized into six sections, as follows: 1) this introductory section, which includes summary information on the archaeology, prehistory, Native peoples, and Euroamerican historical development of the project area; 2) an overview of the relevant

federal, state, and tribal laws and regulations, and other appropriate procedures and requirements; 3) a description of the proposed sampling program and its potential physical effects; and 4) a plan for coordination and consultation with all affected parties to address known and likely impacts to cultural resources in implementing the proposed work.

1.2 CULTURAL SETTING

The broader context of the cultural development of the upper Columbia region[1] provides the critical framework for understanding the importance of the cultural resources in the area. Archaeological and historical resources reflect broad patterns of cultural use and development, just as ongoing traditional use of areas and natural resources represents cultural continuity that can be important to individual and social identities. This section of the CRCP serves as a brief introduction to the cultural history of the upper Columbia region.

Archaeological research contributes significantly to our understanding of the prehistoric past. In the upper Columbia region, systematic archaeological research began in the late 1930s and has continued to the present. Almost 500 archaeological resources have been recorded in and along Lake Roosevelt, representing prehistoric, protohistoric, ethnohistoric, and historic-period human use and occupation. Research at some of these resources has provided the outlines of prehistoric cultural development in the upper Columbia region. Human presence in the region extends back at least 11,000 years. These first humans lived in small groups and were mobile foragers, hunting and gathering plants. The presence of the Columbia River led to an early focus on the abundance of riverine resources. Beginning about 8,000 years ago, populations appear to have increased and led to a gradual trend to less mobility and more permanent settlements. The growing population also led to use of a greater diversity of resources and increasing reliance on fish.

[1] The phrase "upper Columbia region" herein refers to the drainage of the upper Columbia River from around Grand Coulee to the Arrow Lakes area in British Columbia. The upper Columbia region includes, but is not limited to the Site as defined in the Settlement Agreement. This distinction is important because general patterns of cultural development in the upper Columbia region as a whole provide the framework for addressing the significance of the cultural resources within the Site boundaries.

Permanent settlements increased in size and became concentrated in the river valleys beginning about 6,000 years ago, probably in response to continued population growth. Use of resources in upland areas expanded to meet the needs of the burgeoning populations and settlements. These trends continued until about 1,000 years ago, when there is evidence for a decline in population size. There were fewer settlements, villages were smaller, and there was less use of upland areas.

Cultural patterns of the late prehistoric period were reflected in the lives of the Native peoples at the time of Euroamerican contact. At the time of contact, the UCR was the homeland of the Lakes, Colville, Spokane, and Sanpoil peoples. The Lakes people occupied the Columbia River valley from the vicinity of modern Northport, Washington, north into the Arrow Lakes area of modern British Columbia. The Colville lived along the river downstream of the Lakes as far as around the mouth of the Spokane River. Downriver of the Colville were the Spokane, in the Spokane River drainage, and the Sanpoil, who lived along the Columbia River from around the mouth of the Spokane River to the near the modern location of the Grand Coulee Dam.

All of these groups spoke Interior Salish languages and shared many cultural features. Their cultural differences largely reflected differences in the local environments in which they lived. The social, political, and economic foundation of these groups was historically the winter village. The villages were concentrated in the river valleys, and each village was politically independent. Residents of the villages relied on provisions gathered, dried, and stored during the summer to survive through the winter. With the coming of spring, families began moving out of the winter village and shifting among the warm-season camps near resource locations. Gathering of plants and hunting game in upland areas were important subsistence activities during this season, but salmon constituted the most important food staple. Kettle Falls was a major aboriginal fishery, attracting people from throughout the region.

Native life began to change with the introduction of elements of Euroamerican culture. Horses reached the region in the 1700s and significantly changed Native travel and transportation. European diseases such as smallpox appeared in the late 1700s and had disastrous consequences for Native groups. Populations may have declined as much as 80 percent between the 1780s and 1840s. Direct contact with Euroamericans came in the early 1800s, when fur-trade posts were established on the Spokane River and at Kettle Falls.

When American settlement began in the 1840s, it bypassed the upper Columbia region. The discovery of gold in the region in the 1850s led to a major influx of Americans and growing conflict between the new settlers and Indian groups. A series of treaties with

Indian groups was signed in 1855 but did not include the peoples of the upper Columbia region. As American settlement continued, the federal government responded by creating the Colville Reservation in 1872 for the Colville and Spokane people. The separate Spokane Reservation was established in 1881. Both reservations have subsequently lost lands to the allotment process in the late 1800s and early 1900s and inundation from the waters of Lake Roosevelt. The Colville Reservation is now the home of the Confederated Tribes of the Colville Reservation; the Spokane Reservation is the home of the Spokane Tribe of Indians.

As already noted, the direct Euroamerican presence in the upper Columbia region began with the establishment of fur-trade posts on the Spokane River and at Kettle Falls. These posts were constructed between 1810 and 1825. The fur traders were followed by Christian missionaries in the 1830s and 1840s. A more substantial Euroamerican presence in the region developed in the 1850s, with the discovery of gold near Fort Colvile. Conflicts between miners and Indians led to a military campaign in the Spokane River valley in 1858 and the establishment of an army post (Fort Colville) near Kettle Falls in 1859.

American settlement in the upper Columbia River drainage accelerated in the 1860s, initially spurred by mining. Farmers eventually followed the miners, but agricultural activity was limited until the construction of the Spokane Falls and Northern Railway through the region in 1890. With improved access to markets, farming—especially orchard crops—developed as one of the economic mainstays of the area, although mining has continued to play an important role.

The growing demands for agriculture led to plans to construct a dam at Grand Coulee. The dam would provide water for irrigation and inexpensive hydroelectric power. Construction of the dam began in 1934 and was completed in 1942. More than 82,000 acres above the dam was flooded, resulting in the relocation of 11 towns and about 3,000 residents. Since its creation, Lake Roosevelt has provided a growing number of recreational and tourist activities, which have become increasingly important to local economies.

2 OVERVIEW OF LAWS AND REGULATIONS

Implementation of the RI/FS would occur primarily on federal and Tribal lands. Federal and Tribal laws and regulations addressing cultural resources will therefore provide the primary legal framework for this coordination plan. It is possible, however, that implementation of the RI/FS may require activities on private or non-federal, non-Tribal public lands. This overview therefore includes a brief description of relevant state laws and executive orders. Ferry, Lincoln, and Stevens counties, which border the UCR, do not appear to have any ordinances addressing cultural resources that would be relevant to the Site RI/FS.

Relevant federal, Tribal, and state laws and regulations directly addressing cultural resources are briefly outlined below, as well as pertinent executive orders issued by the President of the United States and the Governor of Washington.

2.1 FEDERAL LEGISLATION AND REGULATIONS

An overview of federal legislation and regulations is provided below. There are three key laws relevant to Site RI/FS activities. The NHPA guides all federal agency actions that could affect cultural resources. Implementation of the RI/FS constitutes an "undertaking" as defined in the NHPA and therefore complying with the NHPA requirements is the responsibility of EPA. The Archeological Resources Protection Act of 1979 (ARPA) and the Native American Graves Protection and Repatriation Act (NAGPRA) apply to activities that could affect archaeological resources and Indian burials on federal and Tribal lands. These laws and their implementing regulations would therefore apply to RI/FS activities conducted on federal and Tribal lands.

2.1.1 National Historic Preservation Act of 1966, as Amended through 1992 (16 USC 470-470w)

The NHPA is the centerpiece of federal legislation protecting cultural resources. In the Act, Congress states that the federal government will "provide leadership in the preservation of the prehistoric and historic resources of the United States," including resources that are federally owned, administered, or controlled. For federal agencies, Sections 106 and 110 of the Act provide the foundation for how federal agencies are to manage cultural resources, but other sections provide further guidance. The implementing regulations for the NHPA are in 36 CFR Part 800. These regulations are summarized below.

2.1.1.1 Section 106

Similar to the National Environmental Policy Act of 1969 (NEPA), Section 106 of the NHPA requires federal agencies to take into account the effects of their actions or programs specifically on historic and archeological properties, prior to implementation. This is accomplished through consultation with the State Historic Preservation Officer (SHPO) and/or the Advisory Council on Historic Preservation (ACHP). On lands held by a Tribe with a Tribal Historic Preservation Officer (THPO), the THPO has the same duties and responsibilities as the SHPO. If an undertaking on federal lands may affect properties having historic value to a federally recognized Indian Tribe, such Tribe shall be afforded the opportunity to participate as interested persons during the consultation process defined in 36 CFR 800. Compliance can also be accomplished using agreed-upon streamlined methods and agreement documents such as programmatic Agreements.

The Section 106 process is designed to identify possible conflicts between historic preservation objectives and the proposed activity, and to resolve those conflicts in the public's interest through consultation. Neither the NHPA nor the ACHP's regulations require that all historic properties be preserved. Rather, they only require the agency proposing the undertaking to consider the effects of the proposed undertaking prior to implementation.

Failure to take into account the effects of an undertaking on historic or cultural properties can result in formal notification from the ACHP to the head of the federal agency of foreclosure of the ACHP's opportunity to comment on the undertaking pursuant to NHPA. A notice of foreclosure can be used by litigants against the federal agency in a manner that can halt or delay critical activities or programs.

The process for compliance with Section 106 consists of the following steps:

1. **Identification of Historic Properties**—Identification of historic properties located within the area of potential effects (APE) is accomplished through review of existing documentation and/or field surveys.
2. **Property Evaluation**—Evaluation of the identified historic properties using National Register criteria (36 CFR Part 63) in consultation with the SHPO and, if necessary, the ACHP. Properties that meet the criteria will be considered "Eligible" for listing in the National Register, and will be subject to further review under Section 106. Properties that do not meet the criteria will be considered "Not Eligible" for listing in the National Register, and will not be subject to further Section 106 review.

3. **Determination of Effect**—An assessment is made of the effects of the proposed project on properties that were determined to meet the National Register criteria, in consultation with the SHPO and if necessary, the ACHP. One of the following effect findings will be made:

   - No Historic Properties Affected—If no historic properties are found or no effects on historic properties are found, the agency official provides appropriate documentation to the SHPO/THPO and notifies consulting parties. However, the federal agency must proceed to the assessment of adverse effects when it finds that historic properties may be affected or the SHPO/THPO or Council objects to a "No Historic Properties Affected" finding. The agency must notify all consulting parties and invite their views.
   - No Historic Properties Adversely Affected—When the Criteria of Adverse Effect are applied (36 CFR 800.5(a)), and it is found that historic properties will not be adversely affected by the undertaking, the agency may make a finding of "No Historic Properties Adversely Affected." This finding is submitted to the SHPO for concurrence. Typically, the Council will not review "No Adverse Effect" determinations. However, the Council will intervene and review "No Historic Properties Adversely Affected" determinations if it deems it appropriate, or if the SHPO/THPO or another consulting party and the federal agency disagree on the finding and the agency cannot resolve the disagreement. If Indian Tribes disagree with the finding, they can request the Council's review directly, but this must be done within the 30-day review period. Agencies must retain records of their findings of "No Historic Properties Adversely Affected" and make them available to the public. The public should be given access to the information when they so request, subject to Freedom of Information Act (FOIA) and other statutory limits on disclosure, including the confidentiality provisions in Section 304 of the NHPA. Failure of the agency to carry out the undertaking in accordance with the finding requires the agency official to reopen the Section 106 process and determine whether the altered course of action constitutes an adverse effect.

- Historic Properties Adversely Affected—Adverse effects occur when an undertaking may directly or indirectly alter characteristics of a historic property that qualify it for inclusion in the Register. Reasonably foreseeable effects caused by the undertaking that may occur later in time, be farther removed in distance, or be cumulative also need to be considered. The finding of "Historic Properties Adversely Affected" is submitted to the SHPO for concurrence. The SHPO/THPO may suggest changes in a project or impose conditions so that adverse effects can be avoided and thus result in a "No Historic Properties Adversely Affected" determination.

4. **Resolution of Adverse Effects/Mitigation**—When adverse effects are found, the consultation must continue among the federal agency, SHPO/THPO, and consulting parties to attempt to resolve them. The agency official must notify the Council when adverse effects are found and should invite the Council to participate in the consultation when circumstances as outlined within 36 CFR 800.6(a)(1)(i)(A)-(C) exist. A consulting party may also request the Council to join the consultation.

   When resolving adverse effects without the Council, the agency official consults with the SHPO/THPO and other consulting parties to develop a Memorandum of Agreement (MOA). The MOA will outline the steps or actions to be taken prior to implementation of the project, in order to mitigate the adverse effects on the historic property. Stipulations included in an MOA may include (but are not limited to) documentation, modification of the project to lessen the adverse effects on the property, efforts to sell or relocate the resource, or step-by-step consultation with interested parties throughout the process to ensure it is carried out according to plan.

   The MOA is executed between the agency official and the SHPO/THPO and filed with required documentation with the Council. This filing is the formal conclusion of the Section 106 process and must occur before the undertaking is approved.

In some cases, streamlining of the Section 106 process can be accomplished through the use of programmatic agreements. The ACHP and the agency official may negotiate a programmatic agreement to govern the implementation of a particular program or the resolution of effects from complex projects or multiple undertakings. Programmatic agreements are particularly useful when programs or projects affecting historic properties are similar and repetitive, and have known effects, such as routine maintenance or a series of similar rehabilitation projects.

2.1.1.2 Section 101(d)(2)

This section of the NHPA provides for the assumption by federally recognized Indian Tribes of all or any part of the functions of a SHPO with respect to Tribal lands (e.g., all lands within the exterior boundaries of any Indian reservation and all dependent Indian communities). Section 101(d)(2) requires federal agencies, in carrying out their Section 106 responsibilities, to consult with federally recognized Indian Tribes that attach religious or cultural significance to a historic property. The agency will consult with federally recognized Indian Tribes in the Section 106 process to identify, evaluate, and treat historic properties that have religious or cultural importance to those groups.

2.1.1.3 Section 110

Section 110 of the NHPA is intended to ensure that historic preservation is integrated into the ongoing programs of Federal agencies. This section of the Act requires agencies to identify, evaluate, and nominate for listing in the National Register, historic properties owned or controlled by the agency; use historic properties to the maximum extent feasible; ensure documentation of historic properties that are to be altered or damaged; carry out programs and projects that further the purpose of the Act; and undertake such planning and actions as may be necessary to minimize harm to any formally designated National Historic Landmark properties.

2.1.1.4 Section 111

Section 111 of the NHPA requires agency officials, to the extent practicable, to establish and implement alternatives for historic properties, including adaptive use, that are not needed for current or projected agency uses or requirements. Further, Section 111 allows the proceeds from any lease to be retained by the agency to defray the cost of administration, maintenance, repair, and related expenses of historic properties.

2.1.1.5 Section 112

Section 112 of the NHPA requires that agency officials who are responsible for protection of historic properties pursuant to the NHPA ensure that all actions taken by employees or contractors meet professional historic preservation standards established by the Secretary of the Interior (Professional Qualifications Standards of the Secretary of the Interior's Standards and Guidelines in Archaeology and Historic Preservation [NPS 1983]).

2.1.1.6 Section 304

Section 304 of the NHPA requires that information about the location, character, or ownership of a historic property be withheld from public disclosure when the federal agency head or other public official determines that disclosure may cause a significant invasion of privacy, risk and/or harm to the historic property, or impede the use of a traditional religious site by practitioners.

2.1.1.7 CERCLA and the NHPA

EPA's *CERCLA Compliance with Other Laws Manual: Part II. Clean Air Act and Other Environmental Statutes and State Requirements* (USEPA 1989) outlines how "substantive compliance" with the NHPA is to be achieved in Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) actions.[2] The initial step is determining if cultural resources are known or are likely to be present "in or near the area under study in the RI." This step may require conducting a survey of both the location of the proposed remedial action and any associated actions that would occur off-site. The CERCLA manual referenced above defines three stages of a survey: Stage IA, literature search and sensitivity study; Stage IB, field investigation; and Stage II, site definition and evaluation. All studies should include Stage IA but implementation of Stage IB is contingent on the results of Stage IA, and the need for Stage II is contingent on the results of Stage IB. If results of the survey identify significant cultural resources (i.e., resources listed or considered eligible for listing on the National Register), effects of the proposed remedial action and associated actions to the significant resources must be evaluated. Adverse effects to significant resources must be either avoided or mitigated. Any proposed mitigation measures must be incorporated into the remedial design process.

2.1.2 Archeological Resources Protection Act of 1979 (16 USC 470aa-470ll)

ARPA is essentially an update to the 1906 Antiquities Act. It expands and strengthens the activities prohibited under the Antiquities Act, increases the criminal penalties for violation, establishes civil penalties, and provides further guidelines for the issuance of permits. This Act continues to apply only to federal and Indian lands (the definition of

[2] As stated in the June 2, 2006 Settlement Agreement (USEPA 2006), "The Parties intend that this RI/FS, while not being carried out under an administrative order or judicial order issued pursuant to the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), will be consistent with the National Contingency Plan ('NCP'), 40 CFR Part 300."

"Indian lands" in ARPA differs very slightly from the definition of "Tribal lands" in the NHPA). Most archaeological excavations and collection of artifacts on these lands are allowed only with an ARPA permit. Trafficking in illegally obtained archeological resources from federal and Indian lands is also prohibited. Individuals convicted of violating the Act are liable for the value of the archaeological resource itself, and the cost of restoration or repair of the damage caused by illegal excavation or collection.

The implementing regulations are 43 CFR Part 7 (Department of the Interior), which applies to Federal lands that are not within military reservations or national forests. The regulations include detailed definitions of "archaeological resource" and "Indian lands" (lands held in trust by the United States on behalf of a federally recognized Tribe or individual members of a federally recognized Tribe).

2.1.3 Native American Graves Protection and Repatriation Act (25 USC 3001-3013)

NAGPRA establishes that Native American human remains and associated funerary objects found on federal or Tribal lands belong to the lineal descendants of the Native American. When the lineal descendants cannot be determined, the remains belong to the Tribe on whose land the remains were found (when found on Tribal lands), or to the Indian Tribe with the "closest cultural affiliation."[3] This latter rule also applies to unassociated funerary objects, sacred objects, and objects of cultural patrimony (all defined in the Act) NAGPRA applies to both human remains intentionally excavated (which would require an ARPA permit) and those accidentally discovered.

NAGPRA also requires all federal agencies and museums to inventory their holdings of Native American human remains and funerary objects. Once the inventories are completed, the agencies and museums are to notify the appropriate Tribes of the remains and other objects in their collections. The remains and associated funerary objects are to be returned (repatriated) at the request of the lineal descendant(s) or Tribe. The same requirement applies to unassociated funerary objects, sacred objects, and objects of cultural patrimony for which a cultural affiliation can be demonstrated. Exceptions to the repatriation requirement are objects that are "indispensable for completion of a specific scientific study, the outcome of which would be of major benefit to the United States."

[3] Cultural affiliation is defined in the implementing regulations [43 CFR 10.2(e)] and refers to a relationship of shared group identity, which can be reasonably traced historically or prehistorically between a present day Indian tribe or Native Hawaiian organization and an identifiable earlier group.

The implementing regulations are 43 CFR Part 10, which largely expand on the elements of the statute. The regulations detail 1) the process of consultation with Indian Tribes to address either intentional excavation of human remains or inadvertent discovery of human remains; 2) how agencies and museums are to inventory their collections; and 3) the repatriation process. When human remains, funerary objects, sacred objects, and objects of cultural patrimony are inadvertently discovered on federal lands the following steps are to be followed: 1) ongoing activity in the area of the find must cease and a reasonable effort made to protect the find; and 2) the federal land agency (i.e., the federal agency on whose lands the remains or objects have been found) must be immediately notified by telephone, with written confirmation. The federal land agency must then notify the appropriate Tribe(s) and further secure and protect the discovery. The activity may be halted for up to 30 days while an appropriate response to the find is negotiated by the federal agency and the appropriate Tribe(s).

2.1.4 American Indian Religious Freedom Act (42 USC 1996)

This act states that it is the policy of the United States to protect and preserve the rights of American Indians to practice traditional religions. That policy includes rights of access to sacred sites and to the use and possession of sacred objects. There are no implementing regulations.

2.2 PRESIDENTIAL EXECUTIVE ORDERS

Presidential executive orders define policies and procedures for federal agencies to facilitate their execution of laws passed by the U.S. Congress or clarify how specific laws are to be implemented. Presidential executive orders can be considered instructions or directives from the President to federal agencies on how to carry out specific laws. The executive orders listed below are either directly related to cultural resources or define relationships between federal agencies and tribes.

2.2.1 Executive Order 11593. Protection and Enhancement of the Cultural Environment

Issued in 1971, Executive Order 11593 states that the federal government would provide leadership in "preserving, restoring, and maintaining the historic and cultural environment of the Nation." Federal agencies were directed to inventory cultural resources under their jurisdiction and nominate National Register-eligible properties to the National Register. Properties that have been determined eligible are not to be

transferred, sold, demolished, or altered without providing the ACHP on Historic Preservation with an opportunity to comment. Properties to be demolished or substantially altered were to be documented prior to demolition or alteration. National Register properties or National Register-eligible properties under federal control were to be maintained following standards set by the Secretary of the Interior. Executive Order 11593 also assigns specific responsibilities to the Secretary of the Interior, including managing the National Register of Historic Places and assisting and advising other federal agencies in the management of cultural resources.

2.2.2 Executive Order 13007. Indian Sacred Sites

Issued in 1996, Executive Order 13007 directs federal agencies to provide access and ceremonial use of Indian sacred sites, where practicable, legal, and not inconsistent with essential agency functions. Agencies are also directed to avoid adversely impacting sacred sites and maintain the confidentiality of such sites. A "sacred site" as defined by this executive order is a specific location that is sacred because of its religious significance to or ceremonial use in an Indian religion.

2.2.3 Executive Order 13175. Consultation and Coordination with Indian Tribal Governments

Issued in 2000, Executive Order 13175 directs federal agencies to consult with Tribal officials in the development of policies and regulations that have "tribal implications" or that preempt Tribal law. Executive Order 13175 also emphasizes the importance of government-to-government relationships between the U.S. Government and Tribes. Agencies must designate an official responsible for implementing the Executive Order and must document Tribal consultation in the development of the relevant policies and regulations.

2.3 TRIBAL LEGISLATION AND REGULATIONS

Tribal laws and regulations addressing cultural resources would apply to lands on the reservations and off-reservation trust lands. The Confederated Tribes of the Colville Reservation (CCT) and the Spokane Tribe of Indians (STI) are the two Tribes whose laws and regulations would be potentially applicable to the Site. The legal code of the CCT addresses cultural resources, as summarized below. This code applies to both on-reservation actions and off-reservation actions by federal agencies that could affect cultural resources. STI does not currently have laws that specifically address cultural

resources. Both Tribes have THPOs, who have the same authority and responsibilities as the SHPO on their respective reservations and on off-reservation trust lands.

2.3.1 Confederated Tribes of the Colville Reservation. Colville Tribal Law and Order Code Chapter 4-4, Cultural Resources Protection

This Colville Tribal Code establishes the Colville Cultural Resources Board, which has the responsibility of developing policies and procedures to protect cultural resources of interest and concern to the Colville Tribes, both on and off the Colville Reservation. The Board reviews proposed federal agency actions off the reservation and is responsible for reviewing all proposed on-reservation actions that could affect significant cultural resources. The code also establishes a Colville Register of Historic and Archaeological Properties for listing of historic properties on the Colville Reservation.

This code defines the roles and responsibilities of the Colville History and Archaeology Department, which include identifying significant cultural resources on the reservation, nominating properties to the National Register and the Colville Register, and promoting efforts to protect cultural resources on the reservation.

Chapter 4-4 of Colville Tribal Code prohibits the excavation, disturbance, or other adverse effects to archaeological resources and historic properties on the reservation without a permit issued by the History and Archaeology Department. The code defines the procedure for the issuance of permits and the duties of permittees.

2.4 STATE LEGISLATION AND REGULATIONS

Washington State laws and regulations regarding archaeological and historical resources, as well as the law protecting Indian graves, are not applicable on federal lands or on Tribal trust lands. These laws would apply, however, to any RI/FS-related activities that would affect private lands or non-federal or non-Tribal public lands.

2.4.1 Revised Code of Washington (RCW) Chapter 27.44, Indian Graves and Records

This legislation prohibits the removal or other disturbance of Indian burials, cairns, and "glyptic or painted records." "Burials" and "graves" are not defined in the statute. Excavation or removal of burials is permitted only under provisions of a permit issued by the Washington Department of Archaeology and Historic Preservation. Procedures for obtaining permits are defined in WAC Chapter 25-48.

2.4.2 RCW Chapter 27.53, Archaeological Sites and Resources

This legislation prohibits the excavation or disturbance of archaeological sites on public and private lands in Washington except under provisions of a permit issued by the Washington Department of Archaeology and Historic Preservation. Procedures for obtaining permits are defined in WAC Chapter 25-48.

2.4.3 RCW Chapter 68.60, Abandoned and Historic Cemeteries and Historic Graves

This legislation prohibits the destruction, alteration, or other disturbance of historical and abandoned cemeteries and historic graves (Indian graves and burials are protected in RCW Chapter 27.44). A historic cemetery is defined in the statute as one established before November 1889. A historic grave is a grave or graves outside of a cemetery placed prior to June 1990.

2.4.4 RCW Chapter 43.21C, State Environmental Policy Act

This legislation directs state and local agencies in Washington to address environmental impacts of proposed projects. The implementing rules (WAC Chapter 197-11) require that impacts to historic and cultural resources are to be addressed in the State Environmental Policy Act process.

3 PROPOSED SAMPLING PROGRAM

A summary of the proposed sampling locations (coordinates) are provided within Table C3-1; with a detailed description of sampling techniques provided within the Quality Assurance Project Plan (QAPP). As indicated within the QAPP, sediment sampling activities will be completed to depths no greater than approximately 6 to 10 in. below ground surface using a decontaminated steel (modified) Van Veen power grab or Eckman box core sampler.

During this work, up to 146 primary (includes tributary references) and reserve surface sediment sampling locations between the U.S.–Canada border and Grand Coulee Dam have been identified for sample retrieval, see Maps C3-1 through C3-7. A detailed list of sampling station coordinates are provided within Table C3-1. In the event that samples cannot be retrieved from a primary sampling area, the nearest alternative sampling location will be sampled.

Surface sediment samples will be collected using a decontaminated steel Van Veen power grab sampling devices, or similar device (e.g., Eckman, or Ponar box core sampler). These samplers are capable of collecting up to 57 L (15 gal) of sample per grab each sampling station. A backup sampler will also be available in the event that the primary grab is damaged, malfunctions, or is lost. Sampling stations will be approached at slow boat speeds with minimal wake to minimize disturbance of bottom sediments prior to sampling, particularly in shallow sampling locations.

The sampler will be deployed using a hydraulic winch and an overhead davit or boom at a controlled rate of speed. The position of the sampler relative to the riverbed will be shown on the vessel's depth sounder or by rigging the hydrowire to a meter wheel or using pre-marked meter lengths on the cable itself. After the sample is collected, the sampling device will be lifted slowly off the bottom, then steadily raised to the surface at a speed of about 30 cm/sec (1 ft/sec).

Material in the sampler will be photographed and the photograph labeled with station location, date, and time of sample. Overlying water will be siphoned off near one corner of the sampler and porewater will be extracted directly from the sampler using an airstone. Following porewater extraction, all sediment samples will be placed in transparent Lexan tub for inspection by on-site cultural resource monitors. Following cultural inspection and clearance, a decontaminated Lexan sampling scoop or similar

device (e.g., stainless steel trowel or spoon) will be used to collect sediment for analytical and biological testing per the quality assurance project plan.

4 COORDINATION PLAN

The objective of the CRCP is to ensure that implementation of the RI/FS and associated sampling activities does not adversely affect any cultural resources. The plan therefore defines a general process and more specific procedures to meet this objective.

The two chief challenges in meeting this objective are 1) the iterative process of remedial investigations; and 2) the high density of cultural resources in the study area. The iterative process is a challenge because there are likely to be several rounds of sampling (and associated actions) that extend over several years. Coordination and consultation must therefore also be an iterative process as methods and locations are defined for each round of sampling.

The high density of cultural resources is a challenge because it is highly likely that every round of intrusive sampling will occur at the identified location of one or more cultural resource(s). At the same time, the high density is potentially misleading by suggesting that all cultural resources in the UCR have been identified. Most—if not all—of the Lake Roosevelt lands have been surveyed for cultural resources in the past. Few of the surveys conducted prior to about 1975 are likely to have met current regulatory and professional standards. In addition, many of the previous surveys focused on archaeological resources to the exclusion of other types of cultural resources (and older archaeological surveys documented only evidence of prehistoric use or occupation). Finally, it is likely that there are some locations previously surveyed at which burials or buried archaeological resources are present but not evident and therefore not recorded at the time of the survey (many surveys both in the past and in the present rely entirely or primarily on surface evidence of archaeological resources or burials).

This plan therefore defines procedures that address sampling at both known locations of cultural resources and locations where no cultural resources are presently recorded.

4.1 GENERAL CONSULTATION FRAMEWORK

Successful implementation of the RI/FS and of this CRCP, given the issues defined above, will require ongoing consultation and coordination with the NPS, the USBR, the CCT, the STI, and the Washington SHPO (i.e., the consulting parties). Other consulting parties (as defined in 36 CFR 800.2(c)) may be recognized in the future whose participation would be important for general consultation or coordination in the RI/FS process or for specific sampling locations. For the purposes of cultural resources coordination activities, the

"consulting parties" referred to in this plan are distinguished from other "participating parties" to the RI/FS process.

4.2 CULTURAL RESOURCE PROCEDURES IN THE SAMPLING PROCESS

This section defines general procedures to be followed in the sampling process to minimize the potential for inadvertent disturbance of cultural resources. More specific protocols to respond to discoveries are defined in the following sections.

A Tribal cultural resources specialist or a professional archaeologist will be present on-site to monitor sediment sampling conducted at a known cultural resource or within 100 m (330 ft) of a known resource. The protocol for this monitoring is defined below.

4.2.1 Archaeological Monitoring in the Sampling Program

To assure compliance with the NHPA and the applicable requirements, procedures, and standards of the NPS, USBR, CCT, and STI, the following procedures have been developed to address potential discoveries, including inadvertent discoveries, of cultural materials and deposits (including sacred objects, funerary objects, and objects of cultural patrimony as defined in NAGPRA) and Indian burials and human remains (as defined in NAGPRA) during sediment and soil sampling and associated activity that could result in ground disturbance.

4.2.1.1 Notification of Planned Sediment and Soil Sampling

Teck American Incorporated (TAI) shall notify EPA at least 15 days in advance of any sample collection activity, unless shorter notice is agreed to by EPA. Notification to EPA may be provided by e-mail or by letter. As for all RI/FS activities at the Site involving sediment collection or ground penetration/disturbance, TAI shall work with potentially affected parties to assess the effects of the planned work and seek ways to avoid, minimize, or mitigate any adverse effects on historic properties. Further, sediment sampling cannot be performed at the Site without 1) clearance of proposed sediment sample locations by tribal and federal/state cultural resources coordinators, and; 2) approval by EPA.

The names and contact information for potentially affected parties (i.e., representatives of the federal land-managing agencies and Tribes) are provided in Attachment C1 of this plan. TAI will work with EPA to establish a procedure for timely notification of these parties.

4.2.1.2 Professional Archaeologist and Tribal Representative On-Site

An archeological monitor and/or Tribal representative will be present on-site when sampling or sampling-related activity occurs. The archaeological monitor and/or Tribal representative will visually examine all samples to determine if evident or likely artifacts are present or if other deposits are present that are likely to be cultural in origin. The archaeological monitor and/or Tribal representative will not make physical contact with the sample unless artifacts or other cultural deposits are present. If artifacts or likely archaeological deposits are present, the archaeologist or Tribal representative will record the location of the materials and photograph the materials in place in such a manner to provide information on provenience. The artifacts and other archaeological materials will then be re-deposited at their original location.

The archaeological monitor and/or Tribal representative will document their observations on a daily basis, including field notes and photographs that record the location, character of the sampling or other ground-disturbing activity, any archaeological discoveries made, and any decisions made within the provisions of this plan by the archaeological monitor and Tribal representative in response to any archaeological discoveries. A standardized archaeological monitoring form may be substituted for the field notes referenced above.

All archaeological monitors and Tribal representatives will be required to have read the applicable health and safety plan and to have complete understanding of the archaeological monitoring provisions of this plan. The archaeological monitors will also be required to meet requirements for personal protective equipment. In addition, all on-site personnel are subject to the directions of the task field supervisor at all times.

4.2.1.3 Discoveries–Archaeological Monitors Present

At the discretion of the archaeological monitor or Tribal representative, ground-disturbing sampling or associated activity may be slowed or halted at any time that a suspected archaeological object or archaeological resource is encountered. The objective of this slowing or halting of ground-disturbing cleanup activity is to allow the archaeologist to confirm and/or make a preliminary assessment of the discovery. At the discretion of the archaeological monitor or Tribal representative, a specific sample may be relocated from the location of the discovery but at the sampling location. Such relocation will be coordinated with the on-site sampling manager or supervisor.

At the request of the archaeological monitor or Tribal representative, the sampling personnel will either

- Assist in securing access to the location of the discovery and take appropriate measures to protect the location of the discovery from rain, stormwater, and other possible disturbances, or
- Assist in moving the artifacts to a protected and secure area of the site away from the immediate sampling area. Removal of artifacts from the discovery location will be undertaken only if leaving the artifacts in place would jeopardize their integrity due to erosion or collection by unauthorized individuals.

The archaeological monitor, Tribal representative, or a member of the TAI Technical Team will remain on-site to ensure the security of the find until more extensive efforts can be made to secure the site from further disturbance or a more extensive evaluation and documentation of the discovery can be made.

Notification of any archaeological discoveries must be provided to EPA for further coordination with consulting parties within 24 hours of the discovery. All telephone notification of discoveries must be promptly followed by notification in writing (via e-mail or conventional mail).

4.2.1.4 Discovery of Human Remains

Native peoples in the study area consider the graves of their ancestors to be important in both their cultural identity and in defining their relationship with the land. These graves are therefore considered sacred and should be left undisturbed. Should inadvertent disturbance occur, the remains and associated materials ("funerary objects") must be treated with respect and honor. All appropriate federal, Tribal, and state laws, regulations, and procedures regarding burials should be rigorously enforced.

In the event that likely or confirmed human remains are encountered, all further sampling or other ground-disturbing activity will cease immediately. To comply with 43 CFR 10.4(b), any discoveries of human remains must be reported to the NPS and USBR immediately by telephone, followed by written notification. Any discoveries within the boundaries of the CCT or the STI reservations must also be reported immediately to the respective Tribe.

TAI will notify EPA for further coordination with consulting parties (consisting minimally of the NPS, USBR, CCT, STI, and the Washington SHPO). The TAI Technical Team will assist the archaeological monitor and Tribal representative in securing the location of the discovery.

If no archaeological monitor or Tribal representative is present, the TAI Technical Team will secure the location of the discovery in such a manner that both maintains the physical integrity of the remains and any associated objects and precludes further disturbance, or a member of the TAI Technical Team will remain on-site until an archaeologist or Tribal representatives can arrive to assess the find.

Other conditions for responses to discoveries of archaeological materials may be defined in the permit(s) issued for the sampling program. Responses to any discoveries of burials must comply with provisions of NAGPRA and its implementing regulations (in addition to those referenced above), as well as the existing protocols of the NPS, USBR, CCT, and STI (copies of these protocols are provided in Attachment C1).

4.2.2 Curation

Artifacts and other cultural materials that may be recovered during the sampling program (with the exception of human remains and associated items subject to NAGPRA) will be curated at a facility that meets the standards of 36 CFR 79. The appropriate facility or facilities will be designated by the NPS and USBR in consultation with the Tribes for items recovered from federal lands. The appropriate Tribe will designate the curation facility for cultural materials recovered from Tribal lands.

4.2.3 Reporting

Within 150 days of completion of each sampling activity that is covered under this plan,[4] a professional archaeologist will prepare a confidential[5] written report and presents the results of the archaeological monitoring and responses to any discoveries of archaeological resources or burials. The report will include 1) copies of field notes, descriptions and maps of all locations at which sampling-related archaeological monitoring was conducted; 2) descriptions of any discoveries made during such monitoring and the outcome of the discoveries (including the rationale for the decisions for the disposition of any finds); 3) descriptions and maps of all non-monitored locations at which inadvertent discoveries were made and the outcome of those discoveries; and 4) recommendations for any changes in the monitoring protocol or coordination plan that

[4] Sampling or other RI/FS activities that do not require coordination under this plan will not result in generation of this reporting requirement.

[5] Refer to Section 5.3, "Confidentiality."

may be appropriate to address results of the monitoring or how well existing coordination procedures worked.

The draft report will be provided to EPA for review and dissemination to the consulting parties for review and comment.

4.3 CONFIDENTIALITY

TAI shall make its best efforts, in accordance with state and federal law, to ensure that its employees and contractors keep the discovery of any found or suspected human remains, other cultural items, and potential historic properties confidential. Pertinent TAI employees and contractors will be required to read and sign a confidentiality statement that specifies procedures to be followed in response to media and public contacts regarding archaeological and other cultural resources. To the extent permitted by law, prior to any release of information, EPA, TAI, and the other consulting parties shall concur on the amount of information, if any, to be released to the public, any third party, and the media and the procedures for such a release.

5 REFERENCES

NPS (National Park Service). 1983 (with updates). Archeology and historic preservation: secretary of the interior's standards and guidelines [as amended and annotated]. National Park Service, Department of Interior. Available at: http://www.nps.gov/history/local-law/arch_stnds_9.htm

USEPA (United States Environmental Protection Agency). 1989. CERCLA compliance with other laws manual: Part II. Clean Air Act and other environmental statutes and state requirements. U.S. Environmental Protection Agency, Region 10, Seattle, WA.

USEPA (United States Environmental Protection Agency). 2006. Settlement agreement for implementation of remedial investigation and feasibility study at the Upper Columbia River Site. June 2, 2006. U.S. Environmental Protection Agency, Region 10, Seattle, WA.

6 GLOSSARY OF TERMS

Burial—A burial is defined in NAGPRA as "[a]ny natural or prepared physical location, whether originally below, on, or above the surface of the earth, into which as part of the death rite or ceremony of a culture, individual human remains are deposited."

Curation—Long-term storage and preservation of archaeological collections. Archaeological collections from federal lands must be curated at facilities that meet the standards of 36 CFR 79.

Ethnohistoric—Information on Native peoples gathered from historical accounts.

Historic, historic-period, historical—The NHPA uses the term "historic" to refer to properties that are listed or have been determined eligible for listing on the National Register of Historic Places. To avoid confusion with this definition of "historic," "historic-period" or "historical" are used to reference resources, places, events, and people associated with the period since the appearance of Euroamericans and the beginning of written accounts (ca. 1780–1810 in the Pacific Northwest).

Protohistoric—The period of time transitional from prehistory to history. In the Pacific Northwest, the protohistoric can be generally defined as from the late 1600s until late 1700s.

Maps

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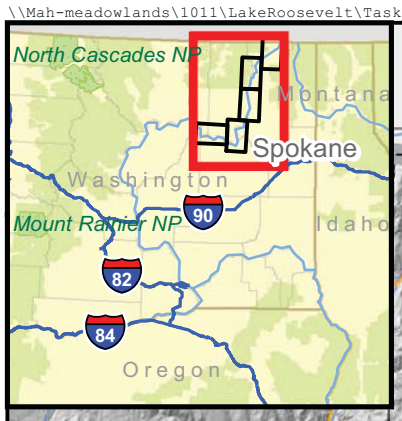

U.S. - Canada Border

Grand Forks

Danville

Laurier

Frontier

Velvet

Toroda

Goldstake

Curlew

Kettle River

Orient

Dulwich

Leadpoint

Bodie

Malo

Karamin

Old Toroda

Marble

Spirit

Onion Creek

Goldfield Mill

Ryan

Barstow

Bossburg

Wauconda

Old Wauconda

Pollard

Boyds

Evans

Powell

Aladdin

Tile 1

Torboy

Republic

Marcus

Harter

Ward

Kettle Falls

Greenwood

Pinkney City

Park Rapids

Tile 2

Orin

Aeneas Valley

Aeneas

Okanogan

Lyman Lake Moses Mountain

Big Road 64

Gold Creek

West Fork

Ferry

Arzina

Rice

Stevens

Arden

Colville River

Bingville

Waterloo

Daisy

Addy

Fairview

Maud

Bluecreek

Cozy Nook

Addy Gifford

Impach

Gifford

Chewelah

Meteor

Bissel

Covada

Kewa

Cedonia Addy

Nespelem

Colville Indian Reservation

Carrs Corner

Waits

Valley

Kulzer

Cedonia

Tile 3

Sanpoil River

Keller

Hunters

Grays

Fruitland

Springdale Hunters

Cline

Springdale

Belvedere

Turk

Deer Trail

Camas

Koontzville

Seatons Grove

Enterprise

Lone Pine

Elmer City

Mason City

Spokane Indian Reservation

Williams Valley

Electric City

Osborne

Miles

Fort Spokane

Ford

Wellpinit

Tumtum

Bagdad Junction

Hesseltine

Tile 5

Seven Bays

Long Lake

Sherman

Lincoln

Little Falls

Tile 4

Wilbur

Creston

Farwell

Crescent

Hanson

Govan

Almira

Telford

Mondovi

Davenport

Reardan

Rocklyn

Gravelles

Grant

Lincoln

Omans

Elanor

Legend

- Populated Places
- County Lines
- Reservations
- 24 Meter Water Depth Contour
- Sediment > 2mm (CCT)
- Sediment > 2mm (Interpolated)
- EPA Alternate Location

HDR | HydroQual

Km 0 5 10

Miles 0 5 10

N

Map C3-1. **Overview of Proposed Sediment Sampling Locations**
Upper Columbia River, WA

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U.S. - Canada Border

Frontier

Velvet

251

Northport

Fir

Leadpoint

25

Marble

Deep Lake Boundary

Spirit

Ryan

Onion Creek

Goldfield Mill

Clugston Creek Onion Creek

Aladdin

Aladdin

Legend

- Populated Places
- County Lines
- 24 Meter Water Depth Contour
- Sediment > 2mm (CCT)
- Sediment > 2mm (Interpolated)
- EPA Alternate Location

HDR | HydroQual

Km
0 1.25 2.5

Miles
0 1.25 2.5

N

Map C3-2. **Tile 1 - Proposed Sediment Sampling Locations**
Upper Columbia River, WA

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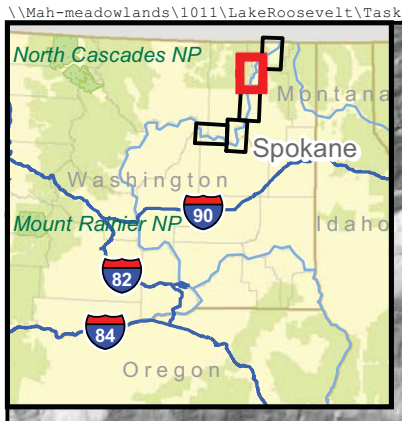

Barstow
Kettle River
395
Boyds
Bear
Evans
Powell
Ryan
25
East Marcus
Marcus
Harter
Echo
Williams Lake
Kettle Falls
Ward
20
Inchelium Kettle Falls
Greenwood

Legend

- Populated Places
- County Lines
- Reservations
- 24 Meter Water Depth Contour
- Sediment > 2mm (CCT)
- Sediment > 2mm (Interpolated)
- EPA Alternate Location

HDR | HydroQual

Km 0 1.25 2.5

Miles 0 1.25 2.5

N

Map C3-3. **Tile 2 - Proposed Sediment Sampling Locations**
Upper Columbia River, WA

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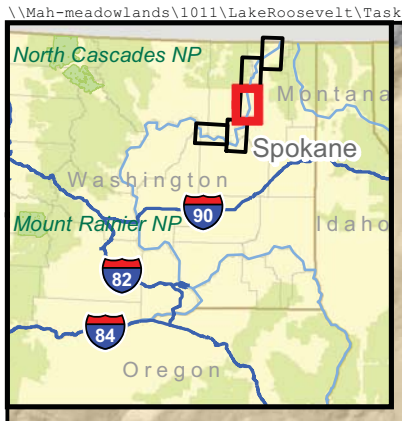

Arzina
Rice
Waterloo
Daisy
Maud
Addy Gifford
Gifford
Colville Indian Reservation
Inchelium
Impach
Meteor
Inchelium Kettle Falls
3 Ferry Crossing Landing
Covada
Bissel
Kewa
Cedonia Addy
Cedonia
Springdale Hunters

Legend

- Populated Places
- County Lines
- Reservations
- 24 Meter Water Depth Contour
- Sediment > 2mm (CCT)
- Sediment > 2mm (Interpolated)
- EPA Alternate Location

HDR | HydroQual

Km
0 1.25 2.5
Miles
0 1.25 2.5
N

Map C3-4. **Tile 3 - Proposed Sediment Sampling Locations**
Upper Columbia River, WA

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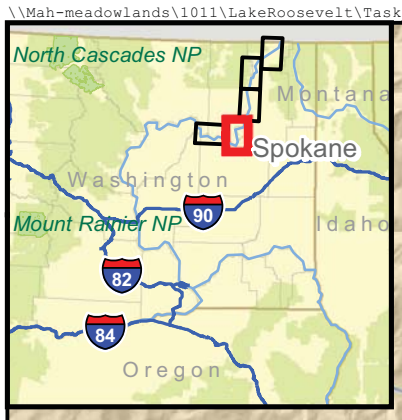


Springdale Hunters
Hunters
Fruitland
25
Enterprise
Colville Indian Reservation
Spokane Indian Reservation
Miles
Fort Spokane
Seven Bays
Lincoln

Legend

- Populated Places
- County Lines
- Reservations
- 24 Meter Water Depth Contour
- Sediment > 2mm (CCT)
- Sediment > 2mm (Interpolated)
- EPA Alternate Location

HDR | HydroQual

0 1.25 2.5 Km

0 1.25 2.5 Miles

N

Map C3-5. **Tile 4 - Proposed Sediment Sampling Locations**
Upper Columbia River, WA

\\Mah-meadowlands\1011\LakeRoosevelt\Task D84 Sediment QAPP Revisions\Sampling Maps\UCRTemplate-Toxicity Tests Landscape.mxd @ 07-09-2012

Belvedere
155
Seatons Grove
Koontzville
Elmer City
Lone Pine
Crown Point Vista
Mason City
Coulee Dam
Grand Coulee Dam
Keller
Colville Indian Reservation
Delano Heights
Electric City
East Heights (subdivision)
Osborne
Grand Coulee Hill
174
Bagdad Junction
Hesseltine
West
52

Legend

- Grand Coulee Dam
- Populated Places
- Reservations
- County Lines
- 24 Meter Water Depth Contour
- Sediment > 2mm (CCT)
- Sediment > 2mm (Interpolated)
- EPA Alternate Location

HDR | HydroQual

Km
0 1.25 2.5

Miles
0 1.25 2.5

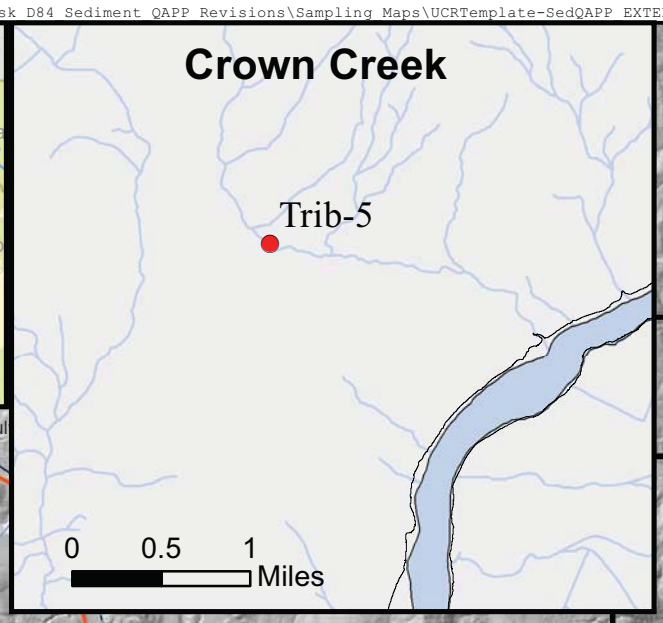
N

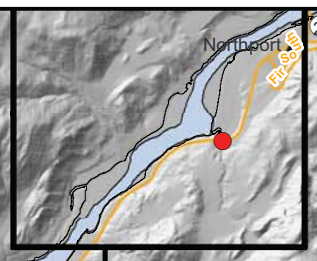
Map C3-6. **Tile 5 - Proposed Sediment Sampling Locations**

Upper Columbia River, WA

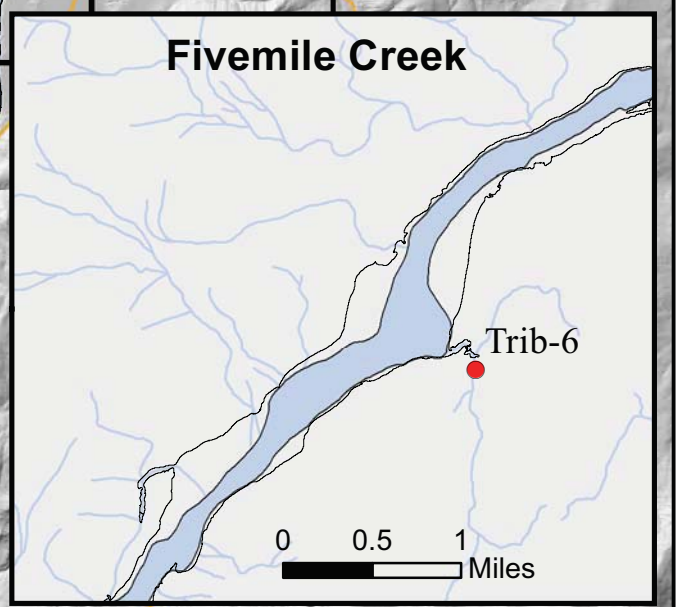
\\Mah-meadowlands\1011\LakeRoosevelt\Task D84 Sediment QAPP Revisions\Sampling Maps\UCRTemplate-SedQAPP EXTERNAL OVERVIEW.mxd @ 07-10-2012

Crown Creek

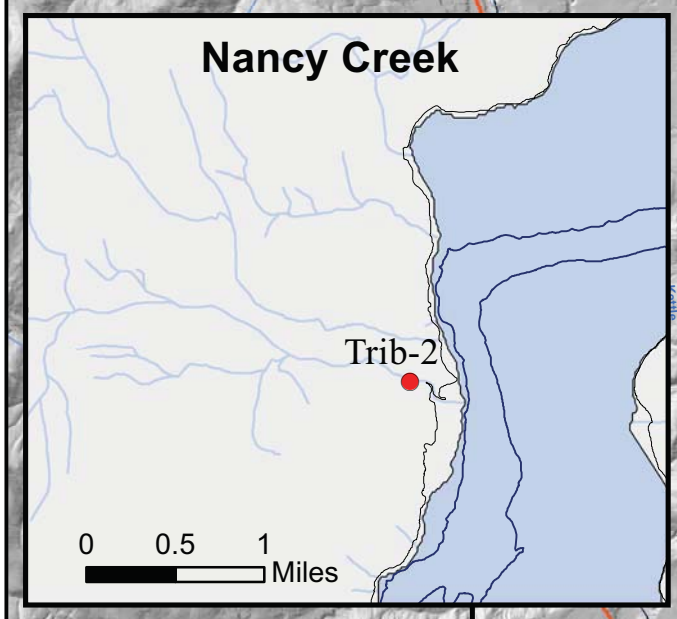




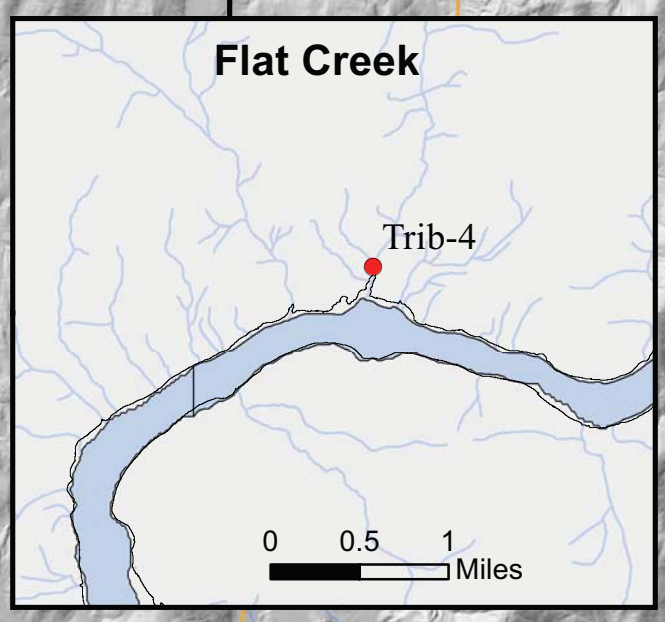
Fivemile Creek



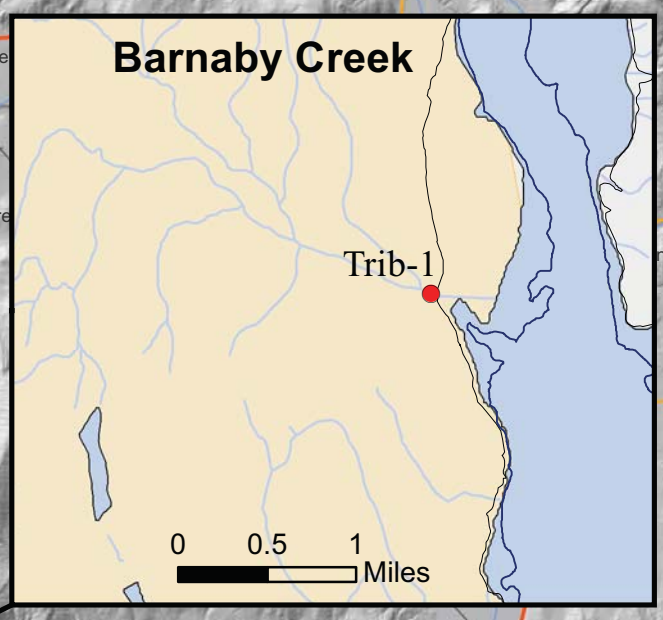
Nancy Creek



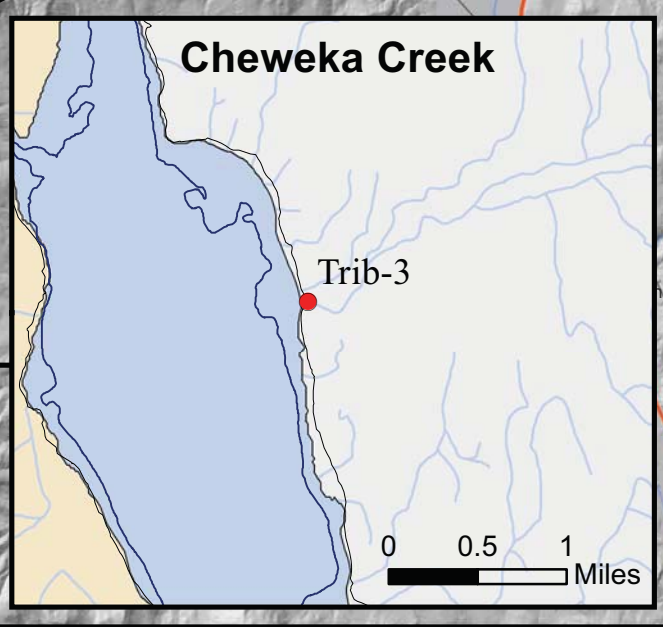
Flat Creek



Barnaby Creek



Cheweka Creek



Legend

- Populated Places
- County Lines
- 24 Meter Water Depth Contour
- Reservations
- EPA Alternate Location

HDR | HydroQual

0 1.25 2.5 Km

0 0.5 1 Miles

N

Map C3-7. **External Reference Locations in U.S. for Phase 2 Sediment Study**

Upper Columbia River, WA

TABLE

Table C3-1. Proposed Surface Sediment Sampling Locations. *A Cultural Resources Working Group review of the proposed sample locations convened on August 7, 2012 and approved sediment sampling within 150 feet (Area = 70,686 ft^2 = 1.6 acres) of each approved sampling position (Letter from Dr. Laura Buelow of the U.S. Environmental Protection Agency dated August 24, 2012).*

River Mile	CSM Unit	X UTM 11N	Y UTN 11N	Latitude	Longitude
744	CSM Unit 1	453509.4201	5427422.5025	48.9980	-117.6356
743	CSM Unit 1	453049.2160	5425706.7652	48.9825	-117.6417
742	CSM Unit 1	451648.4545	5424098.8892	48.9679	-117.6606
740	CSM Unit 1	449383.7152	5422536.5077	48.9537	-117.6914
739	CSM Unit 1	447418.4558	5421563.1309	48.9448	-117.7181
739	CSM Unit 1	447786.7914	5421919.1414	48.9480	-117.7131
738	CSM Unit 1	446702.4589	5420858.9288	48.9384	-117.7278
738	CSM Unit 1	446805.9822	5420459.5044	48.9348	-117.7263
737	CSM Unit 1	445699.4516	5420996.5968	48.9395	-117.7415
737	CSM Unit 1	446362.5845	5421153.1449	48.9410	-117.7325
735	CSM Unit 1	443177.8505	5418969.8971	48.9211	-117.7756
734	CSM Unit 1	442907.6141	5418852.1021	48.9200	-117.7793
734	CSM Unit 1	442467.0883	5418819.2320	48.9196	-117.7853
733	CSM Unit 1	441090.2453	5417255.8861	48.9054	-117.8039
733	CSM Unit 1	441604.8343	5418331.8254	48.9152	-117.7970
732	CSM Unit 1	440379.5707	5416787.8301	48.9012	-117.8135
731	CSM Unit 1	438638.5012	5415121.2071	48.8860	-117.8370
731	CSM Unit 1	439803.8784	5415827.6896	48.8925	-117.8212
731	CSM Unit 1	439332.2297	5416009.6655	48.8941	-117.8277
730	CSM Unit 1	438161.3082	5414310.6777	48.8787	-117.8434
730	CSM Unit 1	438059.8053	5414097.9036	48.8767	-117.8448
730	CSM Unit 1	437662.4861	5414117.1880	48.8769	-117.8502
729	CSM Unit 1	436880.8238	5413705.7781	48.8731	-117.8608
729	CSM Unit 1	436540.9523	5413587.1195	48.8720	-117.8654
728	CSM Unit 1	435609.5237	5413195.8161	48.8684	-117.8780
727	CSM Unit 1	434669.4030	5412226.0305	48.8596	-117.8907
727	CSM Unit 1	434190.3665	5411916.3190	48.8567	-117.8972
726	CSM Unit 1	433680.1512	5411584.2567	48.8537	-117.9041
725	CSM Unit 1	432384.0675	5410533.4624	48.8441	-117.9216
724	CSM Unit 1	432191.0169	5408515.6151	48.8259	-117.9239
724	CSM Unit 1	431675.6534	5408577.7051	48.8264	-117.9309
724	CSM Unit 1	431407.7056	5407978.5225	48.8210	-117.9345
724	CSM Unit 1	431999.6766	5407758.1616	48.8191	-117.9264
723	CSM Unit 1	431061.2423	5407494.7208	48.8166	-117.9391
723	CSM Unit 1	430516.6068	5407063.5406	48.8127	-117.9464
723	CSM Unit 1	430251.0952	5406968.7694	48.8118	-117.9500
722	CSM Unit 1	429259.6594	5407490.5539	48.8164	-117.9636
721	CSM Unit 1	428055.4950	5407623.6644	48.8174	-117.9801
720	CSM Unit 1	426962.7318	5407475.5179	48.8160	-117.9949
719	CSM Unit 1	426117.5261	5404740.7728	48.7913	-118.0059
715	CSM Unit 1	422930.3481	5401213.9989	48.7592	-118.0487
714	CSM Unit 1	422143.2689	5398707.5541	48.7365	-118.0589
710	CSM Unit 2	424498.5577	5393545.3791	48.6904	-118.0259
710	CSM Unit 2	424141.7407	5392332.5779	48.6794	-118.0305
708	CSM Unit 2	422307.5206	5391562.8467	48.6723	-118.0553
707	CSM Unit 2	420548.2110	5391412.7358	48.6707	-118.0792
707	CSM Unit 2	418339.8305	5392015.8116	48.6758	-118.1093
706	CSM Unit 2	418971.9838	5390738.2203	48.6644	-118.1004
706	CSM Unit 2	419432.7220	5390220.0593	48.6598	-118.0941
705	CSM Unit 2	418628.2125	5388994.1163	48.6487	-118.1048

Table C3-1. Proposed Surface Sediment Sampling Locations. *A Cultural Resources Working Group review of the proposed sample locations convened on August 7, 2012 and approved sediment sampling within 150 feet (Area = 70,686 ft^2 = 1.6 acres) of each approved sampling position (Letter from Dr. Laura Buelow of the U.S. Environmental Protection Agency dated August 24, 2012).*

River Mile	CSM Unit	X UTM 11N	Y UTN 11N	Latitude	Longitude
705	CSM Unit 2	419070.5788	5388803.6176	48.6470	-118.0987
704	CSM Unit 2	418880.1322	5387654.2160	48.6367	-118.1011
704	CSM Unit 2	420010.3993	5387622.5715	48.6365	-118.0857
703	CSM Unit 2	419944.9095	5386148.0589	48.6233	-118.0863
701	CSM Unit 2	416956.7457	5384334.9785	48.6066	-118.1265
699	CSM Unit 2	416050.4669	5380836.1877	48.5750	-118.1381
698	CSM Unit 3	416735.0144	5379566.6837	48.5637	-118.1286
696	CSM Unit 3	414919.3797	5376770.9835	48.5383	-118.1526
692	CSM Unit 3	413016.4130	5373254.3451	48.5064	-118.1777
689	CSM Unit 3	412113.9581	5370135.7474	48.4782	-118.1892
688	CSM Unit 3	410840.2606	5368231.4983	48.4609	-118.2060
680	CSM Unit 3	412646.8818	5357580.3021	48.3653	-118.1794
679	CSM Unit 3	411884.2490	5356534.9157	48.3558	-118.1895
678	CSM Unit 3	413961.7518	5354583.3221	48.3386	-118.1610
678	CSM Unit 3	413349.6141	5354533.6893	48.3380	-118.1693
678	CSM Unit 3	412683.5026	5354463.5628	48.3373	-118.1782
678	CSM Unit 3	412129.8358	5354418.5881	48.3368	-118.1857
677	CSM Unit 3	413398.2903	5352205.2719	48.3171	-118.1681
677	CSM Unit 3	412726.9162	5352643.6036	48.3210	-118.1773
676	CSM Unit 3	413948.6113	5351681.2164	48.3125	-118.1606
676	CSM Unit 3	414422.9844	5351520.9095	48.3111	-118.1542
676	CSM Unit 3	414649.1196	5352332.8588	48.3184	-118.1513
675	CSM Unit 3	413784.3845	5350035.8974	48.2976	-118.1625
674	CSM Unit 3	414765.0562	5347924.3964	48.2788	-118.1488
671	CSM Unit 3	413628.0184	5343195.2220	48.2361	-118.1632
671	CSM Unit 3	414124.0527	5343215.7328	48.2363	-118.1565
668	CSM Unit 3	410901.1046	5339274.8928	48.2005	-118.1991
666	CSM Unit 3	411556.0854	5335806.6497	48.1693	-118.1896
666	CSM Unit 3	411018.7702	5336033.4157	48.1713	-118.1968
666	CSM Unit 3	411227.3782	5336335.0334	48.1741	-118.1941
665	CSM Unit 3	410854.7068	5335454.2515	48.1661	-118.1989
665	CSM Unit 3	410705.3603	5334113.1373	48.1540	-118.2006
665	CSM Unit 3	411268.5670	5335730.8443	48.1686	-118.1934
664	CSM Unit 3	411008.6049	5333713.5271	48.1504	-118.1965
664	CSM Unit 3	411317.0992	5333324.1709	48.1470	-118.1923
664	CSM Unit 3	410720.0991	5333756.5288	48.1508	-118.2004
664	CSM Unit 3	410970.5675	5333359.2566	48.1472	-118.1969
663	CSM Unit 3	409919.5526	5332421.6511	48.1387	-118.2108
659	CSM Unit 3	407026.5480	5328246.9336	48.1007	-118.2488
657	CSM Unit 3	407578.6532	5324298.4494	48.0653	-118.2405
652	CSM Unit 3	400540.3906	5322333.7476	48.0465	-118.3345
652	CSM Unit 3	400847.7260	5322829.8370	48.0510	-118.3305
649	CSM Unit 3	397295.6854	5320051.8665	48.0255	-118.3775
648	CSM Unit 3	396304.1652	5319441.8134	48.0198	-118.3907
646	CSM Unit 3	397434.7901	5315605.9057	47.9855	-118.3746
646	CSM Unit 3	398099.5200	5315221.9882	47.9822	-118.3656
646	CSM Unit 3	396847.3055	5316334.6183	47.9920	-118.3826
645	CSM Unit 3	398713.0791	5315131.1322	47.9815	-118.3573
643	CSM Unit 3	398618.1482	5312027.9462	47.9535	-118.3579
643	CSM Unit 3	398839.9041	5310727.6951	47.9419	-118.3546

Table C3-1. Proposed Surface Sediment Sampling Locations. *A Cultural Resources Working Group review of the proposed sample locations convened on August 7, 2012 and approved sediment sampling within 150 feet (Area = 70,686 ft^2 = 1.6 acres) of each approved sampling position (Letter from Dr. Laura Buelow of the U.S. Environmental Protection Agency dated August 24, 2012).*

River Mile	CSM Unit	X UTM 11N	Y UTN 11N	Latitude	Longitude
643	CSM Unit 3	398714.8503	5311566.1192	47.9494	-118.3565
641	CSM Unit 3	399383.8076	5307273.0598	47.9109	-118.3465
640	CSM Unit 3	399053.1499	5306933.8442	47.9078	-118.3509
637	CSM Unit 3	398667.3963	5301315.6713	47.8572	-118.3547
634	CSM Unit 3	397025.1674	5297988.6596	47.8270	-118.3759
632	CSM Unit 3	392537.3457	5299898.6690	47.8434	-118.4363
632	CSM Unit 3	391906.6828	5299446.3188	47.8393	-118.4446
626	CSM Unit 3	386089.6203	5303883.2933	47.8782	-118.5235
609	CSM Unit 3	366204.1236	5308848.2973	47.9190	-118.7908
608	CSM Unit 3	364224.4362	5309115.9473	47.9210	-118.8174
607	CSM Unit 3	364223.8196	5309575.7299	47.9251	-118.8176
606	CSM Unit 3	363009.4477	5310489.9501	47.9331	-118.8341
605	CSM Unit 3	362219.5509	5311913.6540	47.9457	-118.8451
605	CSM Unit 3	362335.6817	5312464.3123	47.9507	-118.8438
605	CSM Unit 3	362427.0537	5313415.7405	47.9593	-118.8428
605	CSM Unit 3	363836.2186	5313271.5550	47.9583	-118.8239
604	CSM Unit 3	361825.4727	5313132.1417	47.9566	-118.8508
604	CSM Unit 3	360887.9216	5313945.7006	47.9637	-118.8636
603	CSM Unit 3	360370.7016	5313754.7389	47.9619	-118.8705
602	CSM Unit 3	359207.2189	5312342.1436	47.9489	-118.8856
601	CSM Unit 3	356060.9582	5312511.8486	47.9497	-118.9278
600	CSM Unit 3	355217.8178	5311280.4868	47.9385	-118.9386
599	CSM Unit 3	353792.3763	5311819.0023	47.9430	-118.9579
598	CSM Unit 3	352173.8334	5312027.8193	47.9445	-118.9796
External Reference Locations					
Trib-1	Barnaby Creek	409599.0882	5365221.8770	48.4337	-118.2222
Trib-2	Nancy Creek	417960.0043	5389749.2880	48.6554	-118.1140
Trib-3	Cheweka Creek	412656.5780	5363476.2147	48.4184	-118.1805
Trib-4	Flat Creek	428210.3396	5408246.6044	48.8231	-117.9781
Trib-5	Crown Creek	430719.1785	5412475.2448	48.8614	-117.9446
Trib-6	Fivemile Creek	441398.6667	5416524.0973	48.8989	-117.7996
Reserve Locations					
744	CSM Unit 1	453467.0850	5427258.8783	48.9965	-117.6362
744	CSM Unit 1	453182.7745	5426533.4896	48.9899	-117.6400
744	CSM Unit 1	453588.2571	5427558.5769	48.9992	-117.6345
743	CSM Unit 1	453044.9424	5425055.4056	48.9766	-117.6417
742	CSM Unit 1	452591.6512	5424701.4318	48.9734	-117.6478
741	CSM Unit 1	451031.6871	5423758.5958	48.9648	-117.6690
739	CSM Unit 1	448355.4421	5422309.9013	48.9516	-117.7054
737	CSM Unit 1	363791.7652	5311551.4066	47.9428	-118.8240
737	CSM Unit 1	445899.6744	5421131.3897	48.9407	-117.7388
737	CSM Unit 1	446122.3203	5420985.1424	48.9394	-117.7357
735	CSM Unit 1	442963.6188	5419186.2676	48.9230	-117.7786
735	CSM Unit 1	443093.4939	5418969.8631	48.9210	-117.7768
735	CSM Unit 1	443543.8270	5419245.9786	48.9236	-117.7707
734	CSM Unit 1	442815.2564	5418839.6755	48.9199	-117.7806
732	CSM Unit 1	441061.5339	5417081.8569	48.9039	-117.8043
732	CSM Unit 1	440549.5791	5417293.9410	48.9057	-117.8113
732	CSM Unit 1	440012.8552	5416681.7387	48.9002	-117.8185
731	CSM Unit 1	439370.7699	5415630.5437	48.8907	-117.8271

Table C3-1. Proposed Surface Sediment Sampling Locations. *A Cultural Resources Working Group review of the proposed sample locations convened on August 7, 2012 and approved sediment sampling within 150 feet (Area = 70,686 ft^2 = 1.6 acres) of each approved sampling position (Letter from Dr. Laura Buelow of the U.S. Environmental Protection Agency dated August 24, 2012).*

River Mile	CSM Unit	X UTM 11N	Y UTN 11N	Latitude	Longitude
731	CSM Unit 1	438796.5388	5415696.0756	48.8912	-117.8350
731	CSM Unit 1	438903.3279	5415215.3541	48.8869	-117.8334
730	CSM Unit 1	438384.6746	5414794.8399	48.8830	-117.8404
730	CSM Unit 1	438147.4244	5414464.0447	48.8800	-117.8436
729	CSM Unit 1	437139.6506	5413801.3798	48.8740	-117.8573
729	CSM Unit 1	436564.8183	5413686.5724	48.8729	-117.8651
728	CSM Unit 1	435504.0364	5412975.9687	48.8664	-117.8794
728	CSM Unit 1	435831.0622	5413561.7065	48.8717	-117.8751
727	CSM Unit 1	433879.2918	5411733.6064	48.8550	-117.9014
726	CSM Unit 1	432851.5242	5411157.8576	48.8498	-117.9153
726	CSM Unit 1	433366.8018	5411453.6148	48.8525	-117.9083
725	CSM Unit 1	432015.0278	5409798.1401	48.8374	-117.9265
725	CSM Unit 1	432291.9754	5409134.4831	48.8315	-117.9226
724	CSM Unit 1	431500.1156	5408365.3311	48.8245	-117.9333
723	CSM Unit 1	431574.9290	5407627.9344	48.8179	-117.9321
723	CSM Unit 1	430826.6285	5407387.8550	48.8156	-117.9423
722	CSM Unit 1	430277.8522	5407169.9098	48.8136	-117.9497
722	CSM Unit 1	429445.7016	5407239.6105	48.8141	-117.9610
721	CSM Unit 1	428466.8141	5407797.1528	48.8190	-117.9745
721	CSM Unit 1	427574.4198	5407796.8690	48.8189	-117.9866
720	CSM Unit 1	426267.6107	5406857.8863	48.8103	-118.0043
718	CSM Unit 1	425881.6760	5403961.6779	48.7842	-118.0090
717	CSM Unit 1	424926.1779	5402793.9814	48.7736	-118.0218
715	CSM Unit 1	422213.0046	5400342.1397	48.7512	-118.0582
712	CSM Unit 1	423883.4961	5395557.8842	48.7084	-118.0346
711	CSM Unit 1	424342.0331	5394268.8047	48.6969	-118.0282
709	CSM Unit 2	423074.9214	5391768.8503	48.6742	-118.0449
708	CSM Unit 2	421223.0965	5391914.9176	48.6753	-118.0701
707	CSM Unit 2	419942.0117	5391598.5128	48.6723	-118.0874
707	CSM Unit 2	419261.0478	5391742.5653	48.6735	-118.0967
707	CSM Unit 2	420001.0260	5392779.1715	48.6829	-118.0869
705	CSM Unit 2	418993.5109	5389358.0759	48.6520	-118.0999
705	CSM Unit 2	419822.6609	5389209.6489	48.6508	-118.0886
705	CSM Unit 2	418517.0001	5390073.1658	48.6584	-118.1065
704	CSM Unit 2	419061.7584	5387607.3498	48.6363	-118.0986
703	CSM Unit 2	420521.5816	5385568.7634	48.6181	-118.0784
702	CSM Unit 2	416976.9193	5384847.9590	48.6112	-118.1264
701	CSM Unit 2	416708.7224	5384856.6594	48.6112	-118.1300
698	CSM Unit 3	416289.2542	5379288.1317	48.5611	-118.1346
697	CSM Unit 3	415116.9224	5378552.6767	48.5543	-118.1503
693	CSM Unit 3	413755.1486	5374478.6852	48.5175	-118.1679
693	CSM Unit 3	412745.7854	5374990.0535	48.5220	-118.1817
691	CSM Unit 3	413570.1954	5372295.3335	48.4978	-118.1700
686	CSM Unit 3	411920.5609	5364655.0886	48.4289	-118.1907
685	CSM Unit 3	411741.7980	5363158.6333	48.4154	-118.1928
683	CSM Unit 3	412187.3026	5360437.4712	48.3910	-118.1862
681	CSM Unit 3	411681.5116	5358429.8534	48.3729	-118.1926
680	CSM Unit 3	413586.0810	5357643.6493	48.3660	-118.1667
679	CSM Unit 3	412794.8433	5355906.5887	48.3503	-118.1770
678	CSM Unit 3	412420.6447	5353611.4682	48.3296	-118.1816

Table C3-1. Proposed Surface Sediment Sampling Locations. *A Cultural Resources Working Group review of the proposed sample locations convened on August 7, 2012 and approved sediment sampling within 150 feet (Area = 70,686 ft^2 = 1.6 acres) of each approved sampling position (Letter from Dr. Laura Buelow of the U.S. Environmental Protection Agency dated August 24, 2012).*

River Mile	CSM Unit	X UTM 11N	Y UTN 11N	Latitude	Longitude
678	CSM Unit 3	411844.1665	5354906.8003	48.3412	-118.1897
677	CSM Unit 3	413310.8246	5353490.8058	48.3287	-118.1696
677	CSM Unit 3	414130.0949	5353398.1086	48.3279	-118.1585
676	CSM Unit 3	413414.0224	5350894.0804	48.3053	-118.1677
675	CSM Unit 3	414715.6921	5349616.9854	48.2940	-118.1498
673	CSM Unit 3	415561.3346	5346467.4193	48.2658	-118.1378
672	CSM Unit 3	415045.5045	5344167.9850	48.2450	-118.1443
670	CSM Unit 3	412780.9335	5341626.0134	48.2219	-118.1743
668	CSM Unit 3	411236.8950	5340403.7388	48.2107	-118.1948
667	CSM Unit 3	410799.9953	5337610.3087	48.1855	-118.2001
667	CSM Unit 3	411375.8938	5338732.3050	48.1956	-118.1926
666	CSM Unit 3	410888.9402	5336566.4881	48.1761	-118.1987
666	CSM Unit 3	411054.1045	5336613.0865	48.1765	-118.1965
665	CSM Unit 3	410772.7857	5335024.3225	48.1622	-118.1999
665	CSM Unit 3	411095.7067	5335058.6293	48.1626	-118.1956
665	CSM Unit 3	411713.3021	5334577.0184	48.1583	-118.1872
665	CSM Unit 3	411402.9060	5334503.1453	48.1576	-118.1913
664	CSM Unit 3	410510.2992	5333386.1065	48.1474	-118.2031
664	CSM Unit 3	411036.2171	5332925.5305	48.1434	-118.1959
661	CSM Unit 3	406892.3536	5332357.5447	48.1377	-118.2515
658	CSM Unit 3	407143.2772	5326143.9382	48.0818	-118.2468
658	CSM Unit 3	406881.7821	5324463.8014	48.0667	-118.2499
654	CSM Unit 3	404117.6052	5321860.1674	48.0428	-118.2864
651	CSM Unit 3	398017.9043	5321965.2712	48.0428	-118.3683
649	CSM Unit 3	395521.8959	5319939.5152	48.0242	-118.4013
648	CSM Unit 3	395851.5591	5318623.1128	48.0124	-118.3965
647	CSM Unit 3	397086.0290	5318241.1340	48.0092	-118.3799
647	CSM Unit 3	396985.9692	5317216.6610	47.9999	-118.3810
645	CSM Unit 3	399113.4720	5314048.0094	47.9718	-118.3517
645	CSM Unit 3	398469.3868	5314615.9455	47.9768	-118.3605
644	CSM Unit 3	399080.6682	5313509.3701	47.9669	-118.3520
643	CSM Unit 3	399407.0937	5312138.6304	47.9547	-118.3473
642	CSM Unit 3	399075.2655	5308876.3601	47.9253	-118.3510
642	CSM Unit 3	398488.3346	5310388.8622	47.9388	-118.3592
640	CSM Unit 3	399543.1256	5306527.2679	47.9042	-118.3442
633	CSM Unit 3	394888.1888	5298252.7991	47.8290	-118.4045
630	CSM Unit 3	391064.1153	5301561.2741	47.8582	-118.4564
622	CSM Unit 3	383720.7709	5309442.3438	47.9277	-118.5566
617	CSM Unit 3	376117.8436	5310454.1125	47.9354	-118.6587
615	CSM Unit 3	372773.0327	5310180.1736	47.9323	-118.7034
609	CSM Unit 3	365474.6107	5308243.7408	47.9134	-118.8004
607	CSM Unit 3	363277.3454	5309964.2159	47.9284	-118.8304
607	CSM Unit 3	363029.3212	5310369.0399	47.9320	-118.8338
606	CSM Unit 3	363791.7652	5311551.4066	47.9428	-118.8240
606	CSM Unit 3	362853.6428	5311396.1753	47.9412	-118.8365
606	CSM Unit 3	363565.6871	5310783.2682	47.9358	-118.8268
606	CSM Unit 3	362719.5815	5310811.8786	47.9359	-118.8381
605	CSM Unit 3	361977.7758	5312566.5373	47.9515	-118.8486
605	CSM Unit 3	362738.2816	5312556.8751	47.9516	-118.8384
604	CSM Unit 3	360767.7616	5312910.7008	47.9544	-118.8649

Table C3-1. Proposed Surface Sediment Sampling Locations. *A Cultural Resources Working Group review of the proposed sample locations convened on August 7, 2012 and approved sediment sampling within 150 feet (Area = 70,686 ft^2 = 1.6 acres) of each approved sampling position (Letter from Dr. Laura Buelow of the U.S. Environmental Protection Agency dated August 24, 2012).*

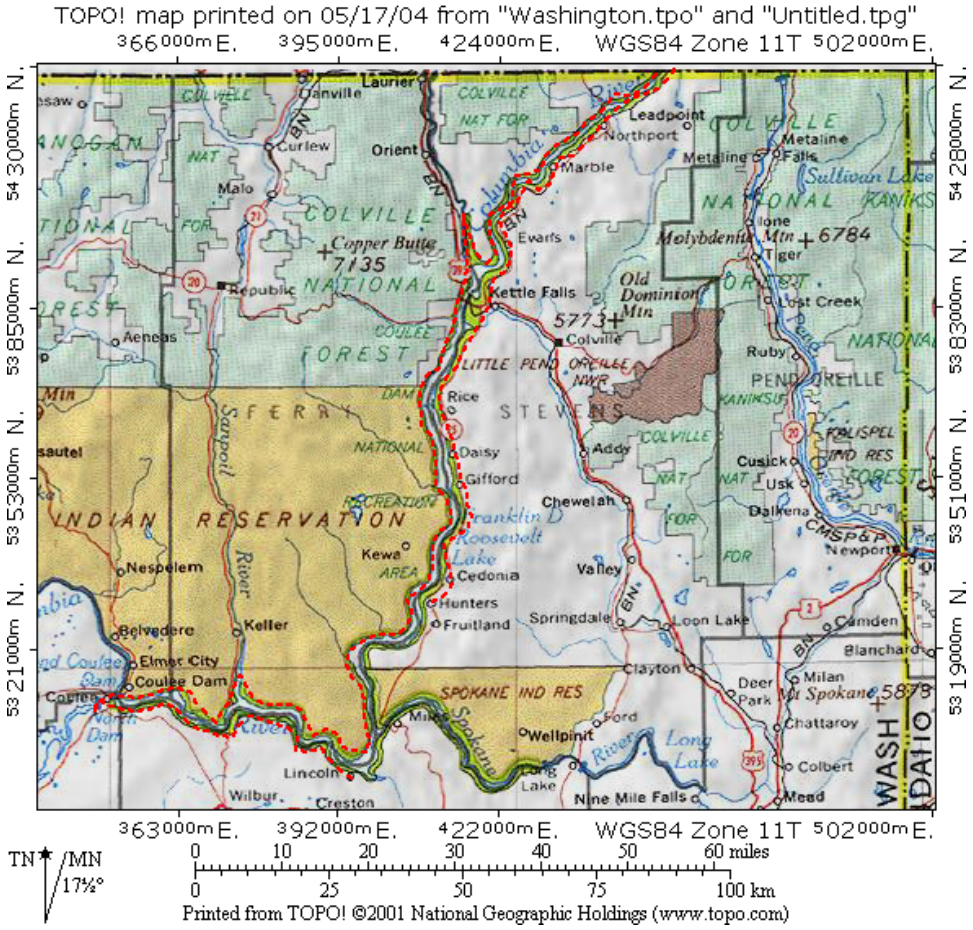
River Mile	CSM Unit	X UTM 11N	Y UTN 11N	Latitude	Longitude
604	CSM Unit 3	361535.2357	5312529.4221	47.9511	-118.8545
603	CSM Unit 3	359502.9597	5312933.1314	47.9543	-118.8818
602	CSM Unit 3	357524.0949	5312862.1105	47.9532	-118.9083
601	CSM Unit 3	356539.8783	5311225.6969	47.9383	-118.9209
599	CSM Unit 3	354493.9201	5311585.8752	47.9411	-118.9484
598	CSM Unit 3	352811.0635	5312741.3546	47.9511	-118.9713

ATTACHMENT C1

PROTOCOLS FOR INADVERTENT DISCOVERIES

Lake Roosevelt Protocols for Native American Graves Protection and Repatriation Act (NAGPRA) Inadvertent Discoveries or Intentional Excavations: Confederated Tribes of the Colville Reservation, National Park Service, and the Bureau of Reclamation

This protocol is intended to cover NAGPRA items exposed by inadvertent discoveries or intentional excavations within the boundaries of lands managed by the National Park Service/Lake Roosevelt National Recreation Area. The term "NAGPRA items" in this document refers to human NAGPRA items, associated funerary objects, and objects of cultural patrimony as they are defined in 25 USC 3001. This document does not address inadvertent discoveries on lands within reservation boundaries or trust land outside of the reservation boundaries of the Confederated Tribes of the Colville Reservation (CCT). Funding of actions is not covered under this protocol.



Map of Lake Roosevelt National Recreation Area

This protocol covers those areas highlighted in red within the recreation area, which is the yellow highlighted portion of the Lake Roosevelt shoreline.

1. If NAGPRA items that are potentially human are encountered, any activity in the vicinity of the discovery shall cease and all reasonable efforts shall be made to protect the NAGPRA items and all appropriate effort shall be made to determine if the NAGPRA items are human. The activity shall resume only when clearance to proceed is received by the CCT Tribal Historic Preservation Officer and the National Park Service's designated official.
2. If the NAGPRA items are determined to be human, the burial or location shall not be disturbed in any way. Any discovered human NAGPRA items and associated artifacts will be treated in a respectful manner.
3. In cases where a potential crime scene exists, *personnel except those necessary to protect the location will leave the immediate vicinity in order to prevent unintentional destruction of crime scene information.* A National Park Service law enforcement officer will be immediately notified.
4. The Colville Tribal Historic Preservation Officer and the archaeologists working for the Colville Tribes and the Park Service (numbers listed below) will also be contacted immediately after law enforcement. For NAGPRA discoveries associated with the Lake Roosevelt shoreline, the Reclamation archaeologist must also be contacted. Live phone contact is required; backup staff are identified if the primary contacts are unavailable. Phone contact will be followed up by written confirmation, e-mail is acceptable. E-mail should not include detailed (site specific information) for security reasons.
5. A professional archaeologist will assist law enforcement in determining if the NAGPRA items are archaeological in origin. If the crime scene is ARPA-related (i.e., there is evidence for intentional disturbance or looting of archaeological materials), an archaeologist shall assist law enforcement as needed in the collection of archeological data to support the ARPA case.
6. Guy Moura, CCT THPO and Program Manager of the CCT History/Archaeology Program is the primary contact for the CCT. Mr. Moura's phone number at the Program is (509) 634-2695 and email is guy.moura@colvilletribes.com. After hours, Mr. Moura can be contacted at (509) 631-1705 (cell). If Mr. Moura cannot be reached, then Jon Meyer, Tribal Archaeologist is the alternate contact at (509) 634-2691 (office) or (509) 631-2130 (cell) and at jon.meyer@colvilletribes.com. In the event that neither Mr. Moura or Mr. Meyer cannot be contacted, then Eric Oosahwee-Voss, CCT Archaeologist will be contacted at (509) 634-2690 (office) or (509) 631-1173 (cell) and at eric.oosahwee-voss@colvilletribes.com. Mr. Meyer or Mr. Oosahwee-Voss shall participate in the NAGPRA consultation process on Mr. Moura's behalf until his return. Jackie Cook, Repatriation Specialist will also participate in the NAGPRA consultation process. Ms. Cook's contact information is (509) 634-2635 (office) or (509) 631-1176 (cell) and jackie.cook@colvilletribes.com. The CCT shall maintain a presence at the location of the discovery as needed until all contacts have been made and appropriate treatment of the NAGPRA items has been conducted.

- Ray DePuydt, Park Archeologist for the Lake Roosevelt National Recreation Area, is the primary contact for the NPS. Mr. DePuydt's phone number is (509) 738-6266, ext. 101 or (509) 631 4673, and his FAX is (509) 633-3862, and internet address is "ray_depuydt@nps.gov." If Mr. DePuydt cannot be contacted in person, then contact Ken Hyde at (509) 633-9441 ext 128.
- Michael Flowers, Power Office Archaeologist, is Reclamation's contact. His phone number is (509) 633-9507 [receptionist], FAX 633-9138, and internet address is "mflowers@usbr.gov." If Mike Flowers is not available, contact Sean Hess, Regional Archaeologist (208) 378-5316, FAX (208) 378-5305, and internet address is "shess@usbr.gov."

7. As soon as the NAGPRA items have been determined to be human, then all effort shall be made in the field to determine whether human NAGPRA items are Native American. If yes, skip steps 8 and 9 below and proceed to step 10.

8. If the NAGPRA items are determined not to be Native American, then Washington State laws apply and shall be followed (Title 68, Chapter 68.50 RCW HUMAN NAGPRA ITEMS).

9. If the NAGPRA items' affiliation cannot be determined in the field, further non-destructive analysis of human NAGPRA items and/or associated cultural materials may be required. The CCT, NPS, and Reclamation shall coordinate regarding the types of non-destructive analysis to be conducted.

10. Provenience information will be collected as specified by the written plan of action. The Reclamation contract language for burials recovered in the shoreline of the National Recreation Area will also apply and should agree with the written plan of action and these protocols.

11. Recording of provenience may include any or all of the following: documenting the location of the burial or scattered NAGPRA items and general site conditions on a site form or on an addendum to an existing form; describing the surface visible NAGPRA items to the degree that can be accomplished without causing additional disturbance to the grave; documenting the location of the burial on a USGS 7.5' topographic sheet and with a GPS unit.

12. If it is possible to rebury or cap the NAGPRA items in place, then that decision shall be documented in the written plan of action (see below).

13. If NAGPRA items must be excavated or removed, procedures will be specified by the written plan of action. The Reclamation contract language for burials recovered in the shoreline of the NRA will also apply and should agree with the written plan of action and these protocols. If NAGPRA items are to be excavated or removed by personnel other than those employed by the CCT or the U.S. government, an ARPA permit will be required from the NPS.

14. Excavation or removal procedures may include any or all of the following: NAGPRA items will be removed using standard professional archaeological practices in a culturally sensitive manner at the direction of a CCT History/Archaeology Department representative. Such practices may include collection of horizontal provenience data referenced to a site datum point; if excavation is required, vertical provenience data shall be tracked through the use of controlled 10-cm levels within a standard grid unit, screening of all excavated fill through 1/8-inch screen mesh, and photographic and to-scale plan map documentation of excavated features. All recovered items shall be listed in the field during collection to minimize handling after recovery.

15. Inadvertent discoveries that result from activities requiring easements or other non-ARPA permits (such as access, construction, etc.) shall be dealt with by the permitting agencies, which may be Reclamation or the NPS. This protocol document will be included with documents issued to permittees.

16. The written plans of action for individual discoveries will detail exact procedures for further implementation of NAGPRA. A sample written plan of action is attached.

Template NAGPRA Plan of Action for Lake Roosevelt

This plan of action shall comply with the requirements of the Native American Graves Protection and Repatriation Act (NAGPRA) (25 USC 3001 et seq.), its implementing regulations (43 CFR Part 10) and the Archaeological Resources Protection Act (ARPA) (16 USC 470 et seq.) with its implementing regulations (43 CFR Part 7).

1. The kinds of objects to be considered as cultural items as defined in Sec. 10.2 (b):
   - ✓ Human remains
   - ✓ Associated funerary objects
   - ✓ Unassociated funerary objects
   - ✓ Objects of cultural patrimony
   - ✓ Sacred objects

These objects are cultural objects as defined under NAGPRA 43CFR Part 10.2 (d).

2. The specific information used to determine custody pursuant to Sec. 10.6:
   - ✓ Traditional association (this is where tribe's area of interest is cited with reference to Lake Roosevelt)
   - ✓ Cultural affiliation
   - ✓ Evidence: Geographical, archaeological, linguistic, folklore, oral tradition, historical

3. The planned treatment, care, and handling of human remains and other objects as defined in NAGPRA

4. The planned archaeological recording of the human remains and other objects as defined in NAGPRA

5. The kinds of analysis planned for each kind of object

6. Any steps to be followed to contact Indian tribe officials at the time of intentional excavation or inadvertent discovery of specific human remains and other objects as defined in NAGPRA

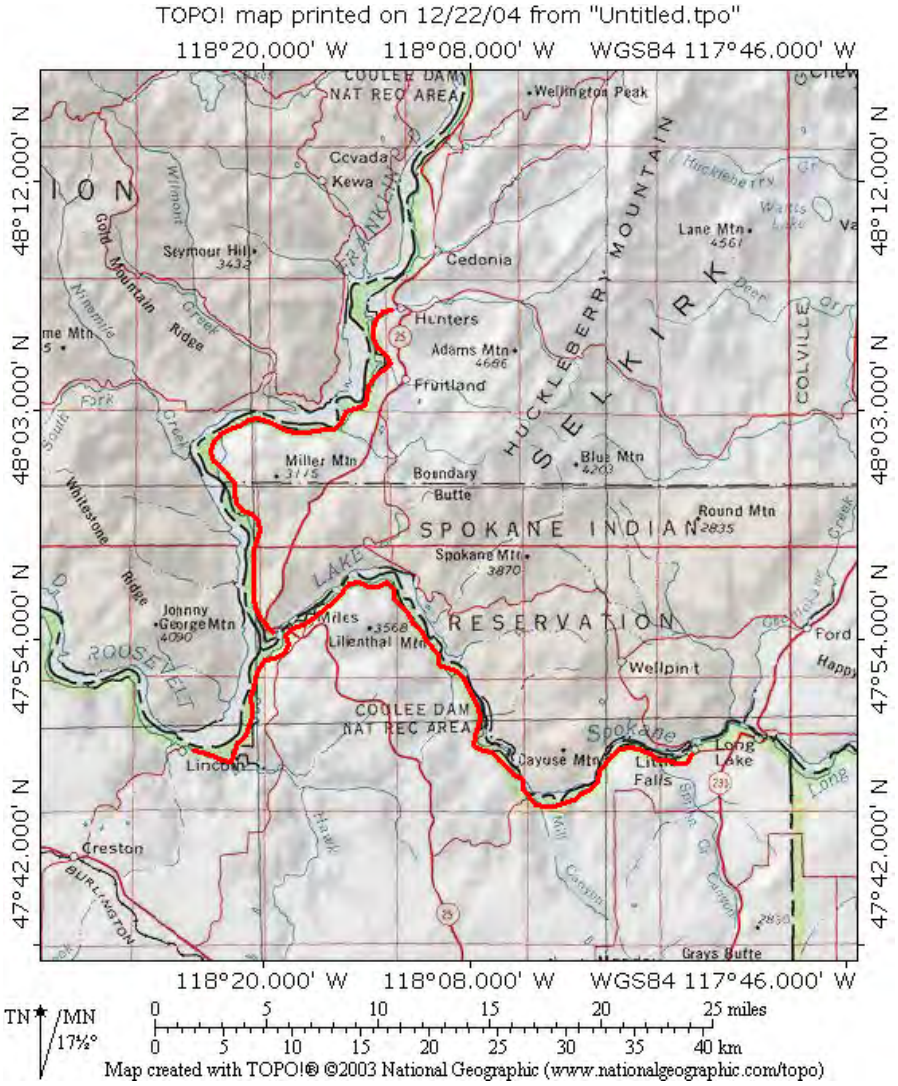
7. The kind of traditional treatment, if any, to be afforded the human remains and other objects as defined in NAGPRA by members of the Indian tribe

8. The nature of reports to be prepared

9. The planned disposition of human remains, and other objects as defined in NAGPRA.

Protocols for NAGPRA Inadvertent Discoveries and Intentional Excavations on the Lake Roosevelt National Recreation Area: Spokane Tribe of Indians, National Park Service, and Bureau of Reclamation

This protocol is intended to cover NAGPRA items exposed by inadvertent discoveries and intentional excavations within the boundaries of lands managed by the National Park Service/Lake Roosevelt National Recreation Area. This document does not address inadvertent discoveries on lands within reservation boundaries of the Spokane Tribe of Indians (STI); for those procedures please see the Spokane Tribe's Procedure for the Inadvertent Disturbance or Discovery of Spokane Human Remains and Cultural Resources. Funding of actions is not covered under this protocol.



Map of Lake Roosevelt National Recreation Area
This protocol covers shoreline areas highlighted in red.

1. If remains that are potentially human are encountered, any activity in the vicinity of the discovery shall cease and all appropriate effort shall be made to determine if the remains are human. NAGPRA dictates that the 'stop work' order shall be for 30 days, but this period can be shortened in consultation between affected parties.

2. If the remains are determined to be human, the burial or location shall not be disturbed in any way. Any discovered human remains and associated artifacts will be treated in a respectful manner.

3. The person(s) making the discovery shall immediately notify NPS law enforcement. In cases where a potential crime scene exists, *personnel except those necessary to protect the location will leave the immediate vicinity in order to prevent unintentional destruction of crime scene information.*

4. The person(s) making the discovery shall immediately notify the Spokane Tribal Historic Preservation Officer (STI THPO), the Park Service archaeologist, and the Reclamation archaeologist (numbers are listed below) immediately after law enforcement.

   Live phone contact is required; backup staff are identified if the primary contacts are unavailable. Phone contact will be followed up by written confirmation, e-mail is acceptable.

5. **Notifications:**

   - Randy Abrahamson, STI THPO, is the primary contact for the STI. Mr. Abrahamson's phone number at the Department is (509) 258-4315, FAX (509) 258-6965, and his Internet address is randya@spokanetribe.com. After work hours, Mr. Abrahamson can generally be reached at (509) 951-0524 (cell). If Mr. Abrahamson cannot be reached, John Matt (Preservation Department Director), James Harrison (Principal Investigator), or Brea Franco (Tribal Archaeologist) shall be contacted at (509) 258-4060. If none of the above people can be reached, then the on-site STI crew leader shall be presumed delegated as the primary STI representative and shall participate in the NAGPRA consultation process until Mr. Abrahamson's return. The STI shall maintain a presence at the location of the discovery as needed until all contacts have been made and appropriate treatment of the remains has been conducted.

   - Michael Flowers, Power Office Archaeologist, is Reclamation's contact. His phone number is (509) 633-9507 [receptionist], FAX 633-9138, and internet address is "mflowers@usbr.gov." If Mike Flowers is not available, contact Sean Hess, Regional Archaeologist (208) 378-5316, FAX (208) 378-5305, and internet address is "shess@usbr.gov."

- Ray DePuydt, Park Archeologist for the Lake Roosevelt National Recreation Area, is the primary contact for the NPS. Mr. DePuydt's phone number is (509) 738-6266, ext. 101 or (509) 631 4673, and his FAX is (509) 633-3862, and internet address is "ray_depuydt@nps.gov." If Mr. DePuydt cannot be contacted in person, then contact Ken Hyde at (509) 633-9441 ext 128.

- Spokane Tribal Law Enforcement can be reached at 1-888-258-6899 and/or 258-7766, and NPS Chief Ranger Marty Huseman at (509) 633-9441, ext. 123. Ms. Huseman can be reached by cell at (509) 631-4755. If she is not available, North District Ranger Bryan Yetter's number is (509) 738-6266 ext. 162 or cell (509) 631-4722.

6. A professional archaeologist will assist law enforcement in determining if the remains are archaeological in origin. If the discovery is determined to be a recent crime scene, field personnel shall follow direction from law enforcement officers.

7. If the discovery is determined to be an ARPA crime scene (i.e., there is evidence for intentional disturbance or looting of archaeological materials), an archaeologist shall assist law enforcement as needed in the collection of archeological data to support the ARPA case.

8. If the discovery is determined not to be a crime scene, an attempt will be made to determine whether the remains are human remains.

9. Documentation: If the remains are human, the location of the burial or scattered remains and general site conditions shall be documented. Documentation will include locating the burial on a USGS 7.5' topographic sheet and with a GPS unit, and recording the location on a site form or on an addendum to an existing form. Surface visible remains will be described to the degree that can be accomplished without causing any additional disturbance.

   If NAGPRA applies to the remains, a written plan of action will be drafted by the NPS and Reclamation archaeologists in coordination with the STI THPO. The party responsible for making the NAGPRA determination must document in writing the basis of that determination. Documentation methods will be described in the written plan of action for each discovery.

10. If possible and if agreed upon by all parties, human remains and associated objects shall be protected in place. If it is possible to rebury or cap the remains in place, then further actions under NAGPRA are not required. If the tribe prefers, protective actions can be conducted after locational information is collected.

11. If it is not possible to protect the remains in place, all efforts shall be made to determine in the field whether NAGPRA applies to the human remains. If NAGPRA does not pertain to the discovered remains, then WA state laws apply and shall be followed (Chapter 27.44 RCW: INDIAN GRAVES AND RECORDS, at http://www.oahp.wa.gov/rcw2744.htm).

12. Recovery: Remains or associated items that cannot be protected in place shall be recovered in a culturally sensitive manner according to the written plan of action developed by the STI, the NPS, and Reclamation. If remains are threatened and must be recovered before a written plan of action can be completed, the steps identified below shall be followed, at minimum:

    Collection of horizontal provenience data referenced to a site datum point; if excavation is required, vertical provenience data shall be tracked through the use of controlled 10-cm levels within a standard grid unit, screening of all excavated fill through 1/4-inch screen mesh (1/8-inch if sediments are sand), and photographic and scale map documentation of excavated features. Methods employed shall be designed to document information about burial practices and to recover any associated grave goods.

13. The NPS shall publish Notices of Intent to Make Disposition in local newspapers. The newspapers shall be named in the Written Plan of Action for each discovery.

14. After recovery and during the 30-day waiting period after newspaper notices are published by the NPS, NAGPRA items shall be stored and protected by the STI.

15. The written plans of action for individual discoveries within the Lake Roosevelt National Recreation Area will detail exact procedures for further implementation of NAGPRA.

Spokane Tribe of Indians
P.O. Box 100-Wellpinit, WA 99040
Tel 509-458-6500, Fax 509-458-6575

Century of Survival
1881-1981:
Procedure for the Inadvertent Disturbance or Discovery of Spokane Human Remains and Cultural Resources

Introduction

Because many ground-disturbing processes, both natural and cultural, have the effect of prompting the destruction of evidence of Spokane Tribal heritage, it is the policy of the Spokane Tribe of Indians (hereafter "Spokane Tribe") to leave Spokane human remains and cultural resources in place and undisturbed. Purposeful disturbance of these resources without proper permit and consultation and/or approval of the Spokane Tribe is a violation of federal, Tribal, State, and/or local law. The National Historic Preservation Act (NHPA) and the Native American Graves Protection and Repatriation Act (NAGPRA) require that federal agencies take responsibility for damage to or loss of human burials caused by the project actions or that occur on off-reservation lands under the management jurisdiction. The Spokane Tribe has been delegated the federal authority as a Tribal Historic Preservation Office for Reservation lands pursuant to Section 101 (d)(2) of the National Historic Preservation Act.

Geographic Area of Applicability

This procedure for the inadvertent disturbance or discovery of Spokane human remains and cultural resources applies to all lands within the boundaries of the Spokane Indian Reservation and is advisory for all lands within the Spokane Tribe's aboriginal territory, as determined in proceedings before the Indian Claims Commission. For the purposes of cultural resource management, the ceded territory is bounded by and includes the Columbia River on the west, the Canadian border to the north, the Idaho border to the east, Rosalia to the southeast, Rosalia to the southeast, and Ritzville to the southwest.

Procedure

In cases of inadvertent disturbance or discovery of Spokane human burials or cultural resources, the following procedure is to be followed:

1. Upon inadvertent disturbance or discovery of human burials or cultural resources, any action(s) affecting the burials or resources shall immediately be halted.

2. The person(s) making the discovery shall immediately notify the appropriate office of the coroner or police. Upon a determination of the appropriate death investigation authority that the location of the remains is not the result of a crime, the following procedures shall apply:

    a) The entity making such disturbance or discovery shall notify the landowner, occupant, or manager. If the land occupant or manager is notified in lieu of the landowner, the occupant or manager will immediately notify the landowner. The entity making the disturbance or discovery will immediately notify the Spokane Tribal Historic Preservation Office, Wellpinit, Washington, in person or by telephone (at 509-258-4315), or by fax (at 509-248-6965), of the disturbance or discovery. The entity is advised to keep written documentation of such contact.

    b) The entity making the disturbance, or discovery will exert its best effort to protect such remains and/or objects until the landowner and/or land occupant or manager arrives to protect these remains and/or objects. Within 24 hours of notification, the

landowner shall supply protection for such remains and/or objects, until disposition or control of such remains and objects has been implemented.

3. The Spokane Tribal Historic Preservation Officer or designated representative(s) shall inspect in person the affected sited, human remains, or cultural resources, and shall determine, if possible evidence at the site, oral history, and/or existing records, the cultural affiliation of such site, human remains, and/or objects, until disposition or control of such remains and objects has been implemented.

   a. If the exposed human remains or cultural resources are clearly Native American and have known lineal descendants or owners, the Spokane Tribal Historic Preservation Officer shall then have the opportunity to make disposition or to take control of such human remains and/or associated funerary objects.

   b. If the exposed human remains and /or associated funerary objects are clearly prehistoric or non-modern Native American in origin and have no known lineal descendants, or if the lineal descendants decline the disposition or control, the Spokane Tribe, as the Indian Tribe which has the closest cultural affiliation and aboriginally occupying the are, claims ownership of such human remains and associated funerary objects, as they choose.[1] The Tribe's ownership and right to disposition and control of the human remains and/or associated funerary objects refers to the entire burial, to the extent it can be recovered, and does not allow in any case for separation of part of an individual's remains from other parts or from their associated funerary objects.

   c. If the exposed human remains and/or associated funerary objects are historic and non-Native American in origin, the Spokane Tribal Historic Preservation Officer will notify the Washington State Historic Preservation Officer (SHPO), Disposition and control over such burials will be determined the SHPO.

   d. If the exposed human remains and/or associated funerary objects are of uncertain or unidentifiable cultural identity, but clearly non-modern in origin, the Spokane Tribal Historic Preservation Officer will use reasonable means, such as professional consultation, to obtain a determination of the responsibility of the entity disturbing such remains. After cultural identity has been satisfactorily determined, the disposition or control of such remains and /or objects shall follow as otherwise provided in this procedure.

   e. If the exposed human remains and/or associated funerary objects are modern or possibly modern in origin, regardless of cultural affiliation, the Spokane Tribal Historic Preservation Officer will notify the local law enforcement authorities. Disposition and control over such burials will be determined by the law enforcement authorities.

[1] For the purposes of this procedure, modern is here defined as less than 50 years old; non-modern is defined as 50 years of age or older. For human remains, the age of such remains is defined as beginning at the death of the individual, to the present.

4. Within 48 hours of notification, the entity with right of disposition and control shall notify the landowner concerning plans for disposition and control over such objects. Actual disposition and control shall be implemented as soon as possible, although may be delayed is so agreed by the landowner and the entity with right of disposition and control, or is the extent of the damage or other circumstances require delay in disposition and control.

The entity performing any action which inadvertently disturbs or damages Spokane human remains or cultural resources shall be responsible for costs of inspection of the damage or disruption by Tribal staff; removal, reburial, and/or restoration of the site; identification of resources. Costs may include but are not limited to staff, equipment, supplies, laboratory costs, and travel. If the entity performing the action which inadvertently disturbs or damages such resource is not also the land owner, such entity is responsible for reimbursing the land owner for costs incurred by the land owner as a direct result of this procedure. In no case shall the required associated with the action or resources involved.

The Spokane Tribal Historic Preservation Office shall make best effort to minimize the costs associated with Inadvertent Disturbance or Discovery, especially when the entity involved fully cooperates with preservation and protection efforts; however, appropriate project undertaking funding shall ensure that sufficient measures are taken to complete the activities described in these procedures.

An entity solely reporting human remains or cultural resources to the Spokane Tribe, provided they have not damaged or disturbed such resources, or caused or been responsible for damage or disturbance of such resources, shall not be responsible for any additional costs under this section.

Relationship to Other Applicable Laws

Full compliance with all aspects of this procedure shall be considered by the Spokane Tribe as full and complete consultation and cooperation with the Spokane Tribe, as required by law, for the purposes of Inadvertent Disturbance and Discovery of human remains and cultural resources.

Limitations

Compliance with this procedure for a particular disturbance or discovery does not constitute consultation and cooperation with the Spokane Tribe on other disturbances or discoveries.

Notification of the Spokane Tribe under this procedure does not release the entity from responsibility for violations of federal, Tribal, state or local law.

Violations

Any entity discovering or disturbing any Spokane human remains or cultural resources who does not follow the procedure described here, shall be considered in violation of this procedure. Such action shall be considered deliberate and causing unauthorized damage to the affected resource; this action is subject to prosecution under applicable federal, Tribal, state and/or local laws.

Recovery of Eroding Human Remains

When approval from the appropriate authorities is given for the collection of scattered human remains or recovery of exposed and immediately endangered remains, standard professional practices will be used to ensure that all associated remains and grave goods are recovered, and that the location is documented to assist future monitoring or management practices. However, those making the recovery shall not open up areas around the burial or discovery with the intention of discovering additional burials and materials or to learn more about the site context. Excavations of this sort are strictly for the salvage of eroding or disturbed burials.

The methods for documentation are to be consistent with practices employed by the Spokane Tribe, including collection of locational data, controlled excavation of the burial pit, and screening of the pit fill.

A professional archaeologist shall be in the field with the burial recovery crew at all times, and shall participate in the documentation of burials in all aspects where their involvement does not violate traditional custom or practices. If permitted by the Spokane, to scale map documentation of excavated features (i.e., distribution of remains and grave goods in the burial pit) is recommended.

The project entity is responsible for the preparation of a site plan map that shows the locations of surface-visible cultural features, significant topographic features, and other information needed to relocate the site in subsequent years for management purposes.

Photographs shall be taken that show the location of excavated burials in relation to identifiable landmarks. Human remains will not be visible in the photograph if not approved by the Spokane Tribe; this authorization will be decided on a case by case basis. The location of un-recovered remains or each excavated grave will be documented on a 7.5' USGS quadrangle topographic map. GPS measurement of location is required.

Associated artifacts and grave goods may be subjected to examination and documentation if that is approved by the Spokane Tribe. Permission from the Spokane Tribal Business Council for examination and documentation of Native American burials and grave good, beyond that required to determine if the remains are Native American in origin, shall be gained in writing and a copy of the written approval shall be provided to the contracting professional investigation of the burial(s).

If the remains are Euro-American in ancestry, standard non-destructive analysis shall be completed of remains and any associated grave goods or mortuary materials.

All grave goods shall be stored with the appropriate skeletal remains.

Any recovered remains will be boxed according to Tribal standards (appropriate size and material to be decided by Tribal Elder in consultation); the contracted investigator will retain and protect the burials in their custody until repatriation occurs or, if such would prove necessary after completion of NAGPRA consultations, the Tribe notifies them to deliver the burial(s) to another location. We anticipate that, after completion of notification processes defined in NAGPRA, Native American remains would be repatriated to Spokane Tribe in Wellpinit, Washington.

Coordination

The Tribal Historic Preservation Officer, is the primary contact for the Spokane Tribe for notification purposes as well as consultation on matters of cultural patrimony. The phone number is (509) 258-4315, or FAX (509) 258-6965. The THPO shall be immediately notified whenever a human burial or scattered human remains are found on any Reservation or ceded land location.

Definitions

Cultural Resources

Cultural resources include (but not by way of limitation): archeological, historic, traditional, and ethnographic resources older than 50 years or originating more than 50 years ago. These include artifacts, features, and sites; pictographs and petroglyphs; traditional cultural properties; sacred sites and continuing practices; traditional gathering areas and resources; the Spokane and Columbia rivers; oral histories, myths, and stories; traditional ceremonies (separate from those practiced at historic sites), gatherings, and activities; and recordings of these in various formats. Those cultural resources specifically excluded from this definition are burial sites, human remains, and associated funerary objects, which possess certain qualities for the Spokane People that are not to be disclosed or discussed in this context.

To further expand this operational definition of cultural resources, three categories of property types should be noted; ancestral lifeways, property is usually an archaeological resource that contains material remains or physical evidence of past human life or activities, including the record of the effects of human activities on the environment. They are capable of revealing scientific and/or humanistic information through archaeological research. For the purposes of the Spokane Tribe, these sites are those that can be dated as originating prior to contact, that is, A.D. 1730.

An historic property may also be archeological in nature, but is better delimited by the time period of contact between the Spokane(e) Peoples and Euro-Americans, that is, between 1730 and 1950. This transitional period and the material culture generated may provide useful insights on assimilation and cultural resistance. In the long run, these contrasts will offer broader cultural and chronological reconstructions, documenting significant events, occupations or activities, and/or structures or landscapes whether extant or vanished, apart from the value of any existing structure or landscape.

Additional cultural properties are those associated with cultural practices or beliefs of a living community that are rooted in that community's history or are important in maintaining its cultural identity. These may also include traditional resource areas, those which traditionally support subsistence or other consumptive or ceremonial use of natural resources. Use can be on-site and visible, inferred from effects, or off-site and referenced in traditional narratives. Traditional ceremonial use may also involve sites, structures, each with their own special local names; as such they are eligible for listing in the National Register Historic Places.

Damage to Cultural Resources

Any intentional or unintentional disturbance to any cultural resource which has not been authorized by the Spokane Tribal Council as appropriate for that resource is considered damage. Damage to cultural resources includes (but not by way of limitation) looting, vandalism, disturbance , or displacement of any artifact, human remains or associated cultural objects, cultural features or sites, sacred sites, or burial sites; collection of non-modern artifacts (older than 50 years) from the surface of the ground; painting, drawing, carving, or other defacement of pictographs or petroglyphs; digging or disturbance in cultural sites; disturbance, clearing, or spraying pesticides in traditional gathering areas; handling of Spokane burial remains or associated objects by non-Tribal members; and desecration of burial grounds.

Entity or Person

For the purposes of the procedure "entity or person" shall mean an individual, corporation, partnership, trust, institution, association, or any other private entity or any officer, employee, agent, department, or instrumentality of the United States, of any Native American Tribe, and/or of any State or political subdivision thereof.

Objects of Cultural Patrimony

For the Spokane Tribe these objects include (not by way of limitation) Spokane Elders' oral histories, myths, stories; burial remains and associated objects of individuals without known descendants; objects associated with cemeteries and sacred sites; and the recordings in any and all media of these classes of objects.

APPENDIX D

QUALITY ASSURANCE MANUAL FOR COLUMBIA ANALYTICAL SERVICES

QUALITY ASSURANCE MANUAL

Columbia Analytical Services, Inc.

1317 South 13th Avenue
Kelso, Washington 98626
(360) 577-7222

Effective Date: March 1, 2009

Approved by:

Laboratory Director/Technical Director: _____
Jeff Christian

Quality Assurance Manager: _____
Julie Gish

Technical Director - Metals: _____
Jeff Coronado

Technical Director - Inorganics: _____
Harvey Jacky

Technical Director - Organics: _____
Jeff Grindstaff

Technical Director - Microbiology: _____
Lynda Huckestein

DOCUMENT CONTROL

NUMBER: _____

Initials: _____ Date: _____

2.0 TABLE OF CONTENTS

Figures Page

Appendices Page

3.0 INTRODUCTION AND COMPANY QUALITY ASSURANCE POLICY

Columbia Analytical Services, Inc. (CAS) is an employee-owned professional analytical services laboratory which performs chemical and microbiological analyses on a wide variety of sample matrices, including drinking water, groundwater, surface water, wastewater, soil, sludge, sediment, tissue, industrial and hazardous waste, and other material.

It is a policy at CAS that there will be sufficient Quality Assurance (QA) activities conducted in the laboratory to ensure that all analytical data generated and processed will be scientifically sound, legally defensible, of known and documented quality, and will accurately reflect the material being tested. This goal is achieved by ensuring that adequate Quality Control (QC) procedures are used throughout the monitoring process, and by establishing a means to assess performance of these Quality Control and other QA activities. Policies and procedures are established in order to meet the quality objectives of clients, accrediting authorities, and certifying organizations. The Quality System is established to meet the requirements of The NELAC Institute (TNI) National Environmental Laboratory Accreditation Program (NELAP).

CAS maintains control of analytical results by adhering to written standard operating procedures (SOPs) and by observing sample custody requirements. All analytical results are calculated and reported in units consistent with project specifications to allow comparability of data.

We recognize that quality assurance requires a commitment to quality by everyone in the organization - individually, within each operating unit, and throughout the entire laboratory.

CAS is a network of laboratories. In addition to the Kelso, WA facility, to which this manual is applicable, CAS also operates laboratories in California, Florida, New York, Arizona, and Texas.

The information in this document has been organized according to the format described in *EPA Requirements for Quality Management Plans, EPA QA/R-2,* USEPA, 2001; and *EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5,* USEPA, 2001.

4.0 PROGRAM DESCRIPTION

The purpose of the QA program at CAS is to ensure that our clients are provided with analytical data that is scientifically sound, legally defensible, and of known and documented quality. The concept of Quality Assurance can be extended, and is expressed in the mission statement of CAS:

> "The mission of Columbia Analytical Services, Inc., is to provide high quality, cost-effective, and timely professional testing services to our customers. We recognize that our success as a company is based on our ability to maintain customer satisfaction. To do this requires constant attention to customer needs, maintenance of state-of-the-art testing capabilities and successful management of our most important asset - our people - in a way that encourages professional growth, personal development and company commitment."

In support of this mission, our QA program addresses all aspects of laboratory operations, including laboratory organization and personnel, standard operating procedures, sample management, sample and quality control data, calibration practices, standards traceability data, equipment maintenance records, method proficiency data (such as method detection limit studies and control charts), document control/storage and staff training records.

4.1 Facilities and Equipment

CAS features over 45,000 square feet of laboratory and administrative workspace. The laboratory has been designed and constructed to provide safeguards against cross-contamination of samples and is arranged according to work function, which enhances the efficiency of analytical operations. The ventilation system has been specially designed to meet the needs of the analyses performed in each work space. Also, CAS minimizes laboratory contamination sources by employing janitorial and maintenance staff to ensure that good housekeeping and facilities maintenance are performed. In addition, the segregated laboratory areas are designed for safe and efficient handling of a variety of sample types. These specialized areas (and access restrictions) include:

- Shipping and Receiving/Purchasing
- Sample Management Office, including controlled-access sample storage areas
- Inorganic/Metals Sample Preparation Laboratories (2)
- Inorganic/Metals "clean room" sample preparation laboratory
- ICP-AES Laboratory
- ICP-MS Laboratory
- AA Laboratory
- Water Chemistry & General Chemistry Laboratories (3)
- Semi-volatile Organics Sample Preparation Laboratory
- Gas Chromatography/High Performance Liquid Chromatography Laboratories (2)

- Gas Chromatography/Mass Spectrometry Laboratory
- Petroleum Hydrocarbon Laboratory
- Semi-volatile Organics Drinking Water Laboratories (2)
- Volatile Organics Laboratory
  - Separate sample preparation laboratory
  - Access by semi-volatile sample preparation staff only after removing lab coat and solvent-contaminated gloves, etc.
- Microbiology Laboratory
- Laboratory Deionized Water Systems (2)
- Laboratory Management, Client Service, Report Generation and Administration
- Data Archival, Data Review and support functions areas
- Information Technology (IT) and LIMS

In addition, the designated areas for sample receiving, refrigerated sample storage, dedicated sample container preparation and shipping provide for the efficient and safe handling of a variety of sample types. Figure 4-1 shows the facility floor plan. The laboratory is equipped with state-of-the-art analytical and administrative support equipment. The equipment and instrumentation are appropriate for the procedures in use. Appendix C lists the major equipment, illustrating the laboratory's overall capabilities and depth.

4.2 Technical Elements of the Quality Assurance Program

The Quality Assurance Program provides a platform on which technical operations are based. The program provides laboratory organization, procedures, and policies by which the laboratory operates. The necessary certifications and approvals administered by external agencies are maintained. This includes method approvals and audit administration. In addition, internal audits are performed to assess compliance with policies and procedures. Standard Operating Procedures (SOPs) are maintained for technical and administrative functions. A document control system is used for SOPs, as well as laboratory notebooks, and this QA Manual. A list of QA Program documents is provided in Appendix A.

Acceptable calibration procedures are defined in the SOP for each test procedure. Calibration procedures for other laboratory equipment (balances, thermometers, etc.) are also defined. Quality Control (QC) procedures are used to monitor the testing performed. Each analytical procedure has associated QC requirements to be achieved in order to demonstrate data quality. The use of method detection limit studies, control charting, technical training and preventative maintenance procedures further ensure the quality of data produced. Proficiency Testing (PT) samples are used as an external means of monitoring the quality and proficiency of the laboratory. PT samples are obtained from qualified vendors and are performed on a regular basis. In addition to method proficiency, documentation of analyst training is performed to ensure proficiency and competency of laboratory analysts and technicians. Sample handling and custody procedures are defined in SOPs. Procedures are also in place to monitor the sample storage areas. The technical elements of the QA program are discussed in further detail in later sections of this QA manual.

4.3 Operational Assessments

There are a number of methods used to assess the laboratory and its daily operations. In addition to the routine quality control (QC) measurements to measure quality, the senior laboratory management examines a number of other indicators to assess the overall ability of the laboratory to successfully perform analyses for its clients. On-time performance, report quality, training, and Quality Assurance are a few of the items that are used to assess performance from an external perspective. A frequent, routine assessment must also be made of the laboratory's facilities and resources in anticipation of accepting an additional or increased workload.

CAS utilizes a number of different methods to ensure that adequate resources are available in anticipation of the demand for service. Regularly scheduled senior staff meetings, tracking of outstanding proposals and an accurate, current synopsis of incoming work all assist the senior staff in properly allocating resources to achieve the required results. All Requests for Proposal (RFP) documents are reviewed by the Project Chemist and appropriate managerial staff to identify any project specific requirements that differ from the standard practices of the laboratory. Any requirements that cannot be met are noted and communicated to the client, as well as requesting the client to provide any project specific Quality Assurance Plans (QAPPs) if available. A weekly status meeting is also conducted with the laboratory staff by the Client Services Manager to inform the staff of the status of incoming work, future projects, or project requirements.

4.4 Document Control

Procedures for control and maintenance of documents are described in the *SOP for Document Control (ADM-DOC_CTRL).* The procedures described in the SOP include distribution, tracking, filing, and copyrighting of CAS controlled documents. The requirements of the SOP apply to all standards preparation logbooks, instrument maintenance logbooks, run logbooks, certificates of analysis, standard operating procedures (SOPs), quality assurance manuals (QAMs), quality assurance project plans (QAPPs), Environmental Health & Safety (EHS) manuals, and other controlled CAS documents.

Each controlled copy of a controlled document will be released only after a document control number is assigned and the recipient is recorded on a document distribution list. Filing and distribution is performed by the Quality Assurance Manager, or designee, and ensure that only the most current version of the document is distributed and in use. A document control number is assigned to logbooks. Completed logbooks that are no longer in use are archived in a master logbook file.

CAS maintains a records system that ensures all laboratory records (including raw data, reports, and supporting records) are retained and available. The archiving system is described in the *SOP for Data Archiving (ADM-ARCH).*

4.5 Subcontracting

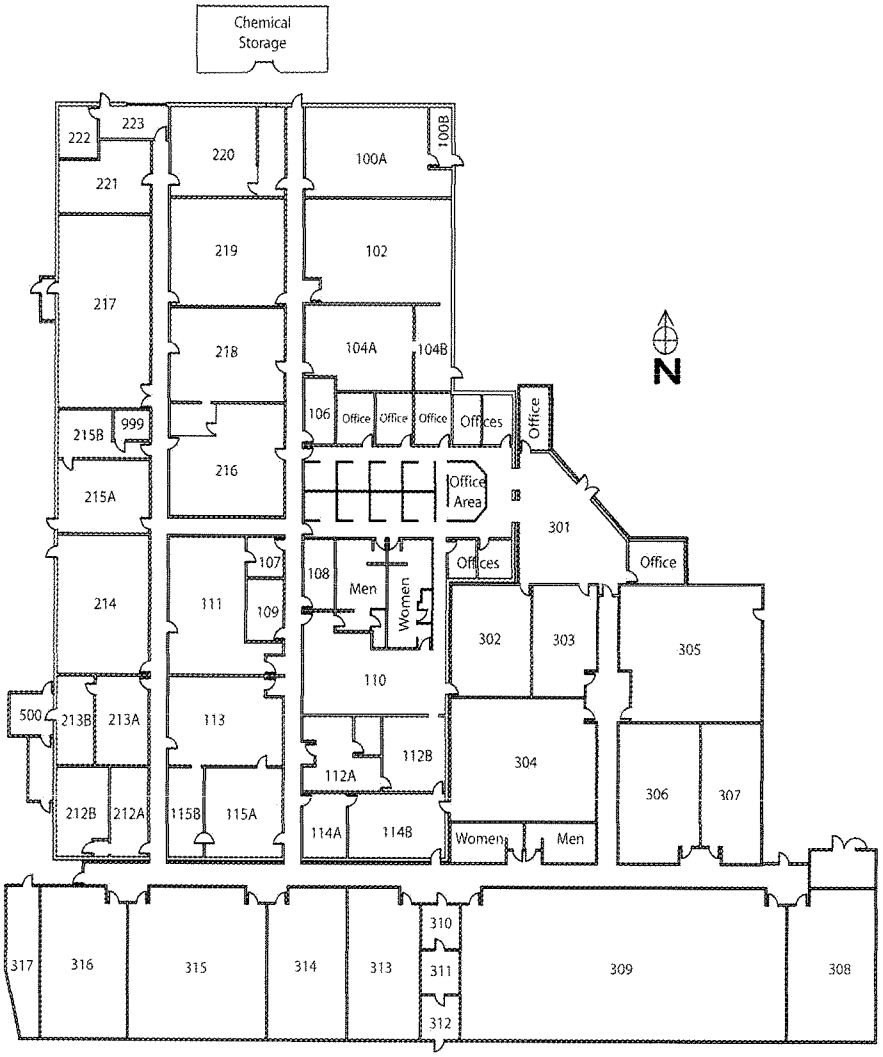
Analytical services are subcontracted when CAS/Kelso needs to balance workload or when the requested analyses are not performed by CAS/Kelso. Subcontracting is only done with the knowledge and approval of the client. Subcontracting to another CAS laboratory is preferred over external laboratory subcontracting. Further, sub-contracting is done using capable and qualified laboratories. Established procedures are used to qualify external subcontract laboratories. These procedures are described in the *SOP for Qualification of Subcontract Laboratories Outside of CAS Network (ADM-SUBLAB).* The Corporate Quality Assurance staff is responsible for qualifying and oversight of subcontract laboratories.

4.6 Procurement

The quality level of reagents and materials (grade, traceability, etc.) required is specified in analytical SOPs. Department supervisors ensure that the proper materials are purchased. Inspection and verification of material ordered is performed at the time of receipt by receiving personnel. The receiving staff labels the material with the date received. Expiration dates are assigned (by the laboratory user) as appropriate for the material. Storage conditions and expiration dates are specified in the analytical SOP. The procedures for purchasing and procurement are described in the *SOP for Purchasing through CAS Purchasing Department in Kelso (SOP ADM-PUR).* Also, refer to section 10.4 for a discussion of reference materials.

Figure 4-1
CAS/Kelso Laboratory Floor Plan

Room #	
100A	Semivolatile GC Lab
100B	Electrical Room
102	Semivolatile GC Lab
104A	Petroleum Hydrocarbon Lab
104B	Petroleum Hydrocarbon Lab
106	Deionized Water System Room
107	Storage
108	Zero Headspace Extraction
109	Storage
110	Lunch Room
111	General Chemistry Lab
112A	Microbiology Lab
112B	Copy Center
113	Metals Lab
114A	Sample Preparation
114B	Sample Preparation
115A	Metals Lab
115B	Metals Lab
212A	Metals Lab
212B	Low Level Mercury Lab
213A	Sample Preparation
213B	Sample Preparation
500	Janitorial Room
214	General Chemistry Lab
215A	Drinking Water Lab
215B	Data Storage
999	Computer Room
216	Data Review Area
217	Sample Storage
218	Volatiles Lab
219	Semivolatile GC/MS Lab
220	Semivolatile GC/MS Lab
221	Drinking Water Lab
222	Purchasing
223	General Receiving
301	Lobby
302	Lunch Room
303	Conference Room
304	Sample Storage
305	Sample Receiving
306	Pharmaceutical A
307	Pharmaceutical B
308	Pharmaceutical C
309	Organics Extractions Lab
310	Communication Room
311	Electrical Room
312	Fire Room/Water System
313	Glass Room
314	Clean Room
315	Metals Digestion Room
316	Tissue Preparation
317	Mechanical



5.0 PROFESSIONAL CONDUCT AND ETHICAL PRACTICES

One of the most important aspects of the success of CAS is the emphasis placed on the integrity of the data provided and services performed. To promote product quality, employees are required to comply with certain standards of conduct and ethical practices. The following examples of CAS policy are representative of these standards, and are not intended to be limiting or all-inclusive:

- Under no circumstances is the willful act of fraudulent manipulation of analytical data condoned. Such acts are to be reported immediately to senior management for appropriate corrective action. Unless specifically required in writing by a client, alteration, deviation or omission of written contractual requirements is not permitted. Such changes must be in writing and approved by senior management.

- Falsification of data in any form will not be tolerated. While much analytical data is subject to professional judgment and interpretation, outright falsification, whenever observed or discovered, will be documented, and appropriate remedies and punitive measures will be taken toward those individuals responsible. Employee discipline is progressive in its severity and each situation is handled individually in that the discipline is designed to fit the circumstances. Potential disciplinary actions may include a verbal warning, written warning, a second written notice (more severe and more strongly worded than a warning), suspension without pay, demotion, or termination.

- It is the responsibility of all CAS employees to safeguard sensitive company and client information. The nature of our business and the well being of our company and of our clients is dependent upon protecting and maintaining proprietary company/client information. All information, data, and reports (except that in the public domain) collected or assembled on behalf of a client is treated as confidential. Information may not be given to third parties without the consent of the client. Unauthorized release of confidential information about the company or its clients is taken seriously and is subject to formal disciplinary action.

All employees are required to sign and adhere to the requirements set forth in the CAS *Confidentiality and Conflicts of Interest Employee Agreement* and the CAS *Commitment to Excellence in Data Quality Policy.* All employees receive in-house ethics training and are periodically reminded of their data quality and ethical conduct responsibilities.

CAS makes every attempt to ensure that employees are free from any commercial, financial, or other undue pressures that might affect their quality of work. Related policies are described in the CAS Employee Handbook. This includes the CAS Ombudsman Program, the CAS Open Door Policy, and the use of flexible work hours. Operational assessments are regularly made to ensure that project planning is performed and that adequate resources are available during anticipated periods of increased workloads (Section 4.3). Procedures for subcontracting work are established, and within the CAS laboratory network additional capacity is typically available for subcontracting, if necessary.

6.0 ORGANIZATION AND RESPONSIBILITIES

The CAS/Kelso staff, consisting of approximately 130 employees, includes chemists, technicians and support personnel. They represent diverse educational backgrounds and experience, and provide the comprehensive skills that the laboratory requires. During seasonal workload increases, additional temporary employees may be hired to perform specific tasks.

CAS is committed to providing an environment that encourages excellence. Everyone within CAS shares responsibility for maintaining and improving the quality of our analytical services. The responsibilities of key personnel within the laboratory are described below. Table 6-1 lists the CAS/Kelso personnel assigned to these key positions. Managerial staff members are provided the authority and resources needed to perform their duties. An organizational chart of the laboratory, as well as the resumes of these key personnel, can be found in Appendix B.

- The role of the **Laboratory Director** is to provide technical, operational, and administrative leadership through planning, allocation and management of personnel and equipment resources. The Laboratory Director provides leadership and support for the QA program and is responsible for overall laboratory efficiency and the financial performance of the Kelso facility. The Laboratory Director has the authority to stop work in response to quality problems. The Laboratory Director also provides resources for implementation of the QA program, reviews and approves this QA Manual, reviews and approves standard operating procedures (SOPs), and provides support for business development by identifying and developing new markets through continuing support of the management of existing client activities.
- The responsibility of the **Quality Assurance Manager** (QAM) is to oversee implementation of the quality program and to coordinate QA activities within the laboratory. The QAM works with laboratory production units to establish effective quality control and assessment plans. The QAM has the authority to stop work in response to quality problems. The QAM is responsible for maintaining the QA Manual and performing an annual review of it; reviewing and approving SOPs and coordinating the annual review of each SOP; maintaining QA records such as metrological records, archived logbooks, PT sample results, etc.; document control; conducting PT sample studies; approving nonconformity and corrective action reports; maintaining the laboratory's certifications and approvals; performing internal QA audits; preparing QA activity reports; etc. The QAM reports directly to the Laboratory Director. The QAM also interacts with the CAS Quality Assurance Director. It is important to note that when evaluating data, the QAM does so in an objective manner and free of outside, or managerial, influence.

  The Chief Quality Officer (CQO) is responsible for the overall QA program at all the CAS laboratories. The CQO is responsible for ensuring that annual internal audits are performed at each CAS laboratory; maintaining a data base of information about state certifications and accreditation programs; writing laboratory-wide SOPs; maintaining a data base of CAS-approved subcontract laboratories; providing assistance to the laboratory QA staff and laboratory managers; preparing a quarterly QA activity report; etc.

- In the case of absence of the Laboratory Director or QA Manager, deputies are assigned to act in that role. Default deputies for these positions are the Client Services Manager or Organics Department Manager (for the Laboratory Director) and the CQO or Laboratory Director (for the QA Manager).

- The **Environmental Health and Safety Officer** (EH&S) is responsible for the administration of the laboratory health and safety policies. This includes the formulation and implementation of safety policies, the supervision of new-employee safety training, the review of accidents, incidents and prevention plans, the monitoring of hazardous waste disposal and the conducting of departmental safety inspections. The EH&S officer is also designated as the Chemical Hygiene Officer. The EH&S Officer has a dotted-line reporting responsibility to CAS' EH&S Director.

- The **Client Services and Sample Management Office Manager** is responsible for the Client Services Department (customer services/project chemists, and Electronic Data Deliverables group) and the sample management office/bottle preparation sections. The Client Services Department provides a complete interface with clients from initial project specification to final deliverables. The sample management office handles all the activities associated with receiving, storage, and disposal of samples. The Client Services Manager has the authority to stop subcontractor work in response to quality problems.

- The **Project Chemist** is a senior-level scientist assigned to each client to act as a technical liaison between the client and the laboratory. The project chemist is responsible for ensuring that the analyses performed by the laboratory meet all project, contract, and regulatory-specific requirements. This entails coordinating with the CAS laboratory and administrative staff to ensure that client-specific needs are understood, and that the services CAS provides are properly executed and satisfy the requirements of the client.

- The Analytical Laboratory is divided into operational units based upon specific disciplines. Each department is responsible for establishing, maintaining and documenting a quality control program based upon the unique requirements within the department. Each **Department Manager and Supervisor** has the responsibility to ensure that quality control functions are carried out as planned, and to guarantee the production of high quality data. Department managers and bench-level supervisors have the responsibility to monitor the day-to-day operations to ensure that productivity and data quality objectives are met. Each department manager has the authority to stop work in response to quality problems in their area. Analysts have the responsibility to carry out testing according to prescribed methods, SOPs, and quality control guidelines particular to the laboratory in which he/she is working.

- The **Sample Management Office** plays a key role in the laboratory QA program by maintaining documentation for all samples received by the laboratory, and by assisting in the archival of all laboratory results. The sample management office staff is also responsible for the proper disposal of samples after analysis.

- **Information Technology** (IT) staff are responsible for the administration of the Laboratory Information Management System (LIMS) and other necessary support services. Other functions of the IT staff include laboratory network maintenance, IT systems development and implementation, education of analytical staff in the use of scientific software, Electronic Data Deliverable (EDD) generation, and data back-up, archival and integrity operations.

Table 6-1
Summary of Technical Experience and Qualifications

Personnel	Years of Experience	Project Role
Jeff Christian, B.S.	30	Laboratory Director
Julie Gish, M.S.	18	Quality Assurance Manager
Lynda Huckestein, B.S.	20	Client Services Manager Sample Management Office Manager
Jeff Coronado, B.S.	19	Metals Department Manager
Harvey Jacky, B.S.	20	General Chemistry Department Manager
Gregory Salate, Ph.D.	9	Extractions Department Manager
Jeff Grindstaff, B.S.	20	Organics Chromatography & Mass Spectrometry Department Manager
Loren Portwood, B.S.	18	Organics Drinking Water Department Manager
Eileen Arnold, B.A.	27	Environmental Health and Safety Officer
Mike Sullivan, B.S.	8	CAS Information Technology Director
Lee Wolf, B.S.	23	CAS Chief Quality Officer
Steve Vincent, B.S.	33	CAS President

7.0 INFORMATION MANAGEMENT

The generation, compilation, reporting, and archiving of electronic data is a critical component of laboratory operations. In order to generate data of known and acceptable quality, the quality assurance systems and quality control practices for electronic data systems must be complete and comprehensive and in keeping with the overall quality assurance objectives of the organization. CAS management provides the tools and resources to implement electronic data systems and establishes information technology standards and policies. Appendix C lists major automated data processing equipment.

7.1 Software Quality Assurance Plan

CAS has defined practices for assuring the quality of the computer software used throughout all laboratory operations to generate, compile, report, and store electronic data. These practices are described in the CAS Software Quality Assurance Plan (SQAP). The purpose of the SQAP is to describe the policies and practices for the procurement, configuration management, development, validation and verification, data security, maintenance, and use of computer software. The policies and practices described in the plan apply to purchased computer software as well as to internally developed computer software. Key components of configuration management plan are policies for controlling the software version that is in use in the laboratory.

7.2 IT Support

The local CAS Information Technology (IT) department is established to provide technical support for all computing systems. The IT department staff continually monitors the performance and output of operating systems. The IT department oversees routine system maintenance and data backups to ensure the integrity of all electronic data. A software inventory is maintained. Additional IT responsibilities are described in the SQAP.

In addition to the local IT department, CAS corporate IT provides support for network-wide systems. CAS also has personnel assigned to information management duties such as development and implementation of reporting systems; data acquisition, and Electronic Data Deliverable (EDD) generation.

7.3 Information Management Systems

CAS has various systems in place to address specific data management needs. The CAS Laboratory Information Management System (LIMS) is used to manage sample information and invoicing. Access is controlled by password. This system is used to establish and define sample identification, analysis specifications, and provide a means of sample tracking. This system is used during sample login to generate the internal Service Request. The Service

Request provides a summary of client information, sample information, required analyses, work instructions, deliverable requirements and other necessary information provided on the chain of custody. The LIMS also is the basis for valuable sample tracking mechanisms used throughout the laboratory. Laboratory analysts generate responsibility reports from the LIMS and perform internal chain of custody via the LIMS.

Where possible, instrument data acquired locally is immediately moved to a server (Microsoft Windows2003® domain). This provides a reliable, easily maintained, high-volume acquisition and storage system for electronic data files. With password entry, users may access the system from many available computer stations, improving efficiency and flexibility. The server is also used for data reporting, EDD generation, and administrative functions. Access to these systems is controlled by password. A standardized EDI (electronic data interchange) format is used as a reporting platform, providing functionality and flexibility for end users. With a common standardized communication platform, the EDI provides data reporting in a variety of hardcopy and electronic deliverable formats, including Staged Electronic Data Deliverable (SEDD) format.

7.4 Backup and Security

CAS laboratory data is either acquired directly to the centralized acquisition server or acquired locally and then transferred to the server. All data is eventually moved to the centralized data acquisition server for reporting and archiving. Differential backups are performed on all file server information once per day, Sunday through Thursday. Full backups are performed each Friday night. Tapes are physically stored in a locked media cabinet within a locked, temperature controlled computer room, with every other full backup also securely stored offsite.

Access to sample information and data is on a need-to-know basis. Access is restricted to the person's areas of responsibility. Passwords are required on all systems. No direct external, non-CAS access is allowed to any of our network systems.

The external e-mail system and Internet access is established via a single gateway to discourage unauthorized entry. CAS uses a closed system for company e-mail. Files, such as electronic deliverables, are sent through the external e-mail system only via a trusted agent. The external messaging system operates through a single secure gateway. Email attachments sent in and out of the gateway are subject to a virus scan. Because the Internet is not regulated, we use a limited access approach to provide a firewall for added security. Virus screening is performed continuously on all network systems.

8.0 SAMPLE MANAGEMENT

8.1 Sampling and Sample Preservation

The quality of analytical results is highly dependent upon the quality of the procedures used to collect, preserve and store samples. CAS recommends that clients follow sampling guidelines described in 40 CFR 136, 40 CFR 141, USEPA SW-846, and state-specific sampling guidelines, if applicable. Sampling factors that must be taken into account to insure accurate, defensible analytical results include:

- Amount of sample taken
- Type of container used
- Type of sample preservation
- Sample storage time
- Proper custodial documentation

CAS uses the sample preservation, container, and holding-time recommendations published in a number of documents. The primary documents of reference are: USEPA SW-846, Third Edition and Updates I, II, IIA, IIB, III, IV for hazardous waste samples; USEPA 600/4-79-020, 600/4-91-010, 600/4-82-057, 600/R-93/100, 600/4-88-039, 600/R-94-111, and Supplements; EPA 40CFR parts 136 and 141; and *Standard Methods for the Examination of Water and Wastewater* for water and wastewater samples (see Section 18 for complete citations). The container, preservation and holding time information for these references is summarized in Table 8-1 for soil, water, and drinking water. The current EPA CLP Statement of Work should be referred to for CLP procedures. Where allowed by project sampling and analysis protocols (such as Puget Sound Protocols) the holding time for sediment, soil, and tissue samples may be extended for a defined period when stored frozen at -20°C.

CAS routinely provides sample containers with appropriate preservatives for our clients. Containers are purchased as precleaned to a level 1 status, and conform to the requirements for samples established by the USEPA. Certificates of analysis for the sample containers are available to clients if requested. Reagent water used for sampling blanks (trip blanks, etc.) and chemical preservation reagents are tested by the laboratory to ensure that they are free of interferences and documented. Our sample kits typically consist of foam-lined, precleaned shipping coolers, (cleaned inside and out with appropriate cleaner, rinsed thoroughly and air-dried), specially prepared and labeled sample containers individually wrapped in protective material, (VOC vials are placed in a specially made, foam holder), chain-of-custody (COC) forms, and custody seals. Container labels and custody seals are provided for each container.

Figure 8-1 shows the chain-of-custody form routinely used at CAS and included with sample kits. For large sample container shipments, the containers may be shipped in their original boxes. Such shipments will consist of several boxes of labeled sample containers and sufficient materials (bubble wrap, COC forms, custody seals, shipping coolers, etc.) to allow the sampling personnel to process the sample containers and return them to CAS. The proper preservative is added to the sample containers prior to shipment, unless otherwise instructed by the client.

If any returning shipping cooler exhibits an odor or other abnormality after receipt and subsequent decontamination by laboratory personnel, a second, more vigorous decontamination process is employed. Containers exhibiting an odor or abnormality after the second decontamination process are promptly and properly discarded. CAS keeps client-specific shipping requirements on file and utilizes major transportation carriers to guarantee that sample shipping requirements (same-day, overnight, etc.) are met. CAS also provides courier service that makes regularly scheduled trips to the Greater Portland, Oregon Metropolitan area.

When CAS ships environmental samples to other laboratories for analysis each sample bottle is wrapped in protective material and placed in a plastic bag (preferably Ziploc®) to avoid any possible cross-contamination of samples during shipping. The sample management office (SMO) follows formalized procedures for maintaining the chain of custody of the sample(s) (*SOP for Chain of Custody for Sample Transfer between Laboratories* [SOP ADM-COC]), proper packaging and shipment, specification of proper methodology, etc. Blue or gel ice is the only temperature preservative used by CAS, unless otherwise specified by the client or receiving laboratory.

8.2 Sample Receipt and Handling

Standard Operating Procedures are established for the receiving of samples into the laboratory. These procedures ensure that samples are received and properly logged into the laboratory, and that all associated documentation, including chain of custody forms, is complete and consistent with the samples received. Complete documentation of all sample storage is maintained in order to preserve the integrity of the samples.

Once samples are delivered to the CAS sample management office (SMO), a Cooler Receipt and Preservation Check Form (CRF - See Figure 8-2 for an example) is used to assess the shipping cooler and its contents as received by the laboratory personnel. Verification of sample integrity includes the following activities:

- Assessment of custody seal presence/absence, location and signature;
- Temperature of sample containers upon receipt;
- Chain of custody documents properly used (entries in ink, signature present, etc.);
- Sample containers checked for integrity (broken, leaking, etc.);

- Sample is clearly marked and dated (bottle labels complete with required information);
- Appropriate containers (size, type) are received for the requested analyses;
- The minimum amount of sample material is provided for the analysis.
- Sample container labels and/or tags agree with chain of custody entries (identification, required analyses, etc.);
- Assessment of proper sample preservation (if inadequate, corrective action is employed); and
- VOC containers are inspected for the presence/absence of bubbles. (Assessment of proper preservation of VOC containers is performed by lab personnel).

Samples are logged into a Laboratory Information Management System (LIMS). Any anomalies or discrepancies observed during the initial assessment are recorded on the CRF and COC documents. Potential problems with a sample shipment are addressed by contacting the client and discussing the pertinent issues. When the Project Chemist and client have reached a satisfactory resolution, the login process may continue and analysis may begin. During the login process, each sample is given a unique laboratory code and a service request form is generated. The LIMS generates a Service Request that contains client information, sample descriptions, sample matrix information, required analyses, sample collection dates, analysis due dates and other pertinent information. The service request is reviewed by the appropriate Project Chemist for accuracy, completeness, and consistency of requested analyses and for client project objectives.

Samples are stored as per method requirements until they undergo analysis, unless otherwise specified, using various refrigerators or freezers, or designated secure areas. CAS has five walk-in cold storage units which house the majority of sample containers received at the laboratory. In addition, there are four additional refrigerators, including dedicated refrigerated storage of VOC samples. The dedicated storage areas for VOC samples are monitored using storage blanks, as described in the *SOP for VOA Storage Blanks (VOC-BLAN)*. CAS also has seven sub-zero freezers capable of storing samples at -20° C primarily used for tissue and sediment samples requiring specialized storage conditions. The temperature of each sample storage unit is monitored daily and the data recorded in a bound logbook. Continuous-graph temperature recorders have also been placed in the walk-in refrigerators to provide a permanent record of the storage conditions to which samples are exposed.

CAS adheres to the method-prescribed or project-specified holding times for all analyses. The sampling date and time are entered into the LIMS system at the time of sample receipt and login. Analysts then monitor holding times by obtaining analysis-specific reports from the LIMS. These reports provide holding time information on all samples for the analysis, calculated from the sampling date and the holding time requirement. To document holding time compliance, the date and time analyzed is printed or written on the analytical raw data. For analyses with a holding time prescribed in hours it is essential that the sample collection time is provided, so holding time compliance can be demonstrated. If not, the sample collection time is assumed as the earliest in the day (i.e. the most conservative).

Unless other arrangements have been made in advance, upon completion of all analyses and submittal of the final report, aqueous samples and sample extracts are retained at ambient temperature for 30 days, soil samples are retained at ambient temperature for 60 days, and tissue samples are retained frozen for 3 months. Upon expiration of these time limits, the samples are either returned to the client or disposed of according to approved disposal practices. All samples are characterized according to hazardous/non-hazardous waste criteria and are segregated accordingly. All hazardous waste samples are disposed of according to formal procedures outlined in the *CAS Environmental Health and Safety Manual.* All waste produced at the laboratory, including the laboratory's own various hazardous waste streams, is treated in accordance with applicable local and Federal laws. Documentation is maintained for each sample from initial receipt through final disposal to ensure that an accurate history of the sample from "cradle to grave" is available.

8.3 Sample Custody

Sample custody transfer at the time of sample receipt is documented using chain-of-custody (COC) forms accompanying the samples. During sample receipt, it is also noted if custody seals were present. This is described in the *SOP for Sample Receiving (SMO-GEN).* Figure 8-1 is a copy of the chain-of-custody form routinely used at CAS.

Facility security and access is important in maintaining the integrity of samples received at CAS/Kelso. Access to the laboratory facility is limited by use of locked exterior doors with a coded entry, except for the reception area and sample receiving doors, which are manned during business hours and locked at all other times. In addition, the sample storage area within the laboratory is a controlled access area with locked doors with a coded entry. The CAS facility is equipped with an alarm system and CAS employs a private security firm to provide nighttime and weekend security.

A barcoding system is used to document internal sample custody. Each person removing or returning samples from/to sample storage while performing analysis is required to document this custody transfer. The system uniquely identifies the sample container and provides an electronic record of the custody of each sample. For sample extracts and digestates the analyst documents custody of the sample extract or digestate by signing on the benchsheet, or custody record, that they have accepted custody. The procedures are described in the *SOP for Sample Tracking and Internal Chain of Custody (SMO-SCOC).*

8.4 Project Setup

The analytical method(s) to be used for sample analysis are chosen based on the client's requirements. Unless specified otherwise, the most recent versions of reference methods are used. For SW-846 methods, some projects may require the most recent *promulgated* version, and some projects may require the most recent *published* version. The Project Chemist will ensure that the correct method version is used. LIMS codes are chosen to identify the analysis method used for analysis. The Project Chemist ensures that the correct methods are selected for analysis, deliverable requirements are identified, and due dates are specified on the LIMS generated Service Request. To communicate and specify project-specific requirements, a Tier V form (Figure 8-3) is used and accompanies the service request form.

Table 8-1
Sample Preservation and Holding Times

DETERMINATION[a]	MATRIX[b]	CONTAINER[c]	PRESERVATION	MAXIMUM HOLDING TIME
Bacterial Tests				
Coliform, Colilert (Standard Methods)	W, DW	P, Bottle or Bag	Cool, 4°C, 0.008% $Na_2S_2O_3$[d]	6-24 hours[e]
Coliform, Fecal and Total (Standard Methods)	W, DW	P,G	Cool, 4°C, 0.008% $Na_2S_2O_3$[d]	6-24 hours[e]
Fecal Streptococci (SM 9230B)	W	P,G	Cool, 4°C, 0.008% $Na_2S_2O_3$[d]	6-24 hours[e]
Inorganic Tests				
Acidity (SM 2310B)	W	P,G	Cool, 4°C	14 days[EPA]
Alkalinity (SM 2320B)	W, DW	P,G	Cool, 4°C	14 days[EPA]
Ammonia (SM 4500NH3)	W, DW	P,G	Cool, 4°C, H_2SO_4 to pH<2	28 days
Biochemical Oxygen Demand (SM 5210B)	W	P,G	Cool, 4°C	48 hours
Bromate (EPA 300.1)	W, DW	P,G	50mg/L EDA, cool to 4°C	28 days
Bromide (EPA 300.1)	W, DW	P,G	None Required	28 days
Chemical Oxygen Demand (SM 5220C)	W	P,G	Cool, 4°C, H_2SO_4 to pH<2	28 days
Chloride (EPA 300.0)	W, DW	P,G	None Required	28 days
Chloride (EPA 9056)	W	P,G	Cool, 4°C	Analyze immediately
Chlorine, Total Residual (SM 4500Cl F)	W, DW	P,G	None Required	24 hours
Chlorite (EPA 300.1)	W, DW	P,G	50mg/L EDA, cool to 4°C	14 days
Chlorophyll-A (SM 11200H)	W	G Amber	Cool, 4°C	Analyze immediately
Chromium VI (EPA 7196A)	W	P,G	Cool, 4°C	24 hours
Color (SM 2120B)	W, DW	P,G	Cool, 4°C	48 hours
Cyanide, Total and Amenable to Chlorination (EPA 335.4, 9010, 9012) (SM 4500CN E,G)	W, DW	P,G	Cool, 4°C, NaOH to pH>12, plus 0.6 g Ascorbic Acid	14 days
Cyanide, Weak Acid Dissociable (SM 4500CN I)	W	P,G	Cool, 4°C, NaOH to pH >12	14 days
Ferrous Iron (CAS SOP)	W, DW	G Amber	Cool, 4°C	24 hours
Fluoride (EPA 300.0)	W, DW	P,G	None Required	28 days
Fluoride (EPA 9056)	W	P,G	Cool, 4°C	Analyze immediately
Hardness (SM 2340C)	W, DW	P,G	HNO_3 to pH<2	6 months
Hydrogen Ion (pH) (SM 4500H B)	W, DW	P,G	None Required	Analyze immediately
Kjeldahl and Organic Nitrogen (ASTM D3590-89)	W	P,G	Cool, 4°C, H_2SO_4 to pH<2	28 days

Table 8-1 (continued)
Sample Preservation and Holding Times[a]

DETERMINATION[a]	MATRIX[b]	CONTAINER[c]	PRESERVATION	MAXIMUM HOLDING TIME
Nitrate (EPA 300.0)	W, DW	P,G	Cool, 4°C	48 hours
Nitrate (EPA 353.2)	W, DW	P,G	Cool, 4°C, H_2SO_4 to pH<2	48 hours
Nitrate (EPA 9056)	W	P,G	Cool, 4°C	Analyze immediately
Nitrate-Nitrite (EPA 353.2)	W, DW	P,G	Cool, 4°C, H_2SO_4 to pH<2	28 days
Nitrite (EPA 300.0)	W, DW	P,G	Cool, 4°C	48 hours
Nitrite (EPA 353.2)	W, DW	P,G	Cool, 4°C, H_2SO_4 to pH<2	48 hours
Nitrite (EPA 9056)	W	P,G	Cool, 4°C	Analyze immediately
Orthophosphate (EPA 365.3)	W, DW	P,G	Cool, 4°C	Analyze immediately
Oxygen, Dissolved (Probe) (SM 4500O G)	W, DW	G, Bottle and Top	None Required	Analyze immediately
Oxygen, Dissolved (Winkler)	W, DW	G, Bottle and Top	Fix on Site and Store in Dark	8 hours
Perchlorate (EPA 314.0)	W, DW	P,G	Protect from temp. extremes	28 days
Phenolics, Total (EPA 420.1)	W	G Only	Cool, 4°C, H_2SO_4 to pH<2	28 days
Phosphorus, Total (EPA 365.3)	W	P,G	Cool, 4°C, H_2SO_4 to pH<2	28 days
Residue, Total (EPA 160.3 & SM 2540B)	W	P,G	Cool, 4°C	7 days
Residue, Filterable (TDS) (SM 2540C)	W	P,G	Cool, 4°C	7 days
Residue, Nonfilterable (TSS) (SM 2540D)	W	P,G	Cool, 4°C	7 days
Residue, Settleable (SM 2540F)	W	P,G	Cool, 4°C	48 hours
Residue, Volatile (EPA 160.4)	W	P,G	Cool, 4°C	7 days
Silica (SM 4500SiO2 C)	W	P Only	Cool, 4°C	28 days
Specific Conductance (EPA 120.1 & SM 2510B)	W, DW	P,G	Cool, 4°C	28 days
Sulfate (EPA 300.0)	W, DW	P,G	Cool, 4°C	28 days
Sulfate (EPA 9056)	W	P,G	Cool, 4°C	Analyze immediately
Sulfide (SM 4500S2 F)	W	P,G	Cool, 4°C, Add Zinc Acetate plus Sodium Hydroxide to pH>9	7 days
Sulfite (SM 4500SO3 B)	W	P,G	None Required	24 hours
Surfactants (MBAS) (SM 5540C)	W	P,G	Cool, 4°C	48 hours
Tannin and Lignin (SM 5550B)	W	P,G	Cool, 4°C	28 days
Turbidity (EPA 180.1)	W, DW	P,G	Cool, 4°C	48 hours

Table 8-1 (continued)
Sample Preservation and Holding Times[a]

DETERMINATION[a]	MATRIX[b]	CONTAINER[c]	PRESERVATION	MAXIMUM HOLDING TIME
Metals				
Metals, except CrVI and Mercury (EPA 200.7, 200.8, 200.9, 6010, 6020)	W, DW	P,G	HNO_3 to pH<2	6 months
	S	G, Teflon-Lined Cap	Cool, 4°C	6 months
Chromium VI (EPA 7195/7191)	W	P,G	Cool, 4°C	24 hours
Mercury (EPA 245.1, 7470, 7471, 1631E)	W	P,G	HNO_3 to pH<2	28 days
	S	P,G	Cool, 4°C	28 days
Organic Tests				
Oil and Grease, Hexane Extractable Material (EPA 1664)	W	G, Teflon-Lined Cap	Cool, 4°C, H_2SO_4 to pH<2	28 days
Organic Carbon, Total (EPA 415.1, 9060 & SM 5310C)	W	P,G	Cool, 4°C, H_2SO_4 to pH<2	28 days
Organic Halogens, Total (EPA 9020)	W	G, Teflon-Lined Cap	Cool, 4°C, H_2SO_4 to pH<2, No headspace	28 days
Organic Halogens, Adsorbable (EPA 1650B)	W	G, Teflon-Lined Cap	Cool, 4°C, HNO_3 to pH<2	6 months
Petroleum Hydrocarbons, Total (EPA 8015)	W	G, Teflon-Lined Cap	Cool, 4°C, HCl or H_2SO_4 to pH<2	7 days until extraction; 40 days after extraction
	S	G, Teflon-Lined Cap	Cool, 4°C	14 days until extraction; 40 days after extraction

Table 8-1 (continued)
Sample Preservation and Holding Times[a]

DETERMINATION[a]	MATRIX[b]	CONTAINER[c]	PRESERVATION	MAXIMUM HOLDING TIME
Volatile Organics				
Petroleum Hydrocarbons, Volatile (Gasoline-Range Organics) (EPA 8015)	W	G, Teflon-Lined Septum Cap	Cool, 4°C, HCl to pH<2 No Headspace	14 days
	S	G, Teflon-Lined Cap	Cool, 4°C Minimize Headspace	14 days
Purgeable Halocarbons (EPA 624, 8021, 8260)	W	G, Teflon-Lined Septum Cap, No Headspace	**No Residual Chlorine Present**: HCl to pH<2, Cool, 4°C, No Headspace **Residual Chlorine Present**: 10% $Na_2S_2O_3$, HCl to pH<2, Cool, 4°C	14 days
	S	G, Teflon-Lined Cap	Cool, 4°C, Minimize Headspace	14 days
	S	Method 5035	Encore, Freeze at -20°C Methanol, Cool, 4°C Sodium Bisulfate Cool, 4°C	7 days 48 hrs to prepare from Encore, 14 days after preparation. 48 hrs to prepare from Encore, 14 days after preparation.
Purgeable Aromatic Hydrocarbons (including BTEX and MTBE) (EPA 624, 8021, 8260)	W	G, Teflon-Lined Septum Cap, No Headspace	**No Residual Chlorine Present**: HCl to pH<2, Cool, 4°C, No Headspace **Residual Chlorine Present**: 10% $Na_2S_2O_3$, HCl to pH<2, Cool 4°C	14 days
	S	G, Teflon-Lined Cap	Cool, 4°C, Minimize Headspace	14 days
	S	Method 5035	Encore, Freeze at -20°C Methanol, Cool, 4°C Sodium Bisulfate Cool, 4°C	7 days 48 hrs to prepare from Encore, 14 days after preparation. 48 hrs to prepare from Encore, 14 days after preparation.
Acrolein, Acrylonitrile, Acetonitrile (EPA 624, 8260)	W	G, Teflon-Lined Septum Cap	Adjust pH to 4-5, Cool, 4°C, No Headspace	14 days
EDB and DBCP (EPA 8260)	W,S	G, Teflon-Lined Cap	Cool, 4°C, 3 mg $Na_2S_2O_3$, No Headspace	28 days

Table 8-1 (continued)
Sample Preservation and Holding Times[a]

DETERMINATION[a]	MATRIX[b]	CONTAINER[c]	PRESERVATION	MAXIMUM HOLDING TIME
Semivolatile Organics				
Petroleum Hydrocarbons, Extractable (Diesel-Range Organics) (EPA 8015)	W,S	G, Teflon-Lined Cap	Cool, 4°C	7 days until extraction;[f] 40 days after extraction
Alcohols and Glycols (EPA 8015)	W,S	G, Teflon-Lined Cap	Cool, 4°C[g]	7 days until extraction;[f] 40 days after extraction
Acid Extractable Semivolatile Organics (EPA 625, 8270)	W,S	G, Teflon-Lined Cap	Cool, 4°C[g]	7 days until extraction;[f] 40 days after extraction
Base/Neutral Extractable Semivolatile Organics (EPA 625, 8270)	W,S	G, Teflon-Lined Cap	Cool, 4°C[g]	7 days until extraction;[f] 40 days after extraction
Polynuclear Aromatic Hydrocarbons (EPA 625, 8270, 8310)	W,S	G, Teflon-Lined Cap	Cool, 4°C, Store in Dark[g]	7 days until extraction;[f] 40 days after extraction
Organochlorine Pesticides and PCBs (EPA 608, 8081)	W,S	G, Teflon-Lined Cap	Cool, 4°C	7 days until extraction;[f] 40 days after extraction
Organophosphorus Pesticides (EPA 8141)	W,S	G, Teflon-Lined Cap	Cool, 4°C[g]	7 days until extraction;[f] 40 days after extraction
Nitrogen- and Phosphorus-Containing Pesticides (EPA 8141)	W,S	G, Teflon-Lined Cap	Cool, 4°C[g]	7 days until extraction;[f] 40 days after extraction
Chlorinated Herbicides (EPA 8151)	W,S	G, Teflon-Lined Cap	Cool, 4°C[g]	7 days until extraction;[f] 40 days after extraction
Organotins (CAS SOP)	W,S	G, Teflon-Lined Cap	Cool, 4°C	7 days until extraction;[f] 40 days after extraction
Chlorinated Phenolics (EPA 1653A)	W	G, Teflon-Lined Cap	H_2SO_4 to pH<2, Cool, 4°C[g]	30 days until extraction; 30 days after extraction
Resin and Fatty Acids (NCASI 85.02)	W	G, Teflon-Lined Cap	NaOH to pH $\geq$10, Cool, 4°C[g]	30 days until extraction; 30 days after extraction

Table 8-1 (continued)
Sample Preservation and Holding Times[a]

DETERMINATION[a]	MATRIX[b]	CONTAINER[c]	PRESERVATION	MAXIMUM HOLDING TIME
Drinking Water Organics				
Purgeable Organics (EPA 524.2)	DW	G, Teflon-Lined Septum Cap	Ascorbic Acid, HCl to pH≤2, Cool, 4°C, No Headspace	14 days
EDB, DBCP, and TCP (EPA 504.1)	DW	G, Teflon-Lined Septum Cap	Cool, 4°C, 3 mg $Na_2S_2O_3$, No Headspace	14 days
Carbamates, Carbamoyloximes (EPA 531.1)	DW	G, Amber, Teflon-Lined Cap	1.8 mL monochloroacetic acid to pH<3; 80 mg/L $Na_2S_2O_3$ if Res.Cl.; Cool, 4°C	28 days
Chlorinated Herbicides (EPA 515.4)	DW	G, Amber, Teflon-Lined Cap	If Res.Cl, 2mg/4omL NaS; Cool, <6°C	14 days until extraction; 21 days after extraction
Chlorinated Pesticides (EPA 508.1, 525.2)	DW	G, Amber, Teflon-Lined Cap	50 mg/L NaS, HCl to pH≤ 2; Cool, 4°C	14 days until extraction; 30 days after extraction
Diquat and Paraquat (EPA 549.2)	DW	G, Amber, Teflon-Lined Cap	100 mg/L $Na_2S_2O_3$ if Res.Cl., Cool, 4°C,	7days until extraction; 21 days after extraction
Endothall (EPA 548.1)	DW	G, Amber, Teflon-Lined Cap	Cool, 4°C	7 days until extraction; 14 days after extraction
Glyphosate (EPA 547)	DW	G, Amber, Teflon-Lined Cap	100 mg/L $Na_2S_2O_3$, Cool, 4°C	14 days
Haloacetic Acids (EPA 552.2)	DW	G, Amber, Teflon-Lined Cap	100 mg/L NH_4Cl, Cool, 4°C	14 days until extraction; 7 days after extraction
Semivolatile Organics (EPA 525.2)	DW	G, Amber, Teflon-Lined Cap	50 mg/L NaS, HCl to pH≤ 2; Cool, 4°C	14 days until extraction; 30 days after extraction
Toxicity Characteristic Leaching Procedure (TCLP)				
Mercury (EPA 1311/7470)	HW	P,G	Sample: Cool, 4°C TCLP extract: HNO_3 to pH<2	28 days until extraction; 28 days after extraction
Metals, except Mercury (EPA 1311/6010)	HW	P,G	Sample: Cool, 4°C TCLP extract: HNO_3 to pH<2	180 days until extraction; 180 days after extraction
Volatile Organics (EPA 1311/8260)	HW	G, Teflon-Lined Cap	Sample: Cool, 4°C Minimize Headspace TCLP extract: Cool, 4°C, HCl to pH<2, No Headspace	14 days until extraction; 14 days after extraction

Table 8-1 (continued)
Sample Preservation and Holding Times[a]

DETERMINATION[a]	MATRIX[b]	CONTAINER[c]	PRESERVATION	MAXIMUM HOLDING TIME
Toxicity Characteristic Leaching Procedure (TCLP)				
Semivolatile Organics (EPA 1311/8270)	HW	G, Teflon-Lined Cap	Sample: Cool, 4°C, Store in Dark[g] TCLP extract: Cool, 4°C, Store in Dark[g]	14 days until TCLP ext'n; 7 days until extraction; 40 days after extraction
Organochlorine Pesticides (EPA 1311/8081)	HW	G, Teflon-Lined Cap	Sample: Cool, 4°C TCLP extract: Cool, 4°C	14 days until TCLP ext'n; 7 days until extraction; 40 days after extraction
Chlorinated Herbicides (EPA 1311/8151)	HW	G, Teflon-Lined Cap	Sample: Cool, 4°C TCLP extract: Cool, 4°C	14 days until TCLP ext'n; 7 days until extraction; 40 days after extraction

a For EPA SW-846 methods the method number is listed generically, without specific revision suffixes.
b DW = Drinking Water, W = Water; S = Soil or Sediment; HW = Hazardous Waste
c P = Polyethylene; G = Glass
d For chlorinated water samples
e The maximum holding time is dependent upon the geographical proximity of sample source to the laboratory.
f Fourteen days until extraction for soil, sediment, and sludge samples.
g If the water sample contains residual chlorine, 10% sodium thiosulfate is used to dechlorinate.

Figure 8-1
Chain of Custody Form

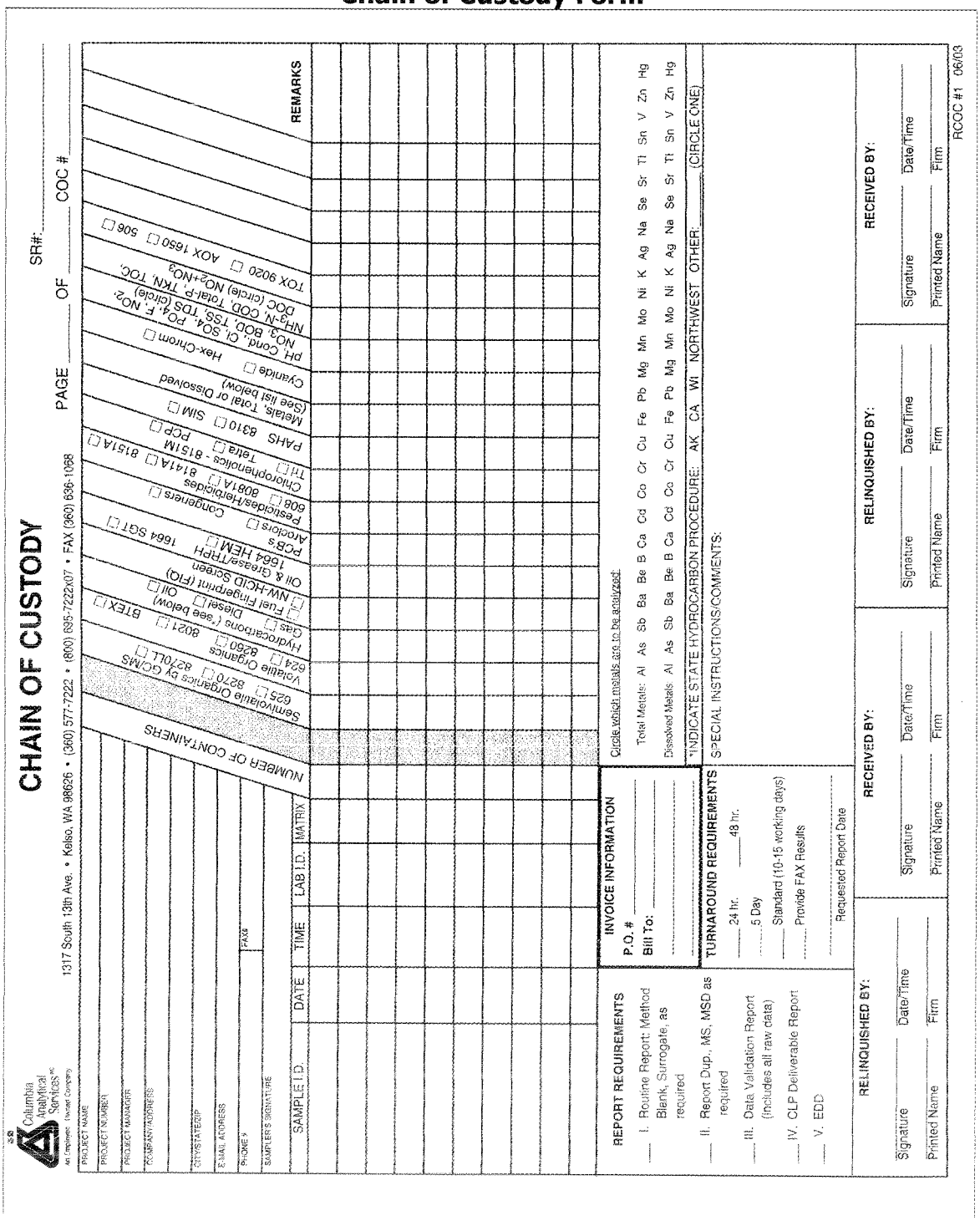


Figure 8-2

Columbia Analytical Services, Inc. PC_____
Cooler Receipt and Preservation Form

Client / Project:_____ Service Request *K09*_____

Received:_____ Opened:_____ By:_____

1. Samples were received via? *US Mail* *Fed Ex* *UPS* *DHL* *GH* *GS* *PDX* *Courier* *Hand Delivered*
2. Samples were received in: (circle) *Cooler* *Box* *Envelope* *Other*_____ *NA*
3. Were custody seals on coolers? NA Y N If yes, how many and where?_____
   If present, were custody seals intact? Y N If present, were they signed and dated? Y N
4. Is shipper's air-bill filed? If not, record air-bill number:_____ NA Y N

5. **Temperature of cooler(s) upon receipt (°C):** _____ _____ _____ _____
   Temperature Blank (°C): _____ _____ _____ _____
   Thermometer ID: _____ _____ _____ _____
6. If applicable, list Chain of Custody Numbers: _____ _____ _____ _____
7. Packing material used. *Inserts* *Baggies* *Bubble Wrap* *Gel Packs* *Wet Ice* *Sleeves* *Other*_____
8. Were custody papers properly filled out (ink, signed, etc.)? NA Y N
9. **Did all bottles arrive in good condition (unbroken)?** *Indicate in the table below.* NA Y N
10. Were all sample labels complete (i.e analysis, preservation, etc.)? NA Y N
11. Did all sample labels and tags agree with custody papers? *Indicate in the table below* NA Y N
12. **Were appropriate bottles/containers and volumes received for the tests indicated?** NA Y N
13. Were the pH-preserved bottles tested* received at the appropriate pH? *Indicate in the table below* NA Y N
14. Were VOA vials and 1631 Mercury bottles received without headspace? *Indicate in the table below.* NA Y N
15. **Are CWA Microbiology samples received with >1/2 the 24hr. hold time remaining from collection?** NA Y N
16. Was C12/Res negative? NA Y N

Sample ID on Bottle	Sample ID on COC	Sample ID on Bottle	Sample ID on COC

Sample ID	Bottle Count	Bottle Type	Out of Temp	Head-space	Broken	pH	Reagent	Volume added	Reagent Lot Number	Initials

*Does not include all pH preserved sample aliquots received. See sample receiving SOP (SMO-GEN).

*Additional Notes, Discrepancies, & Resolutions:*_____

Page 1 of: 1 2

Figure 8-3
Tier V Form

Client :

Project Chemist :

Project Name :

Service Request :

Project Number :

SMO LimsTemplate ID :

Project Description :

QAPP/SOW Information :

Reporting

Tier Level :

PDF:

Report to :

In result field use :

EDD :

Flagging Requirements :

Other Requirements :

Sample Considerations

Sample Limitations :

Sample Prep/Analysis :

Non-Standard Holdtimes :

Historical Data :

Comments :

9.0 ANALYTICAL PROCEDURES

CAS employs methods and analytical procedures from a variety of sources. The primary method references are: USEPA SW-846, Third Edition and Updates I, II, IIA, IIB, III, IVA, IVB, and online updates for hazardous waste samples, and USEPA 600/4-79-020, 600/4-91-010, 600/4-82-057, 600/R-93/100, 600/4-88-039, 600/R-94-111, and Supplements; and *Standard Methods for the Examination of Water and Wastewater* for water and wastewater samples. Complete citations for these references can be found in Section 18.0. Other published procedures, such as state-specific methods, program-specific methods (such as Puget Sound Protocols), or in-house methods may be used. Several factors are involved with the selection of analytical methods to be used in the laboratory. These include the method detection limit, the concentration of the analyte being measured, method selectivity, accuracy and precision of the method, the type of sample being analyzed, and the regulatory compliance objectives. The implementation of methods by CAS is described in SOPs specific to each method. A list of NELAP-accredited methods are given in Appendix E. Further details are described below.

9.1 Standard Operating Procedures (SOPs) and Laboratory Notebooks.

CAS maintains SOPs for use in both technical and administrative functions. SOPs are written following standardized format and content requirements. Each SOP is reviewed and approved by a minimum of two managers (the Laboratory Director and/or Department Manager and the Quality Assurance Manager). All SOPs undergo a documented annual review to make sure current practices are described. The QA Manager maintains a comprehensive list of current SOPs. The document control process ensures that only the most currently prepared version of an SOP is being used. The QA Manual, QAPPs, SOPs, standards preparation logbooks, maintenance logbooks, et al., are controlled documents. The procedures for document control are described in the *SOP for Document Control* (ADM-DOC_CTRL). In addition to SOPs, each laboratory department maintains a current file, accessible to all laboratory staff, of the current methodology used to perform analyses. Laboratory notebook entries are standardized following the guidelines in the *SOP for Making Entries into Logbooks and onto Benchsheets* (ADM-DATANTRY). Entries made into laboratory notebooks are reviewed and approved by the appropriate supervisor at a regular interval.

9.2 Deviation from Standard Operating Procedures

When a customer requests a modification to an SOP (such as a change in reporting limit, addition or deletion of target analyte(s), etc.), the project chemist handling that project must discuss the proposed deviation with the department manager in charge of the analysis and obtain their approval to accept the project. The project chemist is responsible for documenting the approved or allowed deviation from the SOP by placing a detailed description of the deviation attached to the quotation or in the project file and also providing an appropriate comment on the service request when the samples are received.

For circumstances when a deviation or departure from company policies or procedures involving any non-technical function is found necessary, approval must be obtained from the appropriate supervisor, manager, the laboratory director, or other level of authority. Frequent departure from policy is not encouraged. However, if frequent departure from any policy is noted, the laboratory director will address the possible need for a change in policy.

9.3 Modified Procedures

CAS strives to perform published methods as described in the referenced documents. If there is a material deviation from the published method, the method is cited as a "Modified" method in the analytical report. Modifications to the published methods are listed in the standard operating procedure. Standard operating procedures are available to analysts and are also available to our clients for review, especially those for "Modified" methods. Client approval is obtained for the use of "Modified" methods prior to the performance of the analysis.

9.4 Analytical Batch

The basic unit for analytical quality control is the analytical batch. The definition that CAS has adopted for the analytical batch is listed below. The overriding principle for describing an analytical batch is that all the samples in a batch, both field samples and quality control samples, are to be handled exactly the same way, and all of the data from each analysis is to be manipulated in exactly the same manner. The minimum requirements of an analytical batch are:

1) The number of (field) samples in a batch is not to exceed 20.

2) All (field) samples in a batch are of the same matrix.

3) The QC samples to be processed with the (field) samples include:

   a) Method Blank (a.k.a. Laboratory Reagent Blank)

      Function: Determination of laboratory contamination.

   b) Laboratory Control Sample (a.k.a. Laboratory Fortified Blank)

      Function: Assessment of method performance

   c) Matrix Spiked (field) Sample (a.k.a. Laboratory Fortified Sample Matrix)*

      Function: Assessment of matrix bias

   d) Duplicate Matrix Spiked (field) Sample or Duplicate (field) Sample (a.k.a. Laboratory Duplicate)*

      Function: Assessment of batch precision

   * A sample identified as a field blank, an equipment blank, or a trip blank is not to be matrix spiked or duplicated.

4) A single lot of reagents is used to process the batch of samples.

5) Each operation within the analysis is performed by a single analyst, technician, chemist, or by a team of analysts/technicians/chemists.

6) Samples are analyzed in a continuous manner over a timeframe not to exceed 24-hours.

7) (Field) samples are assigned to batches commencing at the time that sample processing begins. For example: for analysis of metals, sample processing begins when the samples are digested. For analysis of organic constituents, it begins when the samples are extracted.

8) The QC samples are to be analyzed in conjunction with the associated field samples prepared with them. However, for tests which have a separate sample preparation step that defines a batch (digestion, extraction, etc.), the QC samples in the batch do not require analysis each time a field sample within the preparation batch is analyzed (multiple instrument sequences to analyze all field samples in the batch need not include re-analyses of the QC samples).

9) The batch is to be assigned a unique identification number that can be used to correlate the QC samples with the field samples.

10) Batch QC refers to the QC samples that are analyzed in a batch of (field) samples.

11) Project-specific requirements may be exceptions. If project, program, or method requirements are more stringent than these laboratory minimum requirements, then the project, program, or method requirements will take precedence. However, if the project, program, or method requirements are less stringent than these laboratory minimum requirements, these laboratory minimum requirements will take precedence.

9.5 Specialized Procedures

CAS not only strives to provide results that are scientifically sound, legally defensible, and of known and documented quality; but also strives to provide the best solution to analytical challenges. Procedures using specialized instrumentation and methodology have been developed to improve sensitivity (provide lower detection limits), selectivity (minimize interferences while maintaining sensitivity), and overall data quality for low concentration applications. Examples are trace-level Mercury and methylmercury analyses, reductive precipitation metals analysis, specialized GC/MS analyses, LC/MS analyses, and ultra-low level organics analyses (including PAHs, pesticides and PCBs).

9.6 Sample Cleanup

CAS commonly employs several cleanup procedures to minimize known common interferences prior to analysis. EPA methods(3620, 3630, 3640, 3660, 3665) for cleanup of sample extracts for organics analysis are routinely used to minimize or eliminate interferences that may adversely affect sample results and data usability.

10.0 CALIBRATION PROCEDURES AND FREQUENCY

All equipment and instruments used at CAS are operated, maintained and calibrated according to the manufacturer's guidelines and recommendations, as well as to criteria set forth in the applicable analytical methodology. Operation and calibration are performed by personnel who have been properly trained in these procedures. Documentation of calibration information is maintained in appropriate reference files. Brief descriptions of the calibration procedures for our major laboratory equipment and instruments are described below. Calibration verification is performed according to the applicable analytical methodology. Calibration verification procedures and criteria are listed in laboratory Standard Operating Procedures. Documentation of calibration verification is maintained in appropriate reference files.
Records are maintained to provide traceability of reference materials.

Equipment which has been subjected to overloading or mishandling, or has been shown by verification or otherwise to be defective; is taken out of service until it has been repaired. The equipment is placed back in service only after verifying by calibration that the equipment performs satisfactorily. An evaluation of the effect of this defect on previous calibrations or tests is made and documented appropriately.

10.1 Temperature Control Devices

Temperatures are monitored and recorded for all of the temperature-regulating support equipment such as sample refrigerators, freezers, and standards refrigerators. Bound record books are kept which contain daily-recorded temperatures, identification and location of equipment, acceptance criteria and the initials of the technician who performed the checks. The procedure for performing these measurements is provided in the *SOP for Support Equipment Monitoring and Calibration (SOP ADM-SEMC).* The SOP also includes the use of acceptance criteria and correction factors.

Where the operating temperature is specified as a test condition (such as ovens, incubators, evaporators) the temperature is recorded on the raw data. All thermometers are identified according to serial number, and the calibration of these thermometers is checked annually against a National Institute of Standards and Technology (NIST) certified thermometer. The NIST thermometer is recertified by a professional metrology organization on an annual basis.

10.2 Analytical Balances

The calibration of each analytical balance is checked by the user each day of use with three Class S or S-1 weights, which assess the accuracy of the balance at low, mid-level and high levels bracketing the working range. Records are kept which contain the recorded measurements, identification of the balance, acceptance criteria, and the initials of user who performed the check. The procedure for performing these measurements and use of acceptance criteria is described in the SOP ADM-SEMC. The weights are recertified using NIST traceable standards by a professional metrology organization on an annual basis.

As needed, the balances are recalibrated using the manufacturers recommended operating procedures. Analytical balances are serviced on a semi-annual basis by a professional metrology organization. New certificates of calibration for each balance are issued to the laboratory on a semi-annual basis.

10.3 Water Purification Systems

CAS uses two independent water purification systems is designed to produce deionized water meeting method specifications. One system consists of a series of pumps, filters, and resin beds designed to yield deionized water meeting the specifications of ASTM Type II water, and *Standard Methods for the Examination of Water and Wastewater* (SM1080, 20th Ed.) *High Quality* water. Activated carbon filters are also in series with the demineralizers to produce "organic-free" water. A second system consists of pumps, filters, and treatment components designed to yield deionized water meeting the specifications of ASTM Type I water, and *Standard Methods for the Examination of Water and Wastewater* (SM1080, 20th Ed.) *High Quality* water. Following a written SOP, the status of each system is monitored continuously for conductivity and resistivity with an on-line meter and indicator light, and readings recorded daily in a bound record book. The meter accuracy is verified annually. Deionizers are rotated and replaced on a regular schedule. Microbiology water is checked at a point downstream of the purification system at a tap in the laboratory, and monitoring documented.

10.4 Source and Preparation of Standard Reference Materials

All analytical measurements generated at CAS are performed using materials and/or processes that are traceable to a reference material. Metrology equipment (analytical balances, thermometers, etc.) is calibrated using reference materials traceable to the National Institute of Standards and Technology (NIST). These primary reference materials are themselves recertified on an annual basis. All sampling containers provided to the client by the laboratory are purchased as precleaned (Level 1) containers, with certificates of analysis available for each bottle type. This information is provided to the client when requested.

Consumable reference materials routinely purchased by the laboratories (e.g., analytical standards) are purchased from nationally recognized, reputable vendors. All vendors have fulfilled the requirements for ISO 9001 certification and/or are accredited by A_2LA. CAS relies on a primary vendor for the majority of its analytical supplies. Consumable primary stock standards are obtained from certified commercial sources or from sources referenced in a specific method. Supelco, Ultra Scientific, AccuStandard, Chem Services, Inc., Aldrich Chemical Co., Baker, Spex, etc. are examples of the vendors used. Reference material information is recorded in the appropriate logbook(s) and materials are stored under conditions that provide maximum protection against deterioration and contamination. The logbook entry includes such information as an assigned logbook identification code, the source of the material (i.e. vendor identification), solvent (if applicable) and concentration of analyte(s), reference to the certificate of analysis and an assigned expiration date. The date that the standard is received in the laboratory is marked on the container. When the reference material is used for the first time, the date of usage and the initials of the analyst are also recorded on the container.

Stock solutions and calibration standard solutions are prepared fresh as often as necessary according to their stability. All standard solutions are properly labeled as to analyte concentration, solvent, date, preparer, and expiration date; these entries are also recorded in the appropriate notebook(s) following the *SOP for Making Entries into Logbooks and onto Benchsheets* (SOP No. ADM-DATANTRY). Prior to sample analysis, all calibration reference materials are verified with a second, independent source of the material (see section 11.3.5).

10.5 Inductively Coupled Plasma-Atomic Emission Spectrograph (ICP-AES)

Each emission line on the ICP is calibrated daily against a blank and against standards. Analyses of calibration standards, initial and continuing calibration verification standards, and inter-element interference check samples are carried out as specified in the applicable method SOP and analytical method (i.e. EPA 200.7, 6010B, 6010C, CLP SOW, etc.).

10.6 Inductively Coupled Plasma-Mass Spectrometer (ICP-MS)

Each element of interest is calibrated for using a blank and a single standard. Prior to calibration, a short-term stability check is performed on the system. Following calibration, an independent check standard is analyzed, and a continuing calibration verification standard (CCV) is analyzed with every ten samples.

10.7 Atomic Absorption Spectrophotometers (AAS)

These instruments are calibrated daily using a minimum of four standards and a blank. Calibration is validated using reference standards, and is verified at a minimum frequency of once every ten samples. Initial calibration points cannot be "dropped" from the resulting calibration curve.

10.8 GC/MS Systems

All GC/MS instruments are calibrated at a minimum of five different concentration levels for the analytes of interest (unless specified otherwise) using procedures outlined in Standard Operating Procedures and/or appropriate USEPA method citations. All reference materials used for this function are vendor-certified standards. Calibration verification is performed at method-specified intervals following the procedures in the SOP and reference method. Compounds selected as system performance check compounds (SPCCs) must show a method-specified response factor in order for the calibration to be considered valid. Calibration check compounds (CCCs) must also meet method specifications for percent difference from the multipoint calibration. For isotope dilution procedures, the internal standard response(s) and labeled compound recovery must meet method criteria. Method-specific instrument tuning is regularly checked using bromofluorobenzene (BFB) for volatile organic chemical (VOC) analysis, or decafluorotriphenylphosphine (DFTPP) for semi-volatile analysis. Mass spectral peaks for the tuning compounds must conform both in mass numbers and in relative intensity criteria before analyses can proceed. Calibration policies for organics chromatographic analyses are described in the *SOP for Calibration of Instruments for Organics Chromatographic Analyses (SOP SOC-CAL).*

10.9 Gas Chromatographs and High Performance Liquid Chromatographs

Calibration and standardization follow SOP guidelines and/or appropriate USEPA method citations. All GC and HPLC instruments are calibrated at a minimum of five different concentration levels for the analytes of interest (unless specified otherwise). The lowest standard is equivalent to the method reporting limit; additional standards define the working range of the GC or LC detector. Results are used to establish response factors (or calibration curves) and retention-time windows for each analyte. Calibration is verified at a minimum frequency of once every ten samples, unless otherwise specified by the reference method. *SOP for Calibration of Instruments for Organics Chromatographic Analyses (SOP SOC-CAL).*

10.10 LC/MS Systems

Calibration and tuning procedures are included in analytical SOPs written specifically for these tests. In general, multiple concentration levels for the analytes of interest are used to generate calibration curves. All reference materials used for this function are vendor-certified standards. Calibration and tuning verification is performed at SOP-defined intervals. Any other system performance checks are described in the applicable SOP. Calibration policies for organics chromatographic analyses are described in the *SOP for Calibration of Instruments for Organics Chromatographic Analyses (SOP SOC-CAL).*

10.11 UV-Visible Spectrophotometer (manual colorimetric analyses)

Routine calibrations for colorimetric and turbidimetric analyses involve generating a 5-point calibration curve including a blank. Initial calibration points cannot be "dropped" from the resulting calibration curve. Correlation coefficients must meet method or SOP specifications before analysis can proceed. Independent calibration verification standards (ICVs) are analyzed with each batch of samples. Continuing calibration is verified at a minimum frequency of once every ten samples. Typical UV-Visible spectrophotometric methods at CAS include total phenolics, phosphates, surfactants and tannin-lignin.

10.12 Flow Injection Analyzer (automated colorimetric analysis)

A minimum of six standards and a blank are used to calibrate the instrument for cyanide analysis. A blank and (minimum of) five standards are used to calibrate the instrument for all other automated chemistries. Initial calibration points cannot be "dropped" from the resulting calibration curve. Standard CAS acceptance limits are used to evaluate the calibration curve prior to sample analysis.

10.13 Ion Chromatographs

Calibration of the ion chromatograph (IC) involves generating a calibration curve with the method-specified number of points (or more). Initial calibration points cannot be "dropped" from the resulting calibration curve. A correlation coefficient of $\geq$ 0.995 for the curve is required before analysis can proceed. Quality Control (QC) samples that are routinely analyzed include blanks and laboratory control samples. The target analytes typically determined by the IC include nitrate, nitrite, chloride, fluoride, sulfate and drinking water inorganic disinfection byproducts. Calibration verification is performed at method-specified intervals following the procedures in the SOP and reference method.

10.14 Turbidimeter

Calibration of the turbidimeter requires analysis of three Nephelometric Turbidity Unit (NTU) formazin standards. Quality Control samples that are routinely analyzed include blanks, Analytical Products Group® QC samples (or equivalent) and duplicates.

10.15 Ion-selective electrode

The method-prescribed numbers of standards are used to calibrate the electrodes before analysis. The slope of the curve must be within acceptance limits before analysis can proceed. Quality Control samples that are routinely analyzed include blanks, LCSs and duplicates.

10.16 Pipets

The calibration of pipets and autopipettors used to make critical-volume measurements is verified following the *SOP for Checking Pipet Calibration*. Both accuracy and precision verifications are performed, at intervals applicable to the pipet and use. The results of all calibration verifications are recorded in bound logbooks.

10.17 Other Instruments

Calibration for the total organic carbon (TOC), total organic halogen (TOX), and other instruments is performed following manufacturer's recommendations and applicable SOPs.

11.0 QUALITY CONTROL

A primary focus of Columbia Analytical Services Quality Assurance (QA) Program is to ensure the accuracy, precision and comparability of all analytical results. Prior to using a procedure for the analysis of field samples, acceptable method performance is established by performing demonstration of capability analyses and performance characteristics are established by performing method detection limit studies and assessing accuracy and precision according to the reference method. CAS has established Quality Control (QC) objectives for precision and accuracy that are used to determine the acceptability of the data that is generated. These QC limits are either specified in the methodology or are statistically derived based on the laboratory's actual historical data obtained from the various QC measurements for each analytical method. The Quality Control objectives are defined below.

11.1 Quality Control Objectives

11.1.2 Demonstration of Capability - Where required by mandatory test method, regulation, or accreditation protocols, a demonstration of capability (DOC) is made prior to using any test method. This demonstration is made following regulatory, accreditation, or method specified procedures. In general, this demonstration does not test the performance of the method in real world samples, but in the applicable clean matrix free of target analytes and interferences.

A quality control reference material or quality control sample is obtained. The analyte(s) is (are) diluted in a volume of clean matrix (for analytes which do not lend themselves to spiking, e.g., TSS, the demonstration of capability may be performed using quality control samples). Where specified, the method-required concentration levels are used. Four aliquots are prepared and analyzed according to the test procedure. The mean recovery and standard deviations are calculated and compared to the corresponding acceptance criteria for precision and accuracy in the test method or laboratory-generated acceptance criteria (if there are not established mandatory criteria). All parameters must meet the acceptance criteria. Where spike levels are not specified, actual Laboratory Control Sample results or MDL study results may be used to meet this requirement, provided acceptance criteria is met.

11.1.3 Accuracy - Accuracy is a measure of the closeness of an individual measurement (or an average of multiple measurements) to the true or expected value. Accuracy is determined by calculating the mean value of results from ongoing analyses of laboratory-fortified blanks, standard reference materials, and standard solutions. In addition, laboratory-fortified (i.e. matrix-spiked) samples are also measured; this indicates the accuracy or bias in the actual sample matrix. Accuracy is expressed as percent recovery (% REC.) of the measured value, relative to the true or expected value. If a measurement process produces results whose mean is not the true or expected value, the process is said to be biased. Bias is the systematic error either inherent in a method of analysis (e.g., extraction efficiencies) or

caused by an artifact of the measurement system (e.g., contamination). CAS utilizes several quality control measures to eliminate analytical bias, including systematic analysis of method blanks, laboratory control samples and independent calibration verification standards. Because bias can be positive or negative, and because several types of bias can occur simultaneously, only the net, or total, bias can be evaluated in a measurement

11.1.4 Precision - Precision is the ability of an analytical method or instrument to reproduce its own measurement. It is a measure of the variability, or random error, in sampling, sample handling and in laboratory analysis. The American Society of Testing and Materials (ASTM) recognizes two levels of precision: repeatability - the random error associated with measurements made by a single test operator on identical aliquots of test material in a given laboratory, with the same apparatus, under constant operating conditions, and reproducibility - the random error associated with measurements made by different test operators, in different laboratories, using the same method but different equipment to analyze identical samples of test material.

"Within-batch" precision is measured using replicate sample or QC analyses and is expressed as the relative percent difference (RPD) between the measurements. The "batch-to-batch" precision is determined from the variance observed in the analysis of standard solutions or laboratory control samples from multiple analytical batches.

11.1.5 Control Limits - The control limits for accuracy and precision originate from two different sources: For analyses having enough QC data, control limits are calculated at the 99% confidence limits. For analyses not having enough QC data, or where the method is prescriptive, control limits are taken from the method on which the procedure is based. If the method does not have stated control limits, then control limits are assigned method-default or reasonable values. Control limits are updated periodically when new statistical limits are generated for the appropriate surrogate, laboratory control sample, and matrix spike compounds (typically once a year) or when method prescribed limits change. The updated limits are reviewed by the Quality Assurance Manager. The new control limits replace the previous limits and data is assessed using the new values. The current acceptance limits for accuracy and precision are available from the laboratory and on the accompanying CD-ROM. For inorganics, the precision limit values listed are for laboratory duplicates. For organics, the precision limit values listed are for duplicate laboratory control samples or duplicate matrix spike analyses.

11.1.6 Representativeness - Representativeness is the degree to which the field sample, being properly preserved, free of contamination, and analyzed within holding time, represents the overall sample site or material. This can be extended to the sample itself, in that representativeness is the degree to which the subsample that is analyzed represents the entire field sample submitted for analysis. CAS has sample handling procedures to ensure that the sample used for analysis is representative of the entire sample. These include the *SOP for Subsampling and Compositing of Samples* and the *SOP for Tissue Sample Preparation*. Further, analytical SOPs specify appropriate sample handling and sample sizes to further ensure the sample aliquot that is analyzed is representative in entire sample.

11.1.7 Comparability – Comparability expresses the confidence with which one data set can be compared to another and is directly affected by data quality (accuracy and precision) and sample handling (sampling, preservation, etc). Only data of known quality can be compared. The objective is to generate data of known quality with the highest level of comparability, completeness, and usability. This is achieved by employing the quality controls listed below and standard operating procedures for the handling and analysis of all samples. Data is reported in units specified by the client and using CAS or project-specified data qualifiers.

11.2 Method Detection Limits and Method Reporting Limits

Method Detection Limits (MDL) for methods performed at CAS/Kelso are determined annually, and may change slightly from year to year. If and MDL study is not performed annually, an MDL verification chedk is performed quarterly on every instrument used in the analysis. The MDLs are determined by following the *SOP for the Determination of Method Detection Limits and Limits of Detection,* which is based on the procedure in 40 CFR Part 136, Appendix B. As required by NELAP and DoD protocols, the validity of MDLs is verified using MDL verification samples. The Method Reporting Limit (MRL) is the lowest amount of an analyte in a sample that can be quantitatively determined with stated, acceptable precision and accuracy under stated analytical conditions (i.e. the lower limit of quantitation). Therefore, analyses are calibrated to the MRL, or lower. To take into account day-to-day fluctuations in instrument sensitivity, analyst performance, and other factors, the MRL is established at three times the MDL (or greater). The current MDLs and MRLs are available from the laboratory.

11.3 Quality Control Procedures

The specific types, frequencies, and processes for quality control sample analysis are described in detail in method-specific standard operating procedures and listed below. These sample types and frequencies have been adopted for each method and a definition of each type of QC sample is provided below. In addition, a number of other quality control processes that may impact analytical results are also described below.

11.3.1 Method Blank (a.k.a. Laboratory Reagent Blank)

The method blank is an analyte-free matrix (water, soil, etc.) subjected to the entire analytical process. When analyte-free soil is not available, anhydrous sodium sulfate, organic-free sand, or an acceptable substitute is used. The method blank is analyzed to demonstrate that the analytical system itself does not introduce contamination. The method blank results should be below the Method Reporting Limit (MRL) or, if required for DoD projects, < ½ MRL for the analyte(s) being tested. Otherwise, corrective action must be taken. A method blank is included with the analysis of every sample preparation batch, every 20 samples, or as stated in the method, whichever is more frequent.

11.3.2 Calibration Blanks

For some methods, calibration blanks are prepared along with calibration standards in order to create a calibration curve. Calibration blanks are free of the analyte of interest and, where applicable, provide the zero point of the calibration curve. Additional project-specific requirements may also apply to calibration blanks.

11.3.3 Continuing Calibration Blanks

Continuing calibration blanks (CCBs) are solutions of either analyte-free water, reagent, or solvent that are analyzed in order to verify the system is contamination-free when CCV standards are analyzed. The frequency of CCB analysis is either once every ten samples or as indicated in the method, whichever is greater. Additional project-specific requirements may also apply to continuing calibration blanks.

11.3.4 Calibration Standards

Calibration standards are solutions of known concentration prepared from primary standard or stock standard materials. Calibration standards are used to calibrate the instrument response with respect to analyte concentration. Standards are analyzed in accordance with the requirements stated in the particular method being used.

11.3.5 Initial (or Independent) Calibration Verification Standards

Initial (or independent) calibration verification standards (ICVs) are standards that are analyzed *after* calibration with newly prepared standard(s) but *prior to* sample analysis, in order to verify the validity and accuracy of the standards used in the calibration. Once it is determined that there is no reference material defect or systematic error in preparation of the calibration standard(s), standards are considered valid and may be used for subsequent calibrations and quantitative determinations (as expiration dates and methods allow). The ICV standards are prepared from materials obtained from a source independent of that used for preparing the calibration standards ("second-source"). ICVs are also analyzed in accordance with method-specific requirements.

11.3.6 Continuing Calibration Verification Standards

Continuing calibration verification standards (CCVs) are midrange standards that are analyzed in order to verify that the calibration of the analytical system is still acceptable. The frequency of CCV analysis is either once every ten samples, or as indicated in the method.

11.3.7 Internal Standards

Internal standards are known amounts of specific compounds that are added to each sample prior to instrument analysis. Internal standards are generally used for GC/MS and ICP-MS procedures to correct sample results that have been affected by changes in instrument conditions or changes caused by matrix effects. The requirements for evaluation of internal standards are specified in each method and SOP.

11.3.8 Surrogates

Surrogates are organic compounds which are similar in chemical composition and chromatographic behavior to the analytes of interest, but which are not normally found in environmental samples. Depending on the analytical method, one or more of these compounds is added to method blanks, calibration and check standards, and samples (including duplicates, matrix spike samples, duplicate matrix spike samples and laboratory control samples) prior to extraction and analysis in order to monitor the method performance on each sample. The percent recovery is calculated for each surrogate, and the recovery is a measurement of the overall method performance.

$$Recovery\ (\%) = (M/T) \times 100$$

Where: M = The measured concentration of analyte,
T = The theoretical concentration of analyte added.

11.3.9 Laboratory Control Samples (a.k.a. Laboratory Fortified Blanks)

The laboratory control sample (LCS) is an aliquot of analyte-free water or analyte-free solid (or anhydrous sodium sulfate or equivalent) to which known amounts of the method analyte(s) is (are) added. A reference material of known matrix type, containing certified amounts of target analytes, may also be used as an LCS. An LCS is prepared and analyzed at a minimum frequency of one LCS per 20 samples, with every analytical batch or as stated in the method, whichever is more frequent. The LCS sample is prepared and analyzed in exactly the same manner as the field samples.

The percent recovery of the target analytes in the LCS is compared to established control limits and assists in determining whether the methodology is in control and whether the laboratory is capable of making accurate and precise measurements at the required reporting limit. Comparison of batch-to-batch LCS analyses enables the laboratory to evaluate batch-to-batch precision and accuracy.

$$Recovery\ (\%) = (M/T) \times 100$$

Where: M = The measured concentration of analyte,
T = The theoretical concentration of analyte added.

11.3.10 Matrix Spikes (a.k.a. Laboratory Fortified Sample Matrix)

Matrix spiked samples are aliquots of samples to which a known amount of the target analyte (or analytes) is(are) added. The samples are then prepared and analyzed in the same analytical batch, and in exactly the same manner as are routine samples. For the appropriate methods, matrix spiked samples are prepared and analyzed and at a minimum frequency of one spiked sample (and one duplicate spiked sample, if appropriate) per twenty samples. The spike recovery measures the effects of interferences caused by the sample matrix and reflects the accuracy of the method for the particular matrix in question. Spike recoveries are calculated as follows:

$$Recovery\ (\%) = (S - A) \times 100 \div T$$

Where: S = The observed concentration of analyte in the spiked sample,
A = The analyte concentration in the original sample, and
T = The theoretical concentration of analyte added to the spiked sample.

11.3.11 Laboratory Duplicates and Duplicate Matrix Spikes

Duplicates are additional replicates of samples that are subjected to the same preparation and analytical scheme as the original sample. Depending on the method of analysis, either a duplicate analysis (and/or a matrix spiked sample) or a matrix spiked sample and duplicate matrix spiked sample (MS/DMS) are analyzed. The relative percent difference between duplicate analyses or between an MS and DMS is a measure of the precision for a given method and analytical batch. The relative percent difference (RPD) for these analyses is calculated as follows:

$$Relative\ Percent\ Difference\ (RPD) = (S1 - S2) \times 100 \div S_{ave}$$

Where S1 and S2 = The observed concentrations of analyte in the sample and its duplicate, or in the matrix spike and its duplicate matrix spike, and

S_{ave} = The average of observed analyte concentrations in the sample and its duplicate, or in the matrix spike and its duplicate matrix spike.

Depending on the method of analysis, either duplicates (and/or matrix spikes) or MS/DMS analyses are performed at a minimum frequency of one set per 20 samples. If an insufficient quantity of sample is available to perform a laboratory duplicate or duplicate matrix spikes, duplicate LCSs will be prepared and analyzed.

11.3.12 Interference Check Samples

An interference check sample (ICS) is a solution containing both interfering and analyte elements of known concentration that can be analyzed to verify background and interelement correction factors in metals analyses. The ICS is prepared to contain known concentrations (method or program specific) of elements that will provide an adequate test of the correction factors. The ICS is analyzed at the beginning and end of an analytical run or at a method-specified frequency. Results must meet method criteria and any project-specific criteria.

11.3.13 Post Digestion Spikes

Post digestion spikes are samples prepared for metals analyses that have an analyte spike added to determine if matrix effects may be a factor in the results. The spike addition should produce a method-specified minimum concentration above the method reporting limit. A post digestion spike is analyzed with each batch of samples and recovery criteria are specified for each method.

11.3.14 Control Charting

The generation of control charts is routinely performed at CAS. Surrogate, Matrix Spike and LCS recoveries are all monitored and charted. In addition, the laboratory also monitors the Relative Percent Difference (RPD) measurement of precision. Control charts are available to each individual laboratory unit to monitor the data generated in its facility using control charts that have been programmed to identify various trends in the analytical results. If trends in the data are perceived, various means of corrective action may then be employed in order to prevent future problems with the analytical system(s). Finally, data quality reports using control charts are generated for specific clients and projects pursuant to contract requirements. The control charting procedure is described in the SOP for *Control Charting Quality Control Data* (ADM-CHRT).

11.3.15 Glassware Washing

Glassware washing and maintenance play a crucial role in the daily operation of a laboratory. The glassware used at CAS undergoes a rigorous cleansing procedure prior to every usage. A number of SOPs have been generated that outline the various procedures used at CAS; each is specific to the end-use of the equipment as well as to the overall analytical requirements of the project. In addition, other equipment that may be routinely used at the laboratory is also cleaned following instructions in the appropriate SOP.

12.0 DATA REDUCTION, VALIDATION, AND REPORTING

CAS reports the analytical data produced in its laboratories to the client via the certified analytical report (CAR). This report includes a transmittal letter, a case narrative, client project information, specific test results, quality control data, chain of custody information, and any other project-specific support documentation. The following procedures describe our data reduction, validation and reporting procedures.

12.1 Data Reduction and Review

Results are generated by the analyst who performs the analysis and works up the data. All data is initially reviewed and processed by analysts using appropriate methods (e.g., chromatographic software, instrument printouts, hand calculation, etc.). Equations used for calculation of results are found in the applicable analytical SOPs. The resulting data set is either manually entered (e.g., titrimetric or microbiological data) into an electronic report form or is electronically transferred into the report from the software used to process the original data set (e.g., chromatographic software). Once the complete data set has been transferred into the proper electronic report form(s), it is then printed. The resulting hardcopy version of the electronic report is then reviewed by the analyst for accuracy. Once the primary analyst has checked the data for accuracy and acceptability, the hardcopy is forwarded to the supervisor or second qualified analyst, who reviews the data for errors. Where calculations are not performed using a validated software system, the reviewer rechecks a minimum of 10% of the calculations. When the entire data set has been found to be acceptable, a final copy of the report is printed and signed by the laboratory supervisor, departmental manager or designated laboratory staff. The entire data package is then placed into the appropriate service request file, and an electronic copy of the final data package is forwarded to the appropriate personnel for archival. Data review procedures are described in the *SOP for Laboratory Data Review Process.*

Policies and procedures for manual editing of data are established. The analyst making the change must initial and date the edited data entry, without obliteration of the original entry. The policies and procedures are described in the *SOP for Making Entries into Logbooks and onto Benchsheets* (SOP ADM-DATANTRY).

Policies and procedures for electronic manual integration of chromatographic data are established. The analyst performing the integration must document the integration change by printing both the "before" and "after" integrations and including them in the raw data records. The policies and procedures are described in the *SOP for Manual Integration of Chromatographic Peaks* (SOP ADM-INT).

12.2 Confirmation Analysis

12.2.1 Gas Chromatographic and Liquid Chromatographic Analyses

For gas chromatographic (GC) and liquid chromatographic (LC) analyses, all positive results are confirmed by a second column, a second detector, a second wavelength (HPLC/UV), or by GC/MS analysis, unless exempted by one of the following situations:

- The analyte of interest produces a chromatogram containing multiple peaks exhibiting a characteristic pattern, which matches appropriate standards. This is limited to petroleum hydrocarbon analyses (e.g., gasoline and diesel) and does not include polychlorinated biphenyls.

- The sample meets all of the following requirements:

    1. All samples (liquid or solid) come from the same source (e.g., groundwater samples from the same well) for continuous monitoring. Samples of the same matrix from the same site, but from different sources (e.g., different sampling locations) are not exempt.

    2. All analytes have been previously analyzed in sample(s) from the same source (within the last year), identified and confirmed by a second column or by GC/MS. The chromatogram is largely unchanged from the one for which confirmation was carried out. The documents indicating previous confirmation must be available for review.

12.2.2 Confirmation Data

Confirmation data will be provided as specified in the method. Identification criteria for GC, LC or GC/MS methods are summarized below:

- GC and LC Methods

    1. The analyte must fall within plus or minus three times the standard deviation (established for the analyte/column) of the retention time of the daily midpoint standard in order to be qualitatively identified. The retention-time windows will be established and documented, as specified in the appropriate Standard Operating Procedure (SOP).

    2. When sample results are confirmed by two dissimilar columns or detectors, the agreement between quantitative results must be evaluated. The relative percent difference between the two results is calculated and evaluated against SOP and/or method criteria.

- GC/MS Methods - Two criteria are used to verify identification:

    1. Elution of the analyte in the sample will occur at the same relative retention time (RRT) as that of the analyte in the standard.

    2. The mass spectrum of the analyte in the sample must, in the opinion of a qualified analyst or the department manager, correspond to the spectrum of the analyte in the standard or the current GC/MS reference library.

12.3 Data Review and Validation

The integrity of the data generated is assessed through the evaluation of the sample results, calibrations, and QC samples (method blanks, laboratory control samples, sample duplicates, matrix spikes, trip blanks, etc.). A brief description of the evaluation of these analyses is described below, with details listed in applicable SOPs. The criteria for evaluation of QC samples are listed within each method-specific SOP. Other data evaluation measures may include (as necessary) a check of the accuracy check of the QC standards and a check of the system sensitivity. Data transcriptions and calculations are also reviewed.

Note: Within the scope of this document, all possible data assessment requirements for various project protocols cannot be included in the listing below. This listing gives a general description of data evaluation practices used in the laboratory in compliance with NELAP Quality Systems requirements. Additional requirements exist for certain programs, such as projects under the DoD QSM protocols, AFCEE QAPP protocols, and project-specific QAPPs.

- Method Calibration – Following the analysis of calibration blanks and standards according to the applicable SOP the calibration correlation coefficient, average response factor, etc. is calculated and compared to specified criteria. If the calibration meets criteria analysis may continue. If the calibration fails, any problems are isolated and corrected and the calibration standards reanalyzed. Following calibration and analysis of the independent calibration verification standard(s) the percent difference for the ICV is calculated. If the percent difference is within the specified limits the calibration is complete. If not, the problem associated with the calibration and/or ICV are isolated and corrected and verification and/or calibration is repeated.

- Continuing Calibration Verification (CCV) – Following the analysis of the CCV standard the percent difference is calculated and compared to specified criteria. If the CCV meets the criteria analysis may continue. If the CCV fails, routine corrective action is performed and documented and a 2nd CCV is analyzed. If this CCV meets criteria, analysis may continue, including any reanalysis of samples that were associated with a failing CCV. If the routine corrective action failed to produce an immediate CCV within criteria, then either acceptable performance is demonstrated (after additional corrective action) with two consecutive calibration verifications, or a new initial calibration is performed. For DoD projects, the concentration of these two consecutive must be varied as required by the DoD QSM, Version 3.

- Method Blank – Results for the method blank are calculated as performed for samples. If results are less than the MRL (<½ MRL for DoD projects), the blank may be reported. If not, associated sample results are evaluated to determine the impact of the blank result. If possible, the source of the contamination is determined. If the contamination has affected sample results the blank and samples are reanalyzed. If positive blank results are reported, the blank (and sample) results are flagged with an appropriate flag, qualifier, or footnote.

- Sample Results (Inorganic) – Following sample analysis and calculations (including any dilutions made due to the sample matrix) the result is verified to fall within the calibration range. If not, the sample is diluted and analyzed to bring the result into calibration range. When sample and sample duplicates are analyzed for precision, the calculated RPD is compared to the specified limits. The sample and duplicate are reanalyzed if the criteria are exceeded. The samples may require re-preparation and reanalysis. For metals, additional measures as described in the applicable SOP, may be taken to further evaluate results (dilution tests and/or post-digestion spikes). Results are reported when within the calibration range, or as estimates when outside the calibration range. When dilutions are performed the MRL is elevated accordingly and qualified. Efforts are made to meet the project MRL's including alternative analysis.

- Sample Results (Organic) – For GC/MS analyses, it is verified that the analysis was within the prescribed tune window. If not, the sample is reanalyzed. Following sample analysis and calculations (including any dilutions made due to the sample matrix) peak integrations, retention times, and spectra are evaluated to confirm qualitative identification. Internal standard responses and surrogate recoveries are evaluated against specified criteria. If internal standard response does not meet criteria, the sample is diluted and reanalyzed. Results outside of the calibaration range are diluted to within the calibration range. For GC and HPLC tests, results from confirmation analysis are evaluated to confirm positive results and to determine the reported value. The procedure to determine which result to report is described in the SOP *Confirmation Procedure for GC and HPLC Analysis(SOC-CONF).* If obvious matrix interferences are present, additional cleanup of the sample using appropriate procedures may be necessary and the sample is reanalyzed. When dilutions are performed the MRL is elevated accordingly and qualified. Efforts are made to meet the project MRL's including additional cleanup.

- Surrogate Results (Organic) – Following sample analysis and data reduction, the percent recovery of each surrogate is compared to specified control limits. If recoveries are acceptable, the results are reported. If recoveries do not fall within control limits, the sample matrix is evaluated. When matrix interferences are present or documented, the results are reported with a qualifier that matrix interferences are present. If no matrix interferences are present and there is no cause for the outlier, the sample is reprepared and reanalyzed. However, if the recovery is above the upper control limit with non-detected target analytes, the sample may be reported. All surrogate recovery outliers are appropriately qualified on the report.

- Duplicate Sample and/or Duplicate Matrix Spike Results – The RPD is calculated and compared to the specified control limits. If the RPD is within the control limits the result is reported. If not, an evaluation of the sample is made to verify that a homogenous sample was used. Despite the use of homogenizing procedures prior to sample preparation or analysis, the sample may not be homogenous or duplicate sample containers may not have been sample consistently. If non-homogenous, the result is reported with a qualifier about the homogeneity of the sample. Also, the results are compared to the MRL. If the results are less than five times the MRL, the results are reported with a qualifier that the high RPD is due to the results being near the MRL. If the sample is homogenous and results above five times the MRL, the samples and duplicates are reanalyzed. If re-analysis also produces out-of-control results, the results are reported with an appropriate qualifier.

- Laboratory Control Sample Results – Following analysis of the LCS the percent recovery is calculated and compared to specified control limits. If the recovery is within control limits, the analysis is in control and results may be reported. If not, this indicates that the analysis is not in control. Samples associated with the 'out of control' LCS, shall be considered suspect and the samples re-extracted or re-analyzed or the data reported with the appropriate qualifiers. For analysis where a large number of analytes are in the LCS, it becomes more likely that some analytes (marginal exceedences) will be outside the control limits. The procedure described in the 2003 NELAC standards,l Appendix D.1.1.2.1 are used to determine if the LCS is effective in validating the analytical system and the associated samples.

- Matrix Spike Results – Following analysis of the MS the percent recovery is calculated and compared to specified control limits. If the recovery is within control limits the results may be reported. If not, and the LCS is within control limits, this indicates that the matrix potentially biases analyte recovery. It is verified that the spike level is at least five times the background level. If not, the results are reported with a qualifier that the background level is too high for accurate recovery determination. If matrix interferences are present or results indicate a potential problem with sample preparation, steps may be taken to improve results; such as performing any additional cleanups, dilution and reanalysis, or re-preparation and reanalysis. Results that do not meet acceptance limits are reported with an appropriate qualifier.

12.4 Data Reporting

When an analyst determines that a data package has met the data quality objectives (and/or any client-specific data quality objectives) of the method and has qualified any anomalies in a clear, acceptable fashion, the data package is reviewed by a trained chemist. Prior to release of the report to the client, the project chemist reviews and approves the entire report for completeness and to ensure that any and all client-specified objectives were successfully achieved. The original raw data, along with a copy of the final report, is filed in project files by service request number for archiving. CAS maintains control of analytical results by adhering to standard operating procedures and by observing sample custody requirements. All data are calculated and reported in units consistent with project specifications, to enable easy comparison of data from report to report.

To the extent possible, samples shall be reported only if all QC measures are acceptable. If a QC measure is found to be out of control, and the data is to be reported, all samples associated with the failed quality control measure shall be reported with the appropriate data qualifier(s). The *SOP for Data Reporting and Report Generation* addresses the flagging and qualification of data. The CAS-defined data qualifiers, state-specific data qualifiers, or project-defined data qualifiers are used depending on project requirements. A case narrative may be written by the project chemist to explain problems with a specific analysis or sample, etc.

For subcontracted analyses, the Project Chemist verifies that the report received from the subcontractor is complete. This includes checking that the correct analyses were performed, the analyses were performed for each sample as requested, a report is provided for each analysis, and the report is signed. The Project Chemist accepts the report if all verification items are complete. Acceptance is demonstrated by forwarding the report to the CAS client.

12.5 Documentation

CAS maintains a records system which ensures that all laboratory records of analysis data retained and available. Analysis data is retained for 5 years from the report date unless contractual terms or regulations specify a longer retention time. The archiving system is described in the *SOP for Data Archiving*.

12.5.1 Documentation and Archiving of Sample Analysis Data

The archiving system includes the following items for each set of analyses performed:

- Benchsheets describing sample preparation (if appropriate) and analysis;
- Instrument parameters (or reference to the data acquisition method);
- Sample analysis sequence;
- Instrument printouts, including chromatograms and peak integration reports for all samples, standards, blanks, spikes and reruns;
- Logbook ID number for the appropriate standards;
- Copies of report sheets submitted to the work request file; and
- Copies of Nonconformity and Corrective Action Reports, if necessary.

Individual sets of analyses are identified by analysis date and service request number. Since many analyses are performed with computer-based data systems, the final sample concentrations can be automatically calculated. If additional calculations are needed, they are written on the integration report or securely stapled to the chromatogram, if done on a separate sheet.

For organics analysis, data applicable to all analyses within the batch, such as GCMS tunes, CCVs, batch QC, and analysis sequences; are kept using a separate documentation system. This system is used to archive data on a batch-specific basis and is segregated according to the date of analysis. This system also includes results for the most recent calibration curves, as well as method validation results.

12.6 Deliverables

In order to meet individual project needs, CAS provides several levels of analytical reports. Standard specifications for each level of deliverable are described in Table 12-1. Variations may be provided based on client or project specifications. This includes (but is not limited to) to following specialized deliverables:

- ADEC – Alaska Department of Conservation specified data package
- ACOE/HTRW – Army Corps of Engineers specified data package and reporting requirements (HTRW, CERP, FUDS, etc.)
- AFCEE – Air Force Center for Environmental Excellence project-specific reporting

When requested, CAS provides Electronic Data Deliverables (EDDs) in the format specified by client need or project specification. CAS is capable of generating EDDs with many different formats and specifications. The EDD is prepared by report production staff using the electronic version of the laboratory report to minimize transcription errors. User guides and EDD specification outlines are used in preparing the EDD. The EDD is reviewed and compared to the hard-copy report for accuracy.

Table 12-1
Descriptions of CAS Standard Data Deliverables

Tier I. Routine Certified Analytical Report (CAR) includes the following:

1. Transmittal letter
2. Sample analytical results
3. Method blank results
4. Surrogate recovery results and acceptance criteria for applicable organic methods
5. Chain of custody documents
6. Dates of sample preparation and analysis for all tests

Tier II and IIA. In addition to the Tier I Deliverables, this CAR includes the following:

1. Matrix spike result(s) with calculated recovery and including associated acceptance criteria
2. Duplicate or duplicate matrix spike result(s) (as appropriate to method), with calculated relative percent difference
3. Tier IIA also includes Laboratory Control Sample (LCS) result(s) with calculated recovery and including associated acceptance criteria

Tier III. Data Validation Package. In addition to the Tier II Deliverables, this CAR includes the following:

1. Case narrative
2. Calibration records and results of initial and continuing calibration verification standards, with calculated recoveries
3. Results of laboratory control sample (LCS) or Quality Control check sample, with calculated recovery and/or associated acceptance limit criteria
4. Results of calibration blanks or solvent blanks (as appropriate to method)
5. Summary forms for associated QC and calibration parameters
6. Copies of all raw data, including extraction/preparation bench sheets, chromatograms, and instrument printouts. For GC/MS, this includes tuning criteria and mass spectra of all positive hits. Results and spectra of TIC compounds will be included upon request.

Tier IV. CLP-Level Data Validation Package.

A complete Data Validation Package containing all sample results, quality control and calibration results, and raw data necessary to fulfill all deliverable requirements of an EPA Contract Laboratory Program (CLP) data package.

13.0 PERFORMANCE AND SYSTEM AUDITS

Quality audits are an essential part of CAS/Kelso's quality assurance program. There are two types of audits used at the facility: System Audits are conducted to qualitatively evaluate the operational details of the QA program, while Performance Audits are conducted by analyzing proficiency testing samples in order to quantitatively evaluate the outputs of the various measurement systems.

13.1 System Audits

The system audit examines the presence and appropriateness of laboratory systems. External system audits of CAS/Kelso are conducted regularly by various regulatory agencies and clients. Table 13-1 summarizes some of the major programs in which CAS/Kelso participates. Programs and certifications are added as required. Additionally, internal system audits of CAS/Kelso are conducted regularly under the direction of the Quality Assurance Manager. The internal audit procedures are described in the *SOP for Internal Audits*. The internal audits are performed as follows:

- Comprehensive lab-wide system audit – performed annually. This audit is conducted such that systems, technical operations, hardcopy data, and electronic data are assessed.
- Hardcopy report audits – minimum of 3 per quarter.
- Electronic audit trail reviews – each applicable instrument per quarter.

All audit findings, and corrective actions are documented. The results of each audit are reported to the Laboratory Director and Department Managers for review. Any deficiencies identified are summarized in the audit report. Managers must respond with corrective actions correcting the deficiency within a defined timeframe. Should problems impacting data quality be found during an internal audit, any client whose data is adversely impacted will be given written notification within the corrective action period (if not already provided).

Electronic data audits may be performed in conjunction with hardcopy data audits. The electronic audits focus on organic chromatographic data and include an examination of audit trails, peak integrations, calibration practices and files, GCMS tuning data, peak response data, use of appropriate files, and other components of the analysis. The audit also verifies that the electronic data supports the hardcopy reported data.

Additional internal audits or data evaluations may be performed as needed to address any potential data integrity issues that may arise.

13.2 Performance Audits

CAS/Kelso also participates in the analysis of interlaboratory proficiency testing (PT) samples. Participation in PT studies is performed on a regular basis and is designed to evaluate all analytical areas of the laboratory. CAS routinely participates in the following studies:

- Water Pollution (WP) and additional water parameters, 2 per year.
- Water Supply (WS) PT studies, 2 per year.
- Hazardous Waste/Soil PT studies, 2 per year.
- Underground Storage Tank PT studies, 2 per year.
- Microbiology (WS and WP) PT studies, 2 per year.
- Other studies as required for specific certifications, accreditations, or validations.

PT samples are processed by entering them into the LIMS system as samples (assigned Service Request, due date, testing requirements, etc.) and are processed the same as field samples. The laboratory sections handle samples the same as field samples, performing the analyses following method requirements and performing data review. The laboratory sections submit results to the QA Manager for subsequent reporting to the appropriate agencies or study provider. Results of the performance evaluation samples and audits are reviewed by the Quality Assurance Manager, Laboratory Director, the laboratory staff, and the CAS Quality Assurance Director. For any results outside acceptance criteria, the analysis data is reviewed to identify a possible cause for the deficiency, and corrective action is taken and documented.

Table 13-1
Current CAS Performance and System Audit Programs

Federal and National Programs

- The TNI (The NELAC Institute) National Environmental Laboratory Accreditation Program (NELAP) Accredited Drinking Water, Non-Potable Water, Solid & Hazardous Waste, and Biological Tissue Laboratory
- Naval Facilities Engineering Service Center
  Validated Laboratory for NFESC Parameters
- U.S. Air Force, Air Force Center for Environmental Excellence (AFCEE)
  Approved Laboratory for AFCEE Projects
- U.S. Army Corps of Engineers
  Approved Laboratory for USACE Projects
- U.S. EPA Region 8
  Approved Drinking Water Laboratory

State and Local Programs

- State of Alaska, Department of Environmental Conservation
  UST Laboratory, Lab I.D. UST040
- State of Arizona, Department of Health Services
  License No. AZ0339
- State of Arkansas, Department of Environmental Quality
  Certified Environmental Laboratory, Lab I.D. 88-0637
- State of California, Department of Health Services, Environmental Laboratory Accreditation Program
  Certification No. 2286
- State of Colorado, Department of Public Health and Environment
  Certified Drinking Water Laboratory
- State of Florida, Department of Health
  Primary NELAP Accreditation No. E87412
- State of Georgia, Department of Natural Resources
  Certified Drinking Water Laboratory
- State of Hawaii, Department of Health
  Certified Drinking Water Laboratory
- State of Idaho, Department of Health and Welfare
  Certified Drinking Water Laboratory
- State of Indiana, Department of Health
  Certified Drinking Water Laboratory, Lab I.D. C-WA-01
- State of Louisiana, Department of Environmental Quality
  Accredited Environmental Laboratory, Lab I.D. 3016
- State of Louisiana, Department of Health and Hospitals
  Accredited Drinking Water Laboratory, Lab I.D. LA080001
- State of Maine, Department of Human Services
  Certified Environmental Laboratory, Lab I.D. WA0035
- State of Michigan, Department of Environmental Quality
  Certified Drinking Water Laboratory, Lab I.D. 9949

Table 13-1 (continued)

State and Local Programs (continued)

- State of Minnesota, Department of Health
  Certified Environmental Laboratory, Lab I.D. 053-999-368
- State of Montana, Department of Health and Environmental Sciences
  Certified Drinking Water Laboratory, Lab I.D. 0047
- State of Nevada, Division of Environmental Protection
  Certified Drinking Water Laboratory, Lab I.D. WA35
- State of New Jersey, Department of Environmental Protection
  Accredited Environmental Laboratory, Lab I.D. WA005
- State of New Mexico, Environment Department
  Certified Drinking Water Laboratory
- State of North Carolina, Department of Environment and Natural Resources
  Certified Environmental Laboratory, Lab I.D. 605
- State of Oklahoma, Department of Environmental Quality
  General Water Quality/Sludge Testing, Lab I.D. 9801
- State of Oregon, ORELAP Laboratory Accreditation Program
  Accredited Environmental Laboratory, Lab I.D. WA200001
- State of South Carolina, Department of Health and Environmental Control
  Certified Environmental Laboratory, Lab I.D. 61002
- State of Utah, Department of Health, Division of Laboratory Services
  Accredited Environmental Laboratory
- State of Washington, Department of Ecology, Environmental Laboratory Accreditation Program
  Accreditation No. C1203
- State of Wisconsin, Department of Natural Resources
  Accredited Environmental Laboratory, Lab I.D. 998386840

14.0 PREVENTIVE MAINTENANCE

Preventive maintenance is a crucial element of the Quality Assurance program. Instruments at CAS (e.g., ICP/MS and ICP systems, GC/MS systems, atomic absorption spectrometers, analytical balances, gas and liquid chromatographs, etc.) are maintained under commercial service contracts or by qualified, in-house personnel. All instruments are operated and maintained according to the instrument operating manuals. All routine and special maintenance activities pertaining to the instruments are recorded in instrument maintenance logbooks. The maintenance logbooks used at CAS contain extensive information about the instruments used at the laboratory.

An initial demonstration of analytical control is required on every instrument used at CAS before it maybe used for sample analysis. If an instrument is modified or repaired, a return to analytical control is required before subsequent sample analyses can occur. When an instrument is acquired at the laboratory, the following information is noted in a bound maintenance notebook specifically associated with the new equipment:

- The equipment's serial number;
- Date the equipment was received;
- Date the equipment was placed into service;
- Condition of equipment when received (new, used, reconditioned, etc.); and
- Prior history of damage, malfunction, modification or repair (if known).

Equipment records also include a copy of the manufacturer's manual(s) and dates and results of calibrations.

Preventive maintenance procedures, frequencies, etc. are available for each instrument used at CAS. They may be found in the various SOPs for routine methods performed on an instrument and may also be found in the operating or maintenance manuals provided with the equipment at the time of purchase.

Responsibility for ensuring that routine maintenance is performed lies with the section supervisor. The supervisor may perform the maintenance or assign the maintenance task to a qualified bench level analyst who routinely operates the equipment. In the case of non-routine repair of capital equipment, the section supervisor is responsible for providing the repair, either by performing the repair themselves with manufacturer guidance or by acquiring on-site manufacturer repair. Each laboratory section maintains a critical parts inventory. The parts inventories include the items needed to perform the preventive maintenance procedures listed in Appendix D.

This inventory or "parts list" also includes the items needed to perform any other routine maintenance and certain in-house non-routine repairs such as gas chromatography/mass spectrometry jet separators and electron multipliers and ICP/MS nebulizer. When performing maintenance on an instrument (whether preventive or corrective), additional information about the problem, attempted repairs, etc. is also recorded in the notebook. Typical logbook entries include the following information:

- Details and symptoms of the problem;
- Repairs and/or maintenance performed;
- Description and/or part number of replaced parts;
- Source(s) of the replaced parts;
- Analyst's signature and date; and
- Demonstration of return to analytical control.

See the table in Appendix D for a list of preventive maintenance activities and frequency for each instrument.

15.0 CORRECTIVE ACTION

To the extent possible, samples shall be reported only if all quality control measures are acceptable. If a quality control measure is found to be out of control, and the data is to be reported, all samples associated with the failed quality control measure shall be reported with the appropriate data qualifier(s). Failure to meet established analytical controls, such as the quality control objectives outlined in Section 11, prompts corrective action. In general, corrective action may take several forms and may involve a review of the calculations, a check of the instrument maintenance and operation, a review of analytical technique and methodology, and reanalysis of quality control and field samples. If a potential problem develops that cannot be solved directly by the responsible analyst, the supervisor, team leader, the department manager, and/or the Quality Assurance Manager may examine and pursue alternative solutions. In addition, the appropriate project chemist may be notified in order to ascertain if contact with the client is necessary.

In the event that analyses produce nonconformances with data or results, the problem and the corresponding corrective actions taken are documented on Nonconformity and Corrective Action Reports (See Figure 15-1) following the requirements in the SOP for Corrective Action (SOP No. ADM-CA). This form is utilized to document corrective actions in response to out-of-control situations. The Quality Assurance Manager reviews each problem, ensuring that appropriate corrective action has been taken by the appropriate personnel. The Nonconformity and Corrective Action Report (NCAR) is filed in the associated service request file and a copy is kept by the Quality Assurance Manager. The Quality Assurance Manager periodically reviews all NCARs looking for chronic, systematic problems that need more in-depth investigation and alternative corrective action consideration. In addition, the appropriate project chemist is promptly notified of any problems in order to inform the client and proceed with any action the client may want to initiate.

In addition to internal communication of data issues, the laboratory also maintains a system for dealing with customer complaints. The person who initially receives the feedback (typically the project chemist) is responsible for documenting the complaint. If the project chemist is unable to satisfy the customer, the complaint is brought to the attention of the Client Services Manager, Laboratory Director, or QA Manager for final resolution. The complaint and resolution are documented. The procedure is described in the *SOP for Handling Customer Feedback* (ADM-FDBK).

Corrective action due to a performance audit or a proficiency(PT) sample finding is initiated by the Quality Assurance Manager; the affected laboratory supervisors and managers are promptly informed of performance audit results requiring corrective action.

Figure 15-1

Columbia Analytical Services, Inc.

Nonconformity and Corrective Action Report

NONCONFORMITY

NCAR No. _____

PROCEDURE (SOP or METHOD): EVENT DATE: _____

EVENT: ☐ Missed Holding Time ☐ QC Failure ☐ Lab Error (spilled sample, spiking error, etc.)
☐ Method Blank Contamination ☐ Login Error ☐ Project Management Error
☐ Equipment Failure ☐ Unacceptable PT Sample Result
☐ SOP Deviation ☐ Other (describe):

SAMPLES / PROJECTS / CUSTOMERS / SYSTEMS AFFECTED

DETAILED DESCRIPTION

ORIGINATOR: _____ DATE: _____

PROJECT MANAGER(S): _____ NOTIFIED BY: _____ DATE: _____

CORRECTIVE ACTION AND OUTCOME

Re-establishment of conformity must be demonstrated and documented. Describe the steps that were taken, or are planned to be taken, to correct the particular Nonconformity and prevent its reoccurrence. Include Project Manager instructions here.

Is the data to be flagged in the Analytical Report with an appropriate qualifier? ☐ **No** ☐ **Yes**

APPROVAL AND NOTIFICATION

Supervisor Verification and Approval of Corrective Action _____ Date: _____
Comments:

QA PM Verification and Approval of Corrective Action _____ Date: _____
Comments:

Customer Notified by ☐ Telephone ☐ Fax ☐ E-mail ☐ Narrative ☐ Not notified

Project Manager Verification and Approval of Corrective Action _____ Date: _____
Comments:

(Attach record or cite reference where record is located.)

Original: QA PM
NCAR 2007.doc 9/11/2007

Page 1 of 1

Photocopies: Supervisor and Customer File
File Name: NCAR 2007

16.0 QUALITY ASSURANCE REPORTS

Quality assurance requires an active, ongoing commitment by CAS personnel at all levels of the organization. Communication and feedback mechanisms are designed so that analysts, supervisors and managers are aware of QA issues in the laboratory. Analysts performing routine testing are responsible for generating a data quality narrative or data review document with every analytical batch processed. This report also allows the analyst to provide appropriate notes and/or a case narrative if problems were encountered with the analyses. A Non-Conformity and Corrective Action Report (NCAR) (see Section 15.0) may also be attached to the data prior to review. Supervisors or qualified analysts review all of the completed analytical batches to ensure that all QC criteria have been examined and any deficiencies noted and corrected if possible.

It is the responsibility of each laboratory unit to provide the project chemist with a final report of the data, accompanied by signature approval. Footnotes and/or narrative notes must accompany any data package if problems were encountered that require further explanation to the client. Each data package is submitted to the appropriate project chemist, who in turn reviews the entire collection of analytical data for completeness. The project chemist must also review the entire body of data to ensure that any and all client-specified objectives were successfully achieved. A case narrative may be written by the project chemist to explain any unusual problems with a specific analysis or sample, etc.

The Quality Assurance Manager (QAM) provides overview support to the project chemists as required (e.g., contractually specified, etc.). The QAM is also responsible for the oversight of all internal and external audits, for all proficiency testing sample and analysis programs, and for all laboratory certification/accreditation responsibilities. The QAM provides the Laboratory Director with quarterly reports that summarize the various QA/QC activities that occurred during the previous quarter. The report addresses such topics as the following:

- Status, schedule, and results of internal and external audits;
- Status, schedule, and results of internal and external proficiency testing studies;
- Status of certifications, accreditations, and approvals;
- Status of QA Manual and SOP review and revision;
- Status of MDLs studies;
- Discussion of QC problems in the laboratory;
- Discussion of corrective action program issues;
- Status of staff training and qualification; and
- Other topics as appropriate.

Any operational or quality assurance problems noted by the Laboratory Director are then addressed during the senior staff operations meetings with all appropriate department managers. The Laboratory Director also performs al documented management review annually of the quality and management systems to identify any necessary changes or improvements to the quality system or quality assurance policies.

17.0 PERSONNEL TRAINING

Technical position descriptions are available for all employees, regardless of position or level of seniority. These documents are maintained by the Human Resources personnel and are available for review. In order to assess the technical capabilities and qualifications of a potential employee, all candidates for employment at CAS are evaluated, in part, against the appropriate technical description.

Training begins the first day of employment at CAS when the company policies are presented and discussed. Safety and QA/QC requirements are integral parts of all technical SOPs and, consequently, are integral parts of all training processes at CAS. Safety training begins with the reading of the *Environmental Health and Safety Manual.* Employees are also required to attend periodic safety meetings where additional safety training may be performed by the Environmental, Health and Safety Officer. Employees are responsible for complying with the requirements of the QA Manual and QA/QC requirements associated with their function(s).

Each employee participates in Ethics training, which is part of the CAS Improper Practices Prevention Program. CAS also encourages its personnel to continue to learn and develop new skills that will enhance their performance and value to the Company. Ongoing training occurs for all employees through a variety of mechanisms. The "CAS University" education system, external and internal technical seminars and training courses, and laboratory-specific training exercises are all used to provide employees with professional growth opportunities.

A training plan is developed whenever an employee starts a new procedure to new position. The training plan includes a description of the step-by-step process for training an employee and for initial demonstration of proficiency. Where the analyst performs the entire procedure, a generic training plan may be used. In cases where work cells are used, a training plan specific to the work cell is established.

17.1 Initial Demonstration of Capability (IDOC)

Training in analytical procedures typically begins with the reading of the Standard Operating Procedure (SOP) for the method. Hands-on training begins with the observation of an experienced analyst performing the method, followed by the trainee performing the method under close supervision, and culminating with independent performance of the method on quality control samples. Successful completion of the applicable Demonstration of Capability analysis qualifies the analyst to perform the method independently. Demonstration of Capability is performed by one of the following:

- Successful completion of an Initial Precision and Recovery (IPR) study (required where mandated by the method).

- Analysis of 4 consecutive Laboratory Control Samples, with acceptable accuracy and precision.

- Where spiking is not possible but QC standards are used ("non-spiked" Laboratory Control Samples), analysis of 4 consecutive Laboratory Control Samples with acceptable accuracy and precision.

- Where one of the three above is not possible, special requirements are as follows:

    - Total Settleable Solids: Successful single-blind PT sample analysis and duplicate results with RPD<10%.
    - Color: Four consecutive prepared LCSs with acceptable accuracy and precision of <10% RSD.
    - Physical Tests (Grain size, Corrosivity to Steel, etc.): Supervisor acknowledgement of training and approval.

A flowchart identifying the Demonstration of Proficiency requirements is given in Figure 17-1. The flowchart identifies allowed approaches to assessing Demonstration of Capability when a 4-replicate study is not mandated by the method, when spiking is not an option, or when QC samples are not readily available.

17.2 Continuing Demonstration of Proficiency

A periodic demonstration of proficiency is required to maintain continuing qualification. Continuing Demonstration of Proficiency is required each year, and may be performed one of the following ways:

- Successful performance on external (independent) single-blind PT sample analyses using the test method, or a similar test method using the same technology.

- Performing Initial Demonstration of Capability as described above, with acceptable levels of precision and accuracy.

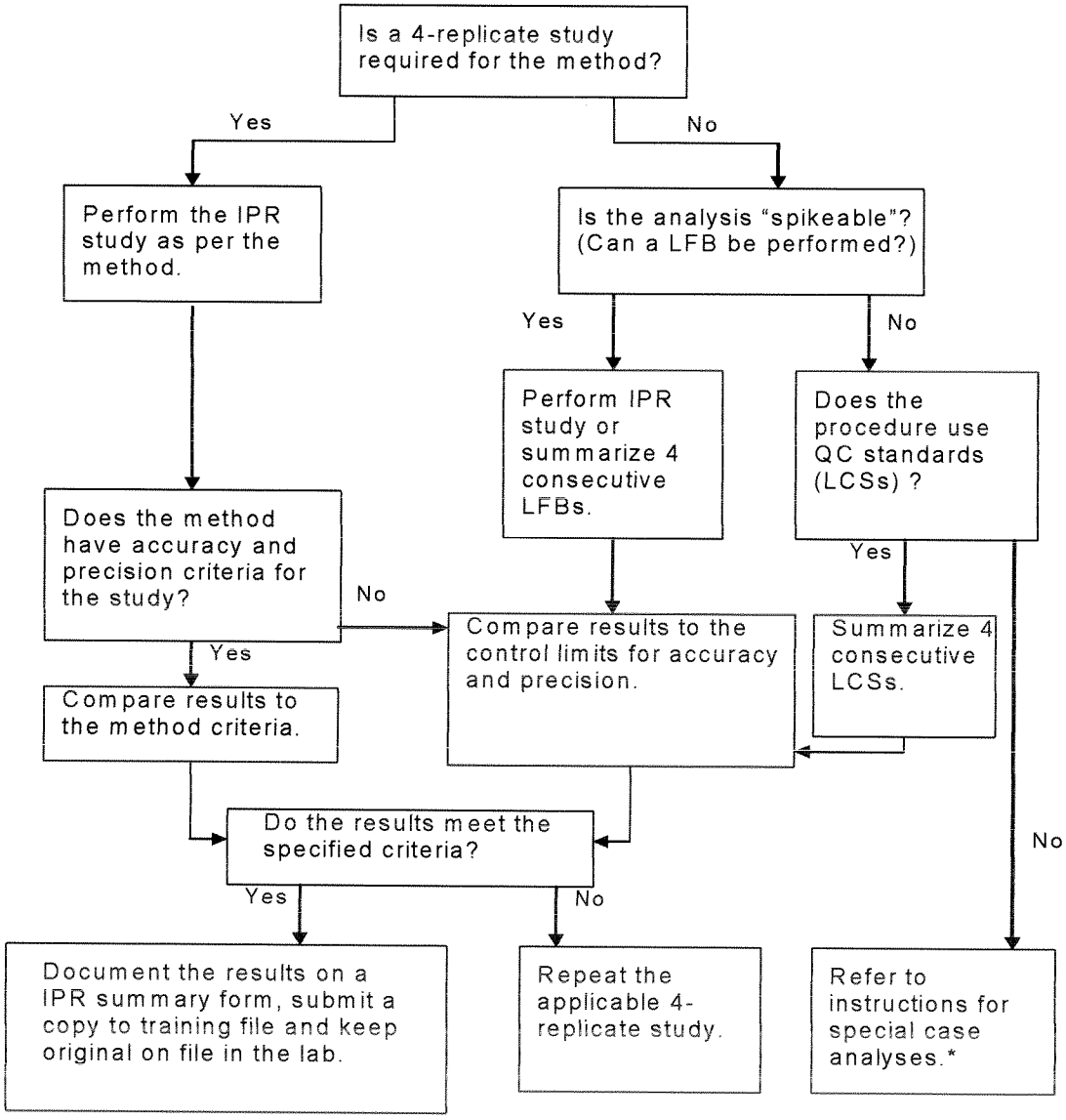
- Analysis of at least 4 consecutive LCSs with acceptable levels of accuracy and precision from in-control analytical batches.

- For methods for which PT samples are not available and a spiked analysis (LFB, MDL, etc.) is not possible, analysis of field samples that have been analyzed by another analyst with statistically indistinguishable results.

17.3 Documentation of Training

Records are maintained to indicate the employee has the necessary training, education, and experience to perform their functions. Information of previously acquired skills and abilities for a new employee is maintained in Human Resources personnel files and CAS resumes. A database is used to record the various technical skills and training acquired while employed by CAS. Information includes the employee's name, a description of the skill including the appropriate method and SOP reference, the mechanism used to document proficiency, and the date the training was completed. General procedures for documenting technical training are described in the *SOP for Documentation of Training (SOP No. ADM-TRANDOC).*

Figure 17-1
Initial Demonstration of Capability Requirements[a]



[a] For IDOC IPR or LFB studies, "second-source" reference materials are used, as per NELAP requirements
*Total Settleable Solids: Successful PT sample analysis and duplicate results with RPD<10%.
*Color: Four consecutive prepared LCSs with acceptable accuracy and precision of <10% RSD.
* Physical Tests (Grain size, Corrosivity to Steel, etc.): Supervisor acknowledgement of training and approval.

18.0 REFERENCES FOR ANALYTICAL PROCEDURES

The analytical methods used at CAS generally depend upon the end-use of the data. Since most of our work involves the analysis of environmental samples for regulatory purposes, specified federal and/or state testing methodologies are used and followed closely. Typical methods used at CAS are taken from the following references:

- *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, SW-846, Third Edition, (September 1986) and Updates I (July 1992), II (September 1994), IIA (August 1993), IIB (January 1995), III (December 1996), Final Update IV (February 2007), and updates posted online at http://www.epa.gov/epaoswer/hazwaste/test/sw846.htm. See Chapters 1, 2, 3, and 4.
- *Methods for Chemical Analysis of Water and Wastes*, EPA-600/4-79-020, (Revised March 1983).
- *Methods for the Determination of Inorganic Substances in Environmental Samples*, EPA/600/R-93/100 (August 1993).
- *Methods for the Determination of Metals in Environmental Samples*, EPA/600/4-91/010 (June 1991) and Supplements.
- *Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater*, EPA 600/4-82-057 (July 1982) and 40 CFR Part 136, Appendix A.
- *Methods for the Determination of Organic Compounds in Drinking Water*, EPA/600/4-88/039 (December 1988) and Supplements.
- *Standard Methods for the Examination of Water and Wastewater*, 18th Edition (1992); 19th Edition (1995), 20th Edition (1998). See Introduction in Part 1000.
- 40 CFR Part 136, Guidelines for Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act.
- 40 CFR Part 141, National Primary Drinking Water Regulations.
- *Analytical Methods for Petroleum Hydrocarbons*, ECY 97-602, Washington State Department of Ecology, June 1997.
- State-specific total petroleum hydrocarbon methods for the analysis of samples for gasoline, diesel, and other petroleum hydrocarbon products (Alaska, Arizona, California, Oregon, Washington, Wisconsin, etc.).

- Annual Book of ASTM Standards, Part 31, Water.
- EPA Contract Laboratory Program, Statement of Work for Organic Analysis, SOW Nos. OLM03.1, OLM03.2, OLM04.2, and OLM04.3.
- EPA Contract Laboratory Program, Statement of Work for Inorganic Analysis, SOW No. ILM04.0, ILM04.1, and ILM05.2.
- *U. S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review*, EPA-540/R-94/012 (February 1993).
- *U. S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, EPA-540/R-94/013 (February 1994).
- National Institute for Occupational Safety and Health (NIOSH) *Manual of Analytical Methods*, Third Edition (August 1987); Fourth Edition (August 1994).
- *Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound*, for USEPA and USACE (March 1986), with revisions through April 1997.
- WDOE 83-13, *Chemical Testing Methods for Complying with the State of Washington Dangerous Waste Regulations* (March 1982) and as Revised (July 1983 and April 1991).
- *Identification and Listing of Hazardous Waste,* California Code of Regulations, Title 22, Division 4.5, Chapter 11.
- *Analytical Methods for the Determination of Pollutants in Pulp and Paper Industry Wastewater*, EPA 821-R-93-017 (October 1993).
- *Analytical Methods for the Determination of Pollutants in Pharmaceutical Manufacturing Industry Wastewaters*, EPA 821-B-98-016 (July 1998).
- National Council of the Pulp and Paper Industry for Air and Stream Improvement (NCASI).
- *Good Automated Laboratory Practices, Principles and Guidance to Regulations For Ensuring Data Integrity In Automated Laboratory Operations*, EPA 2185 (August 1995).
- *Manual for the Certification of Laboratories Analyzing Drinking Water*, 4th Edition, EPA 815-B-97-001 (March 1997).
- National Environmental Laboratory Accreditation Program (NELAP), 2003 Quality Standards.
- *Department of Defense Quality Systems Manual for Environmental Laboratories*, Final Version 3 (January 2006).

APPENDIX A

LIST of QA PROGRAM DOCUMENTS

and

STANDARD OPERATING PROCEDURES

Quality Assurance Manual	2/6/2009
Software Quality Assurance Plan	7/11/05
CAS-Kelso Certifications/Accreditations	Cert_kel.xls
Columbia Analytical Services MDL Tracking Spreadsheet	Mdl_list.xls
Technical Training Summary Database	TrainDat.mdb
Approved Signatories List	AppSignatories.pdf
Personnel resumes/qualifications	HR Department
Personnel Job Descriptions	HR Department
Quality Control Acceptance Criteria	Qclimits.xls
Master Logbook of Laboratory Logbooks	Masterlog-001
Standard Operating Procedure Database	TrainDat.mdb

ADMINISTRATIVE STANDARD OPERATING PROCEDURES

ADMINISTRATIVE - CORPORATE	FILE NAME
CHECKING NEW LOTS OF CHEMICALS FOR CONTAMINATION	ADM-CTMN
CONTROL LIMITS	ADM-CTRL_LIM
CORRECTIVE ACTION	ADM-CA
DATA RECALL	ADM-DATARECALL
HANDLING CUSTOMER FEEDBACK	ADM-FDBK
DETERMINATION OF METHOD DETECTION LIMITS AND LODS	ADM-MDL
DOCUMENT CONTROL	ADM-DOCCTRL
DOCUMENTATION OF TRAINING	ADM-TRANDOC
ELECTRONIC DATA AUDITING	ADM-E_DATAAUDIT
ESTIMATION OF UNCERTAINTY OF MEASUREMENTS	ADM-UNCERT
MAKING ENTRIES INTO LOGBOOKS AND ONTO BENCHSHEETS	ADM-DATANTRY
MANAGERIAL REVIEW OF THE LABORATORY'S QUALITY SYSTEM	ADM-MGMTRVW
MANUAL INTEGRATION OF CHROMATOGRAPHIC PEAKS	ADM-INT
PREPARATION OF ELECTRONIC DATA FOR ORGANIC ANALYSES ELECTRONIC DATA AUDITS	ADM-EDATA
PREPARATION OF STANDARD OPERATING PROCEDURES	ADM-SOP
PROFICIENCY TESTING SAMPLE ANALYSIS	ADM-PTS
PURCHASING THROUGH CAS PURCHASING DEPARTMENT IN KELSO	ADM-PUR
QUALIFICATION OF SUBCONTRACT LABORATORIES OUTSIDE OF CAS NETWORK	ADM-SUBLAB

SIGNIFICANT FIGURES	ADM-SIGFIG
CONFIRMATION of ORGANIC ANALYTE IDENTIFICATION and QUANTITATION	ADM-CONFIRM
PREVENTATIVE ACTION	ADM-PA

ADMINISTRATIVE – LOCAL LABORATORY	FILE NAME
CHECKING PIPETTE CALIBRATION	ADM-CPIP
CONTINGENCY PLAN FOR LABORATORY EQUIPMENT FAILURE	ADM-ECP
CONTROL CHARTING QUALITY CONTROL DATA	ADM-CHRT
DATA ARCHIVING	ADM-ARCH
DATA REPORTING AND REPORT GENERATION	ADM-RG
DEPARTMENT OF DEFENSE PROJECTS LABORATORY PRACTICES AND PROJECT MANAGEMENT	ADM-DOD
ELECTRONIC DATA BACKUP AND ARCHIVING	ADM-EBACKUP
INTERNAL QUALITY ASSURANCE AUDITS	ADM-IAUD
LABORATORY BALANCE MONITORING AND CALIBRATION	ADM-BAL
LABORATORY DATA REVIEW PROCESS	ADM-DREV
METHOD DETECTION LIMIT DOCUMENTATION AND CONTROL	ADM-MDLC
PROJECT MANAGEMENT	ADM-PCM
REAGENT LOGIN AND TRACKING	ADM-RLT
SUPPORT EQUIPMENT MONITORING AND CALIBRATION	ADM-SEMC
SAMPLE BATCHES	ADM-BATCH
SAMPLE MANAGEMENT SOPS	**FILE NAME**
BOTTLE ORDER PREPARATION AND SHIPPING	SMO-BORD
FOREIGN SOILS HANDLING TREATMENT	SMO-FSHT
SAMPLE DISPOSAL	SMO-SDIS
SAMPLE RECEIVING	SMO-GEN
SAMPLE TRACKING AND LABORATORY CHAIN OF CUSTODY	SMO-SCOC
TECHNICAL STANDARD OPERATING PROCEDURES	
SOP TABLE OF CONTENTS	SOPLIST.XLS

COLUMBIA ANALYTICAL SERVICES, INC. , KELSO, WA.
STANDARD OPERATING PROCEDURES TABLE OF CONTENTS

January 19, 2009

PERCHLORATE BY ION CHROMATOGRAPHY	GEN-314-0
CHLORIDE (TITRIMETRIC, MERCURIC NITRATE)	GEN-325.3
TOTAL RESIDUAL CHLORINE - METHOD 330.5	GEN-330.5
CHLORINE, TOTAL/FREE RESIDUAL	GEN-330-4
TOTAL CYANIDES AND CYANIDES AMENABLE TO CHLORINATION	GEN-335
AMMONIA BY FLOW INJECTION ANALYSIS	GEN-350.1
AMMONIA AS NITROGEN BY ION SPECIFIC ELECTRODE	GEN-350.3
NITRATE/NITRITE, NITRITE BY FLOW INJECTION ANALYSIS	GEN-353.2
NITRITE BY COLORIMETRIC PROCEDURE	GEN-354.1
PHOSPHORUS DETERMINATION USING COLORMETRIC PROCEDURE	GEN-365.3
DISSOLVED SILICA	GEN-370.1
GRAVIMETRIC SULFATE	GEN-375.3
SULFIDE, TITRIMETRIC (IODINE)	GEN-376-1
SULFIDE, METHYLENE BLUE	GEN-376-2
PHENOLICS, TOTAL	GEN-420.1
MBAS	GEN-425.1
ORTHOPHOSPHATE BY FLOW INJECTION ANALYSIS-STANDARD METHODS 4500P-F	GEN-4500P-F
HALOGENS TOTAL AS CHLORIDE BY BOMB COMBUSTION	GEN-5050
BIOCHEMICAL OXYGEN DEMAND	GEN-5210B
HALIDES, ADSORBABLE ORGANIC (AOX) - SM 5320B	GEN-5320B
TANNIN AND LIGNIN	GEN-5550
CYANIDE EXTRACTION OF SOLIDS AND OILS	GEN-9013
HALIDES, TOTAL ORGANIC (TOX)	GEN-9020
HALIDES, EXTRACTABLE ORGANIC (EOX)	GEN-9020M
TOTAL SULFIDES BY METHYLENE BLUE DETERMINATION	GEN-9030
TOTAL HALIDES BY OXIDATIVE COMBUSTION AND MICROCOULOMETRY	GEN-9076
CARBON, TOTAL ORGANIC IN SOIL	GEN-ASTM
AUTOFLUFF	GEN-AUTOFLU
SULFIDES, ACIDS VOLATILE	GEN-AVS
HEAT OF COMBUSTION	GEN-BTU
CYANIDE, WEAK ACID DISSOCIABLE	GEN-CNWAD
CHEMICAL OXYGEN DEMAND	GEN-COD
CONDUCTIVITY IN WATER AND WASTES	GEN-COND
CORROSIVITY TOWARDS STEEL	GEN-CORR
HEXAVALENT CHROMIUM - COLORIMETRIC	GEN-CR6
CARBONATE (CO3) BY EVOLUTION AND COLUMETRIC TITRATION	GEN-D513-82M
SULFIDE, SOLUBLE DETERMINATION OF SOLUBLE SULFIDE IN SEDIMENT	GEN-DIS.S2
BULK DENSITY OF SOLID WASTE FRACTIONS	GEN-E1109
FERROUS IRON IN WATER	GEN-FeII
FLUORIDE BY ION SELECTIVE ELECTRODE	GEN-FISE
FORMALDEHYDE COLORIMETRIC DETERMINATION	GEN-FORM
HYDROGEN HALIDES BY ION CHROMATOGTRAPHY (METHOD 26)	GEN-HA26
MERCURY IN COAL SAMPLE PREPARATION BY PARR BOMB COMBUSTION	GEN-HGPREP
HYDAZINE IN WATER USING COLORIMETRIC PROCEDURE	GEN-HYD
TOTAL SULFUR FOR ION CHROMATOGRAPHY	GEN-ICS
ION CHROMATOGRAPHY	GEN-IONC
COLOR, NCASI	GEN-NCAS
OXYGEN CONSUMPTION RATE	GEN-O2RATE
CARBON, TOTAL ORGANIC DETERMINATION (WALKELY BLACK METHOD)	GEN-OSU
Ph IN SOIL AND SOLIDS	GEN-Phs
Ph IN WATER	GEN-Phw
PARTICLE SIZE DETERMINATION - ASTM PROCEDURE	GEN-PSASTM
PARTICLE SIZE DETERMINATION	GEN-PSP
SULFIDES, REACTIVE	GEN-RS

TOTAL SULFIDE BY PSEP	GEN-S2PS
SULFITE	GEN-SO3
SPECIFIC GRAVITY	GEN-SPGRAV
SUBSAMPLING AND COMPOSITING OF SAMPLES	GEN-SUBS
THIOCYANATE	GEN-THIOCN
NITROGEN, TOTAL AND SOLUBLE KJELDAHL	GEN-TKN
POST DIGESTION DETERMINATION OF TOTAL KJELDAHL NITROGEN BY SEMIAUTOMATED COLORIMETRY	GEN-TKNAA
TOTAL ORGANIC CARBON IN WATER	GEN-TOC
TURBIDITY MEASUREMENT	GEN-TURB
ULTIMATE BOD	GEN-UBOD
GLASSWASHING FOR INORGANIC ANALYSES	GEN-WASH
METHYL MERCURY IN SOIL AND SEDIMENT BY ATOMIC FLUORESCENCE SPECTROMETRY	MET-1630S
METHYL MERCURY IN TISSUE BY ATOMIC FLUORESCENCE SPECTROMETRY	MET-1630T
METHYL MERCURY IN WATER BY ATOMIC FLUORESCENCE SPECTROMETRY	MET-1630W
MERCURY IN WATER BY OXIDATION, PURGE&TRAP, AND COLD VAPOR ATOMIC FLUORES. SPECTROMETRY	MET-1631
MERCURY IN WATER	MET-245.1
METALS DIGESTION	MET-3005A
METALS DIGESTION	MET-3010A
METALS DIGESTION	MET-3020A
METALS DIGESTION	MET-3050
CLOSED VESSEL OIL DIGESTION	MET-3051M
DETERMINATION OF METALS & TRACE ELEMENTS BY INDUCTIVELY COUPLED PLASMA-MS (METHOD 6020)	MET-6020
ARSENIC BY BOROHYDRIDE REDUCTION ATOMIC ABSORPTION	MET-7062
METALS DIGESTION	MET-7195
MERCURY IN LIQUID WASTE	MET-7470A
MERCURY IN SOLID OR SEMISOLID WASTE	MET-7471A/B
SELENIUM BY BOROHYDRIDE REDUCTION ATOMIC ABSORPTION	MET-7742
CATION-EXCHANGE CAPACITYOF SOILS (SODIUM ACETATE) - METHOD 9081	MET-9081
SAMPLE PREPARATION OF AQUEOUS SAMPLES BY "CLEAN" TECHNIQUES	MET-ACT
BIOACCESSIBILITY OF METALS IN SOIL AND SOLID WASTE	MET-BIOACC
METALS DIGESTION - CLP	MET-DIG
FLAME ATOMIC ABSORPTION SPECTROPHOTOMETRIC ANALYSES	MET-FAA
SAMPLE FILTRATION FOR METALS ANALYSIS	MET-FILT
METALS LABORATORY GLASSWARE CLEANING	MET-GC
DETERMINATION OF TRACE METALS BY GRAPHITE FURNACE ATOMIC ABSORPTION SPECTROMETRY (GFAA)	MET-GFAA
MERCURY ANALYSIS BY COLD VAPOR ABSORPTION SPECTROPHOTOMETRY	MET-HG
DETERMINATION OF METALS AND TRACE ELEMENTS BY ICP/AES	MET-ICP
DETERMINATION OF METALS & TRACE ELEMENTS BY INDUCTIVELY COUPLED PLASMA-MS (METHOD 200.8)	MET-ICP.MS
MULTIPLE EXTRACTION PROCEDURE	MET-MEP
TRACE METALS IN WATER BY PRECONCENTRATION USING REDUCTIVE PRECIPITATION FOLLOWED BY ICP-MS	MET-RPMS
WASTE EXTRACTION TEST (WET) PROCEDURE (STLC) for NONVOLATILE and SEMIVOLATILE PARAMETERS	MET-STLC
METALS AND SEMIVOLATILES TCLP EXTRACTION (EPA METHOD 1311)	MET-TCLP
SAMPLE PREPARATION OF BIOLOGICAL TISSUES FOR METALS ANALYSIS BY GFAA, ICP-OES, AND ICP-MS	MET-TDIG
TISSUE SAMPLE PREPARATION	MET-TISP
GRAVIMETRIC DETERMINATION OF HEAXANE EXTRACTABLE MATERIAL (1664)	PET-1664
GASOLINE RANGE ORGANICS BY GAS CHROMATOGRAPHY	PET-GRO
ANALYSIS OF WATER, SOLIDS AND SOLUBLE WASTE SAMPLES FOR SEMI-VOLATILE FUEL HYDROCARBONS	PET-SVF

ANALYSIS OF SOLID AND AQUEOUS SAMPLES FOR STATE OF WISCONSIN DIESEL RANGE ORGANICS	PHC-WIDRO
CHLORINATED PHENOLICS IN WASTE WATER BY IN-SITU	SOC-1653A
PHARMACEUTICALS, PERSONAL CARE PRODUCTS AND ENDOCRINE DISRUPTING COMPOUNDS IN WATER BY HPLC/TANDEM MASS SPECTROMETRY (HPLC/MS/MS)	SOC-1694
1,8-DIHYDROXYANTHRAQUINONE BY GC/MS SIM	SOC-18DHYDRAQ
GEL PERMEATION CHROMATOGRAPHY	SOC-3640A
ACETAMIDE HERBICIDE DEGRADATES IN DRINKING WATER BY SPE AND HPLC/MS/MS	SOC-535
ORGANOCHLORINE PESTICIDES AND PCBs (METHOD 608)	SOC-608
SEMIVOLATILE ORGANIC COMPOUNDS BY GC/MS	SOC-625
GLYCOLS	SOC-8015M
ORGANOCHLORINE PESTICIDES BY GAS CHROMATOGRAPHY: CAPILLARY COLUMN TECHNIQUE	SOC-8081
PCBS AS AROCLORS	SOC-8082A
PCBS AS AROCLORS - METHOD 8082A	SOC-8082AAr
CONGENER-SPECIFIC DETERMINATION OF PCBS BY GC/ECD - METHOC 8082A	SOC-8082ACo
CONGENER-SPECIFIC DETERMINATION OF PCBS BY GC/ECD	SOC-8082C
DETERMINATION OF NITROGEN OR PHOSPHORUS CONTAINING PESTICIDES	SOC-8141
CHLORINATED HERBICIDES	SOC-8151
CHLORINATED PHENOLS METHOD 8151 MODIFIED	SOC-8151M
SEMIVOLATILE ORGANIC COMPOUNDS BY GC/MS	SOC-8270C
SEMIVOLATILE ORGANIC COMPOUNDS BY GC/MS - METHOD 8270D	SOC-8270D
SEMIVOLATILE ORGANIC COMPOUNDS BY GC/MS - LOW LEVEL PROCEDURE	SOC-8270L
POLYNUCLEAR AROMATIC HYDROCARBONS BY GAS CHROMATOGRAPHY/MASS SPECTROMETRY SIM	SOC-8270P
SEMIVOLATILE ORGANIC COMPOUNDS BY GC/MS SELECTED ION MONITORING	SOC-8270S
POLYNUCLEAR AROMATIC HYDROCARBONS BY HPLC	SOC-8310
ALDEHYDES BY HPLC	SOC-8315A
NITROAROMATICS AND NITRAMINES BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY	SOC-8330
NITROGLYCERIN AND PETN BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY	SOC-8332
RESIN AND FATTY ACIDS BY GC/MS - NCASI METHOD 85.02 MODIFIED	SOC-85.02
METHANOL IN PROCESS LIQUIDS AND STATIONARY SOURCE EMISSIONS	SOC-9403
HAZARDOUS AIR POLLUTANTS (HAPS) IN PULP AND PAPER INDUSTRY CONDENSATES	SOC-9901
HAPS AND OTHER COMPOUNDS IN IMPINGER/CANISTER SAMPLES FROM WOOD PRODUCTS FACILITIES	SOC-9902
BUTYLTINS	SOC-BUTYL
CALIBRATION OF INSTRUMENTS FOR ORGANICS CHROMATOGRAPHIC ANALYSES	SOC-CAL
CALIBRATION OF INSTRUMENTS FOR ORGANICS CHROMATOGRAPHIC ANALYSES USING EPA 8000C	SOC-CAL8000C
CARBON CLEANUP	SOC-CARCU
CONFIRMATION PROCEDURE FOR GC AND HPLC ANALYSES	SOC-CONF
DIMP	SOC-DIMP
DMD SYNTHESIS	SOC-DMD
TOTAL OLEANOLIC ACID SAPONINS IN WATER BY ACID HYDROLYSIS AND HPLC/MS/MS	SOC-LCMS3
PERCENT LIPIDS IN TISSUE	SOC-LIPID
MONOCHLOROACETIC ACID BY GC-ECD	SOC-MCA
NITROGUANIDINE BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY	SOC-NITG
NONYLPHENOLS ISOMERS AND NONYLPHENOL ETHOXYLATES	SOC-NONYL
ORGANIC ACIDS IN AQUEOUS MATRICES BY HPLC	SOC-OALC
EXTRACTION METHOD FOR ORGANOTINS IN SEDIMENTS, WATER, AND TISSUE	SOC-OSWT
CHLORINATED PESTICIDES BY GC/MS/MS, EPA METHOD 1699 MODIFIED	SOC-PESTMS2
PERFLUORINATED COMPOUNDS BY HPLC/MS/MS	SOC-PFC

PICRIC ACID AND PICRAMIC ACID BY HPLC	SOC-PICRIC
POLYBROMINATED DIPHENYL ETHERS (PBDEs) AND POLYBROMINATED BIPHENYLS (PBBs) BY GC/MS	SOC-ROHS
SEMI-VOLATILE ORGANICS SCREENING	SOC-SCR
1,2-DIBROMOETHANE, 1,2-DIBROMO-3-CHLOROPROPANE, AND 1,2,3-TCP BY GC	SVD-504
ORGANOCHLORINE PESTICIDES AND PCBS IN DRINKING WATER	SVD-508_1
CHLORINATED HEBICIDES IN DRINKING WATER	SVD-515_4
N-NITROSAMINES BY GC/MS/MS	SVD-521
SEMIVOLATILE ORGANIC COMPOUNDS BY GC/MS (METHOD 525.2)	SVD-525
SELECTED PESTICIDES AND FLAME RETARDANTS IN DRINKING WATER BY GC/MS (EPA METHOD 527)	SVD-527
DETERMINATION OF EXPLOSIVES AND RELATED COMPOUNDS IN DRINKING WATER BY GC/MS	SVD-529
CARBAMATES AND CARBAMOYLOXIMES IN WATER BY POST-COLUMN DERIVITIZATION HPLC	SVD-531 -1
GLYPHOSATE IN DRINKING WATER BY HPLC	SVD-547
ENDOTHALL IN DRINKING WATER BY GC/MS	SVD-548
DIQUAT AND PARAQUAT BY HPLC	SVD-549
HALOACETIC ACIDS IN DRINKING WATER	SVD-552
PURGE AND TRAP FOR AQUEOUS SAMPLES	VOC-5030
PURGE AND TRAP/EXTRACTION FOR VOC IN SOIL AND WASTE SAMPLES , CLOSED SYSTEM	VOC-5035
VOLATILE ORGANIC COMPOUNDS BY GC/MS	VOC-524.2
AROMATIC VOLATILE ORGANICS (BTEX) BY GC - METHOD 602	VOC-602BTEX
VOLATILE ORGANIC COMPOUNDS BY GC/MS	VOC-624
AROMATIC VOLATILE ORGANICS (BTEX) BY GC - METHOD 8021	VOC-8021BTEX
VOLATILE ORGANIC COMPOUNDS BY GC/MS	VOC-8260
VOLATILE ORGANIC COMPOUNDS BY GC/MS SELECTIVE ION MONITORING	VOC-8260S
VOA STORAGE BLANKS	VOC-BLAN
SAMPLE SCREENING FOR VOLATILE ORGANIC COMPOUNDS IN SOIL, WATER AND MISC. MATRICES	VOC-BVOC
WA-DOH DRINKING WATER PROTOCOL	VOC-WA.DOH
ZERO HEADSPACE EXTRACTION (EPA METHOD 1311)	VOC-ZHE

STANDARD OPERATING PROCEDURE

SAMPLE FILTRATION FOR METALS ANALYSIS

MET-FILT

Revision 2

Effective Date: February 25, 2011

Approved By:

Supervisor	2/4/11 Date
QA Manager	2/4/11 Date
Laboratory Manager	2/4/11 Date

COLUMBIA ANALYTICAL SERVICES, INC.
1317 South 13th Avenue
Kelso, Washington 98626

DOCUMENT CONTROL	
NUMBER:	
Initials:	Date:

Standard Operating Procedure

for

SAMPLE FILTRATION FOR METALS ANLAYSIS

1. SCOPE AND APPLICATION

1.1. This Standard Operating Procedure (SOP) describes the procedure used for the filtration of aqueous samples in preparation for dissolved metals and/or inorganic chemistry analysis.

1.2. This procedure is applicable to all elements of interest.

2. METHOD SUMMARY

2.1. Unpreserved sample is passed through an acid rinsed 0.45µm membrane filter using vacuum filtration. For samples with limited volume (i.e. ≤50 mL) a disposable syringe and cassette filter may be used in lieu of the vacuum filtration apparatus. The filtrate is then transferred to an appropriate metals container and preserved accordingly. The sample is then ready for dissolved analysis.

3. DEFINITIONS

3.1. **Filtration Blank** - The filtration blank is an artificial sample composed of analyte-free water and is designed to monitor the introduction of artifacts into the filtration process. The filtration blank is carried through the entire filtration procedure.

3.2. **Field Sample** - An environmental sample collected and delivered to the laboratory for analysis; a.k.a., client's sample.

4. INTERFERENCES

4.1. Large amount of sediment or flocculent material can quickly clog the filter. Prior to filtration this material may need to be separated from the sample by centrifugation.

5. SAFETY

5.1. All appropriate safety precautions for handling solvents, reagents and samples must be taken when performing this procedure. This includes the use of personnel protective equipment, such as, safety glasses, lab coat and the correct gloves.

5.2. Chemicals, reagents and standards must be handled as described in the CAS safety policies, approved methods and in MSDS where available. Refer to the CAS Environmental, Health and Safety Manual and the appropriate MSDS prior to beginning this method.

5.3. Nitric Acid and Hydrochloric Acid are used in this method. These acids are extremely corrosive and care must be taken while handling them. A face shield should be used while pouring acid. Safety glasses shall be worn while working with acids. A Lab coat and gloves shall be worn while working with these solutions.

6. SAMPLE COLLECTION, CONTAINERS, PRESERVATION, AND STORAGE

6.1. Samples should be shipped to the laboratory under thermal conditions, in a cooler maintained at 4 ± 2°C, and filtered as soon as possible upon sample receipt. Refer to the SOP *for Sample Receiving (SMO-GEN).*

6.2. The filtration blank and the filtrate must be preserved immediately after filtration and stored at 4 ± 2°C until the time of analysis.

7. REAGENTS

7.1. Reagent grade chemicals shall be used in all tests. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lowering the accuracy of the determination. The preparation for all laboratory prepared reagents and solutions must be documented in a laboratory logbook. Refer to the SOP *Reagent/Standards Login and Tracking (ADM-RTL)* for the complete procedure and documentation requirements.

7.2. 25% HCl, trace metals grade.

7.3. Laboratory deionized water.

7.4. Trace Metals Grade nitric acid.

8. APPARATUS AND EQUIPMENT

8.1. House vacuum system.

8.2. Polysulfone filter holder.

8.3. 1000 mL filter flask.

8.4. 0.45 µm Hydrophyllic Membrane Filters (Pall), 47 mm diameter.

8.5. Plastic bottles certified clean for trace metals analysis.

8.6. BD 60 mL Luer-Lok™ syringe

8.7. PALL Acrodisc 25mm syringe filter with 0.45 um GHP membrane

9. PREVENTIVE MAINTENANCE

9.1. Labware used for Filtration shall follow the cleaning procedure specified in the SOP *METALS LABORATORY GLASSWARE CLEANING* (MET-GC).

10. RESPONSIBILITIES

10.1. It is the responsibility of the analyst to perform the procedure according to this SOP and must complete the required documentation consistent with the SOP *ADM- DATANTRY*. Analysis and interpretation of the results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory and consistent with the SOP for *Documentation of Training (ADM-TRNG)*. Final review and sign-off of the data is performed by the department supervisor/manager or designee and consistent with the SOP for *Data Review (ADM-DREV)*.

10.2. It is the responsibility or the department supervisor/manager to document analyst training. Documenting method proficiency, as described in this SOP, is also the responsibility of the department supervisor/manager.

11. PROCEDURE

11.1. Vacuum Filtration

11.1.1. Set up the acid rinsed filtration apparatus (i.e. filter flask and filter holder) and connect to house vacuum. (Note: All samples must be filtered in the metals clean-room.)

11.1.2. Place a Hydrophyllic membrane filter in the filter holder and clean the filter by allowing approximately 200 mL of 25% HCl to filter through it. Rinse the acid from the filter by then allowing 800-1000 mL of deionized water to also pass through the filter. Remove the filter flask, empty its contents, rinse it thoroughly with deionized water, and replace in the filtration apparatus. The filter and apparatus are now ready for preparing the Filtration Blank.

11.1.3. Pass 500 mL of deionized water through the filter and into the filter flask. The filtrate in this step shall be the artificial sample composed of analyte-free water designed to monitor the introduction of artifacts into the filtration process. This sample is known as the Filtration Blank.

11.1.4. Pass the appropriate amount of unpreserved sample through the filter. (Note: the amount of sample filter depends on the tests being performed and the volume of sample provided by the client. As a general rule 500 mL is sufficient volume to filter.)

11.1.5. When the sample has completed filtering remove the filter flask and transfer the filtrate to a plastic metals bottle that has been label with the appropriate information (i.e. "Dissolved Metals", lab code, client ID.) Immediately preserve the sample with trace metals nitric acid to pH <2.

11.1.6. The sample is now ready for metals analysis.

11.2. Syringe Filtration

11.2.1. Remove the plunger from the syringe housing. Attach a new filter cassette to the housing and add approximately 25-30 mL of 25% HCl to the syringe. Re-insert the plunger and shake the assembly so that the HCl wets the entire inside surface. Remove the plunger; discard the HCl, then rinse the syringe housing and plunger vigorously with DI water.

11.2.2. Add a fresh 50 mL aliquot of 25% HCl to the syringe housing, insert the plunger, and then apply pressure to move the HCl through the filter. Remove the plunger again then fill the syringe with 60 mL of DI water. Re-insert the plunger and apply

pressure to move the DI water through the filter. Repeat the DI rinsing procedure two more times. The syringe apparatus is now ready for use.

11.2.3. After removing the plunger, place a maximum of 60 mL of unpreserved sample in the syringe. Re-insert the plunger and apply pressure to move the sample through the filter, collecting the filtrate in an appropriate pre-clean container.

11.2.4. Preserve the filtered sample as appropriate to the testing to be performed. Metals samples are preserved to pH <2 with nitric acid.

12. QUALITY CONTROL

12.1. Prepare a filtration blank (i.e. Deionized water taken through the filtration process just as a sample would be.) for each batch of sample filtered, each sample batch not to exceed twenty samples.

12.2. This blank can be analyzed if analysis results point to possible contamination during the filtration procedure.

13. TRAINING OUTLINE

13.1. Review the SOP. Also review the applicable MSDS for all reagents and standards used. Following these reviews, observe the procedure as performed by an experienced analyst at least three times.

13.2. The next training step is to assist in the procedure under the guidance of an experienced analyst for a period of 1 day. During this period, the analyst is expected to transition from a role of assisting, to performing the procedure with minimal oversight from an experienced analyst.

13.3. Perform Filtration Blank that is analyzed by the applicable methods to show Initial Demonstration of Capability (IDOC) as described in Section 11. Summaries of the Blank are reviewed and documented by using the appropriate training documentation for ***a non-spikable test*** and signed by the departments Technical Services Manager. Copies of the IDOC and Training Plan are forwarded to QA for record keeping.

13.4. Training is documented following the SOP *for Documentation of Training*.

14. CHANGES FROM PREVIOUS REVISION

14.1. **Sec** 1.1 added *inorganic chemistry*
14.2. Sec 2.1 second sentence is new
14.3. Sec 7.1 is new
14.4. Sec 11 added word *Vacuum Filtration*
14.5. Sec 11.1.2 replaced 300-500 with 800-1000
14.6. Sec 11.2 is new
14.7. Sec 13.3 and 13.4 updated

Attachments

Benchsheet

Columbia Analytical Services, Inc.

Service Request Number(s):

Analysis for:

Vacuum Filtration (Dissolved Metals)

Lab Code		Filtered Volume (ml)			Preservative	PH <2

Comments:

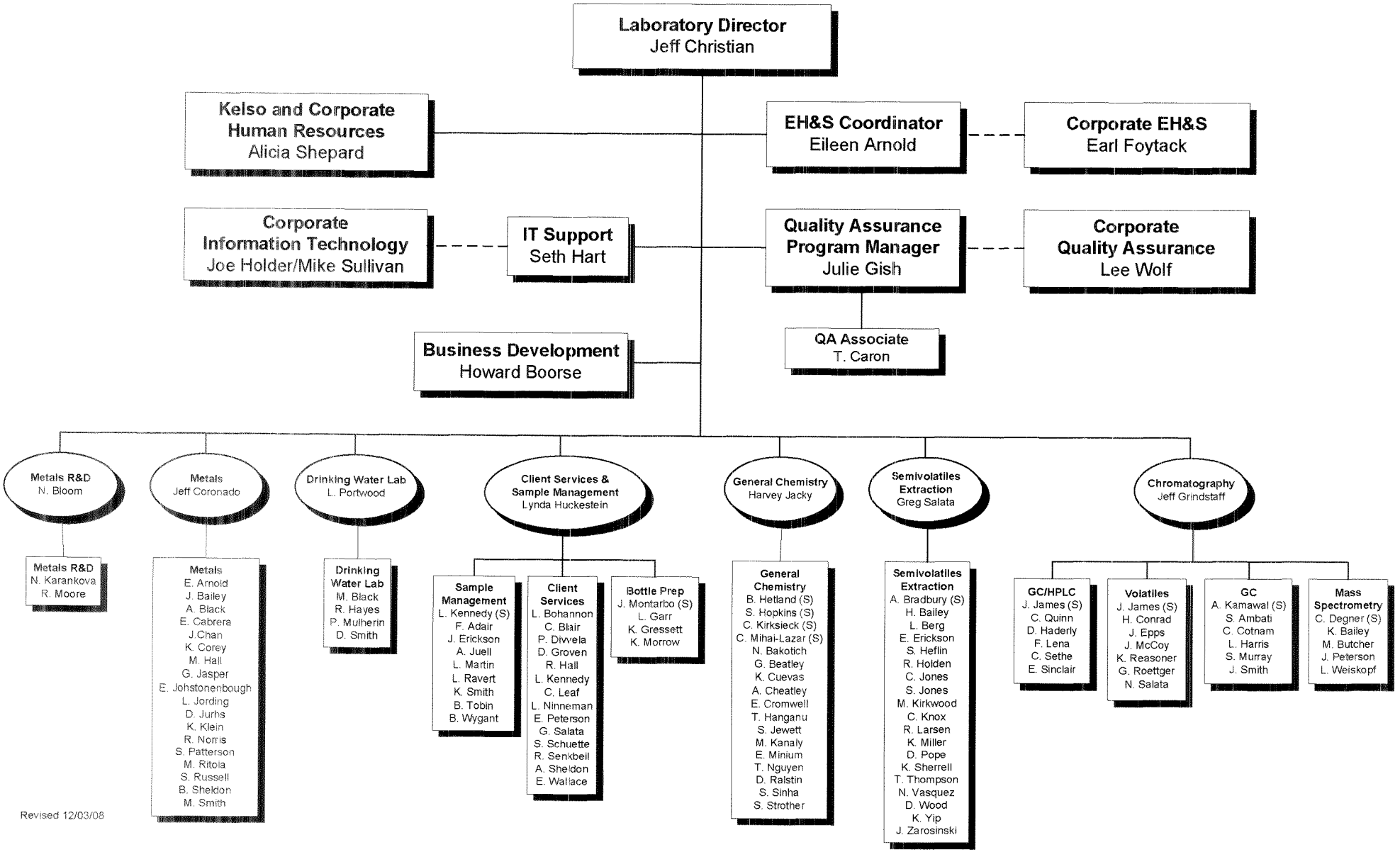
Analyst:	Date:
Reviewed:	Date:

APPENDIX B

ORGANIZATIONAL CHARTS and RESUMES OF KEY PERSONNEL

Columbia Analytical Services

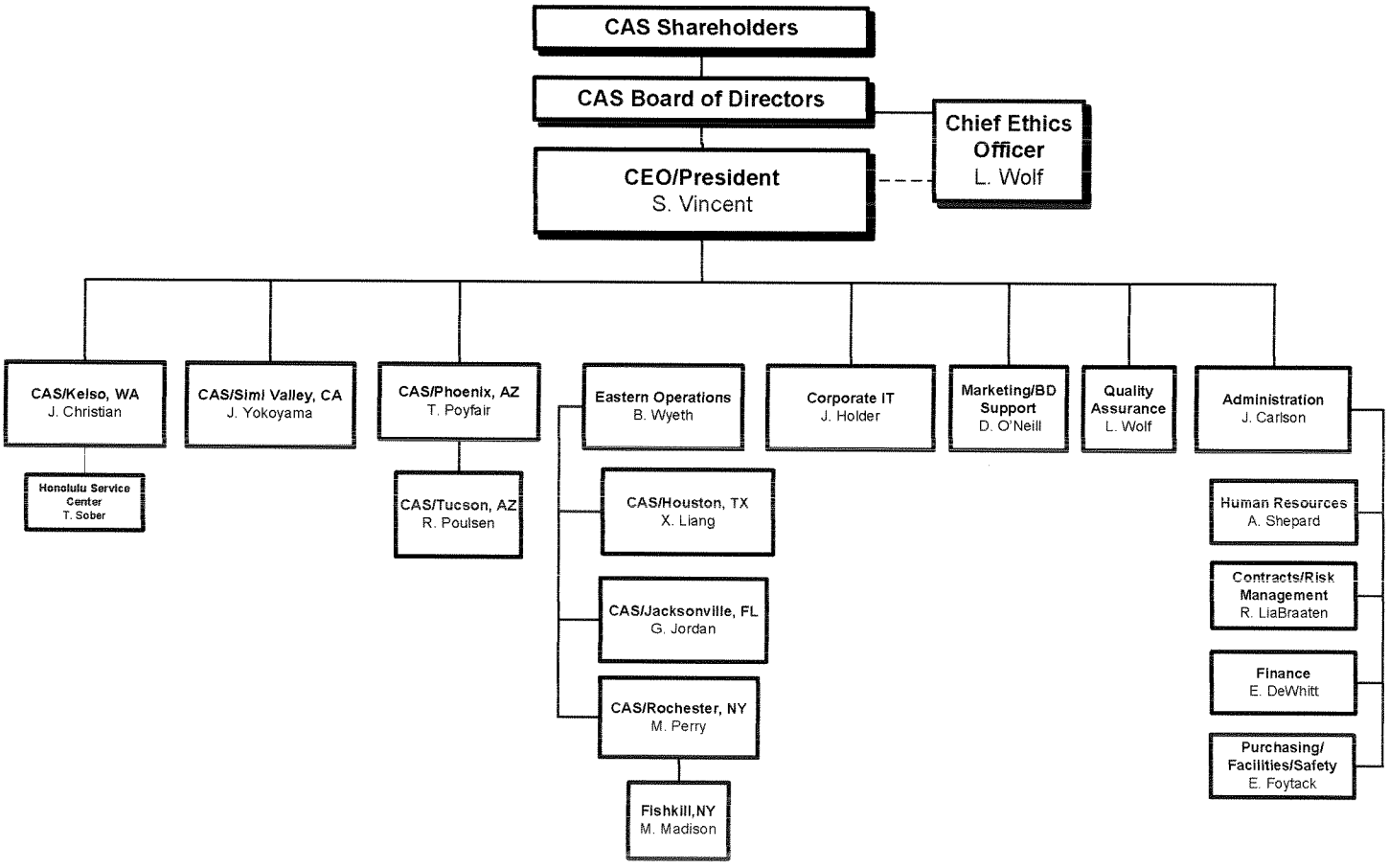
Environmental and General Testing Division
Kelso, Washington
Laboratory Organization



Revised 12/03/08

Columbia Analytical Services

Laboratory Division Organization



Revised 12/03/08

JEFFREY D. CHRISTIAN

1989 TO PRESENT

Columbia Analytical Services, Inc., 1317 S. 13th Avenue, Kelso, WA 98626 (360) 577-7222

Current Position

VICE PRESIDENT/NW REGIONAL DIRECTOR – 1996 to Present

Responsibilities

Responsible for all phases of laboratory operations at the Kelso (WA) and Redding (CA) facilities, including project planning, budgeting, and quality assurance. Primary duties include the direct management of the Kelso laboratory (i.e. serves as the Kelso Laboratory Director, 1993-present). Also responsible for additional duties acquired as a member of the Columbia Analytical Services Holdings, Inc., Board of Directors.

Experience

Laboratory Director, Kelso Laboratory, *Columbia Analytical Services, Inc., Kelso, Washington,* 1993-1995. Responsible for all phases of laboratory operations, including project planning, budgeting, and quality assurance.

Operations Manager, Kelso Laboratory, *Columbia Analytical Services, Inc., Kelso, Washington,* 1992-1993. Responsibilities included directing the daily operation of the Kelso laboratory. Other responsibilities and duties included functioning as a technical consultant to clients, providing assistance in developing and planning analytical schemes to match client objectives, and writing and developing analytical procedures/methods. Also, served as Project Manager for State of Alaska Department of Environmental Conservation contract and Coordinator for EPA Special Analytical Services (SAS) contracts.

Project Chemist and Manager, Metals Analysis Laboratory, *Columbia Analytical Services, Kelso, Washington,* 1989-1992. Responsible for directing the daily operation of the Metals Laboratory, including the sample preparation, AAS, ICP-OES, and ICP-MS Laboratories.

Scientist, *Weyerhaeuser Technology Center, Federal Way, Washington,* 1986-1989. Responsibilities included supervising atomic spectroscopy laboratory which included flame and furnace AAS, ICP-OES, and sample preparation capabilities to handle a wide variety of sample types. Interfaced with internal and external clients to provide technical support. Wrote and developed analytical procedures/methods.

Lead Technician, Metals Lab, *Weyerhaeuser Technology Center, Federal Way, Washington,* 1981-1986. Responsibilities included primary ICP and AAS analyst for EPA-CLP contract work. Extensive experience in wide variety of environmental and product-related testing.

Research Assistant, *ITT Rayonier, Olympic Research Division, Shelton, Washington,* 1978-1981. Responsibilities included performing water quality tests, product-related analytical tests, corrosion tests (i.e., potentiometric polarization techniques), and operated pilot equipment specific to the pulp and paper industry.

Education

B.S., Chemistry, *Evergreen State College, Olympia, Washington,* 1993.
ICP/MS Training Course, *VG-Elemental,* 1992.
Coursework, *Pacific Lutheran University, Tacoma, Washington.* 1988-1989.
Coursework, *Tacoma Community College, Tacoma, Washington.* 1970-1971, 1988-1989.
Perkin-Elmer Advanced Furnace, *Norwalk, Connecticut,* 1986.
CERTIFICATION, Chemistry, *L.H. Bates Technical, Tacoma, Washington,* 1978.
Coursework, *Central Washington University, Ellensburg, Washington.* 1969-1970.

Publications/ Presentations

On request.

JULIE GISH

1996 TO PRESENT

Columbia Analytical Services

Columbia Analytical Services, Inc., 1317 South 13th Ave., Kelso, WA 98626 360.577.7222

Current Position

TECHNICAL MANAGER I, KELSO LAB QUALITY ASSURANCE MANAGER – 2008 to Present

Responsibilities

Responsible for the overall implementation of the laboratory QA program. Responsible for the Quality Assurance Manual, certifications, documenting SOPs, and maintaining proficiency testing (PT) records. Oversee balance calibration and sample storage temperature control. Maintain certifications/accreditations for regulatory agencies and client certifications or approval programs. Act as primary point of contact during laboratory audits and provides audit responses and initiates any corrective actions. Coordinate the analysis and reporting of PT samples. Conduct internal audits and make recommendations for corrective action.

Experience

Scientist IV, Semi-Volatile Mass Spectrometry Laboratory, *Columbia Analytical Services, Inc., Kelso, Washington,* 2002-2008. Primary responsibilities were analysis, interpretation and report generation for semivolatile organics by GC/MS. Analyses included EPA 625, 8270, SIM, and other miscellaneous methodology.

Technical Manager I, Semi-Volatile GC Organics Laboratory, *Columbia Analytical Services, Inc., Kelso, Washington,* 1999-2002. Primary responsibilities include supervision and oversight of semi-volatile GC department. This includes initiating new methods, staff training, workload management, and instrument maintenance/troubleshooting. Duties include departmental compliance with CAS QA and Safety policies. Responsible for analysis, interpretation and report generation for pesticides and PCB's by EPA Methods 608, 8080, 8081, 8082, EPA 8141A, Organotins, and CLP Pesticides.

Scientist III, Semi-Volatile Organics Laboratory, *Columbia Analytical Services, Inc., Kelso, Washington,* 1996-1999. Primary responsibilities were analysis, interpretation and report generation for pesticides and PCB's by EPA Methods 608, 8080, 8081, 8082, and CLP-Pesticides. Secondary responsibilities include organics semi-volatile sample preparation.

Scientist, Volatile Organics Sample Preparation, *Employer's Overload, Longview, Washington – assigned to the Columbia Analytical Services, Inc., Kelso, Washington facility,* 1996. Primary duties included the preparation of water, soil, sediment and tissue samples using EPA Methods 3510, 3520, 3540, 3550, and 3545. Other duties were the further clean up of extracts using EPA Methods 3620 (Florsil), 3610 (Alumina), 3630 (Silica gel), 3650 (Acid/Base Partitioning), and 3660 (Sulfur).

Organics Chemist and GC/MS Chemist, *Coffey Laboratories, Portland, Oregon,* 1990-1996. Primary responsibilities included sample preparation and analysis for EPA FID, ECD, and HPLC using various EPA SW-846 and 500-series methods, as well as other methodology. Later, moved to GC/MS position which included sample preparation, analysis, and associated instrument maintenance for EPA Methods 625, 8027, and 525 BNA's. Also responsible for data review and approval of data packages.

QC Manager/QC Supervisor and Product Manager, Corn Products, *Frito-Lay, Inc., Vancouver, Washington,* 1982-1990. Manager of the QC department overseeing three supervisors and approximately 30 technicians. Responsible for department cost, accuracy, timeliness of data and safety performance. Later, responsible for production oversight of brand name snacks. Responsible for cost, quality and safety performance over three shifts. Managed four supervisors directly and approximately 60 employees indirectly.

Food Technologist, QA Department, *Kraft, Inc., Buena Park, California*, 1978-1981. Responsible for audits, formulations, finished product evaluation, batch reviews and technical support.

Education

MS, Food Science, Minor in Industrial Engineering, *Oregon State Univ. Corvallis, Oregon,* 1978.
BS, Food Science, Minor in Business Administration, *Utah State University, Logan, Utah,* 1975

Publications/ Presentations

Quality Improvement Team Leader, Coffey Laboratories, Portland, Oregon. 1991

Methods Improvement Program, Coffey Laboratories, Portland, Oregon. Seminars on Development and Implementation 1990.

Statistical Process Control and Total Quality Management, Frito-Lay, Vancouver, Washington. Routine Training Classes 1986-1988

LYNDA A. HUCKESTEIN

1989 TO PRESENT

Columbia Analytical Services, Inc., 1317 S. 13th Avenue, Kelso, WA 98626 (360) 577-7222

Current Position

CLIENT SERVICES MANAGER IV – 1998 to Present

Responsibilities

Management of the Client Services Departments: Project Management, Electronic Data Deliverables and Report Generation, and Sample Management. Personally responsible for approximately 1.5 million dollars of client work annually performing technical project management and client service. Provides technical and regulatory interpretation assistance as-well-as project organization to work received by the laboratory.

Documentation of Demonstration of Capabilities is available for review.

Experience

Project Chemist, *Columbia Analytical Service, Inc., Kelso, Washington,* 1992-1998. Primary responsibilities included technical project management and client service in areas of pulp & paper, marine services, mining, and DOD. Also responsible for providing technical and regulatory interpretation assistance as-well-as project organization to work received by the laboratory

Project Chemist and Department Manager, General Chemistry Laboratory, *Columbia Analytical Services, Inc.,* 1989-1992. Responsible for management of the General Chemistry laboratory for routine wastewater, bioassay, and microbiological analyses. Also responsible for supervision of staff, data review, and reporting.

Analyst III, *Columbia Analytical Services, Inc., Kelso, Washington,* 1989. Primary responsibilities included coliform testing, total recoverable petroleum hydrocarbon extractions and analysis, BODs, ammonias, and TKN, in addition to miscellaneous wet chemistry analyses.

Microbiologist/Chemist, *Coffey Laboratories, Portland, Oregon,* 1983. Coliform analysis; water chemistry.

Laboratory Assistant, *Oregon State University, Corvallis, Oregon,* 1983. Wheat spike dissection and tissue culture.

Education

BS, Microbiology, *Oregon State University, Corvallis, Oregon,* 1983.

JEFFREY A. CORONADO

1989 TO PRESENT

Columbia Analytical Services, Inc., 1317 S. 13th Avenue, Kelso, WA 98626 (360) 577-7222

Current Position

Responsibilities

TECHNICAL MANAGER IV, METALS DEPARTMENT MANAGER – 2001 to Present

Primary responsibilities include management of the Metals laboratory department. Responsible for training oversight, data review, report accuracy and timeliness QA/QC implementation, tracking department workload, and scheduling and performance of the Metals department. Also responsible for departmental budgets, method development efforts, and resource allocation.

Documentation of Demonstration of Capabilities is available for review.

Experience

Metals Department Manager, *Columbia Analytical Services, Inc., Kelso, Washington,* 1992-2001. Responsibilities included management of all aspects of the metal laboratory operation, including personnel training and evaluation, review of all metals data, and report generation. Also responsible for client service on a number of ongoing CAS accounts. Technical duties include primary analytical responsibility for trace level metals analysis by ICP/MS. Analyses range from routine water and soil analysis, to marine tissues, as well as industrial applications such as ultra-trace QA/QC work for various semiconductor clients. Also responsible for a number of specialized sample preparation techniques including trace metals in seawater by reductive precipitation, and arsenic and selenium speciation by ion-exchange chromatography. Developed methodology for performing mercury analysis at low part per trillion levels by cold vapor atomic fluorescence..

Supervisor, GFAA Laboratory, *Columbia Analytical Services, Inc., Kelso, Washington,* 1989-1992. Responsibilities included supervision of metals analysis by graphite furnace atomic absorption following SW-846 and EPA CLP methodologies. Duties include workload scheduling, data review, instrument maintenance, personnel training and evaluation.

Education

Field Immunoassay Training Course, *EnSys Inc.*, 1995.
Winter Conference on Plasma Spectrochemistry, *San Diego, California,* 1994.
ICP-MS Training Course, *VG-Elemental*, 1992.
BS, Chemistry, *Western Washington University, Bellingham, Washington,* 1988.
BA, Business Administration, *Western Washington University, Bellingham, Washington,* 1985.

JEFFREY A. GRINDSTAFF

1991 TO PRESENT

Columbia Analytical Services, Inc., 1317 S. 13th Avenue, Kelso, WA 98626 (360) 577-7222

Current Position

TECHNICAL MANAGER III, CHROMATOGRAPHY AND MASS SPECTROMETRY LABORATORIES – 1997 to Present

Responsibilities

Primary responsibilities include management of the GC/MS SemiVoa and VOA laboratory departments. Responsible for training oversight, data review, report accuracy and timeliness QA/QC implementation, tracking department workload, and scheduling and performance of the GC/MS departments. Also responsible for departmental budgets, method development efforts, and resource allocation. Also performs GC/MS maintenance and troubleshooting.

Documentation of Demonstration of Capabilities is available for review.

Experience

Manager, GC/MS VOA Laboratory, *Columbia Analytical Services, Inc., Kelso, Washington,* 1994-1997. Responsible for supervision of GC/MS VOA staff, method development, training, data review, tracking department workload, scheduling analyses, and general maintenance and troubleshooting of GC/MS systems.

Scientist III, GC/MS VOA Laboratory, *Columbia Analytical Services, Inc., Kelso, Washington,* 1991-1994. Responsibilities included scheduling workload, data review, instrument maintenance and troubleshooting, and personnel training and evaluation. Also responsible for supervision of extraction personnel and instrument analysts. Additional supervisory duties included report generation and data review for GC analyses. Responsibilities also included project management and customer service.

Chemist, *Enseco-CRL, Ventura, California,* 1990-1991. Established GC/MS department including inventory maintenance, preparation of state certification data packages, method development, SOPs, and extended data programs. Performed daily maintenance and troubleshooting of GC and GC/MS instrumentation. Scheduled and performed routine and non-routine VOA analyses.

GC/MS Chemist, VOA Laboratory *Coast-to-Coast Analytical Service, San Luis Obispo, California,* 1990-1991. Responsible for standard preparation for VOA analyses and instrument calibration, tuning, and maintenance. Also implemented and further developed EPA methods for quantitative analysis of pesticides and priority pollutants..

Education

Mass Selective Detector Maintenance, *Hewlett-Packard Education Center,* 1993.
Interpretation of Mass Spectra I, *Hewlett-Packard Analytical Education Center,* 1992.
B.S., Chemistry, *California Polytechnic State University, San Luis Obispo, California,* 1989.
A.A., Liberal Arts, *Allan Hancock College, Santa Maria, California.* 1986

Publications/ Presentations

Alternate Method to Lower Detection Limits to Satisfy Regulatory Action Levels for Volatiles in Groundwater, with David Edelman, Kairas Parvez, and Paul Laymon. TAPPI National Meeting, Orlando, Florida. 1996

Affiliations

American Chemical Society. 1989

HARVEY L. JACKY

1999TO PRESENT

Columbia Analytical Services™

Columbia Analytical Services, Inc., 1317 South 13th Ave., Kelso, WA 98626 360.577.7222

Current Position

TECHNICAL MANAGER II – 2008 to Present

Responsibilities

Oversee the operation of the General Chemistry and Microbiology groups. Responsible for the quality and timeliness of the inorganic laboratories analytical reports, departmental budgets, workload coordination, method development efforts, cost-effectiveness, and resource allocation.

Documentation of Demonstration of Capabilities is available for review.

Experience

Project Manager III, *Columbia Analytical Services, Inc., Kelso, WA*, 1999-2008. Responsible for technical project management, ensuring overall data quality and compliance with customer requirements, and providing technical support to clients regarding laboratory application to projects. Additionally, acts as a consultant to clients regarding industrial/environmental compliance issues; serving as liaison between clients and regulatory agencies.

Director of Project Management, *Coffey Laboratories, Portland, Oregon*, 1997-1999. Responsible for technical project management. Communicated with clients to determine needs and expectations. Monitored laboratory production and ensured the timely completion of analytical projects. Technical consultant for clients regarding environmental compliance. Supervised and managed other members of the project management team. Served as a member of the senior management team for oversight of general operations, strategic planning, finances, and policy.

Project Manager/Chemist, *Coffey Laboratories, Portland, Oregon*, 1997-1999. Served as primary liaison between Coffey Laboratories and major clients. Ensured that work was completed in a timely manner and done to client specifications. Served as technical consultant regarding environmental chemistry, soil remediation, and waste water industrial compliance. Clients included the Oregon Department of Transportation, Hazmat Unit, Portland, Oregon; Raythion Demilitarization Co., Umatilla, Oregon; Hydroblast - Wastewater Evaporator Systems, Vancouver, Washington; and Union Pacific Railroad, Northwest Region, Klamath Falls, Oregon.

Technical Sales Representative, *Coffey Laboratories, Portland, Oregon*, 1995-1997. Responsible for marketing and sales, including actively prospecting for new potential clients. Additional responsibilities included procurement and preparation of all major project bids; ensuring that client expectations were met; and maintaining customer satisfaction. Served as consultant regarding industrial compliance issues, environmental remediation projects, and hazardous waste management.

Senior Chemist/Laboratory Chemical Hygiene Officer, *Coffey Laboratories, Portland, Oregon*, 1988-1995. Performed analytical tests including Anions by Ion Chromatography (EPA 300.0), PAHs by HPLC (EPA 8310), Cyanides (EPA 335), and other inorganic, wet chemistry, and organic analytical tests on a wide variety of sample matrices. Responsible for the initial quality assurance review of work performed, supervised and managed personnel. Developed and implemented Laboratory Chemical Hygiene Plan. Directed personnel in regards to safety issues and hazardous waste management. Served as consultant and teacher regarding analytical methodology, environmental compliance, and industrial hygiene.

Education

40-Hour Hazmat Certification, *PBS Environmental*, 1996.
Industrial Emergency Response, *SFSP Seminar*, 1991
BS, Zoology, *Oregon State University, Corvallis, Oregon*, 1988.
BS, General Science, *Oregon State University, Corvallis, Oregon*, 1988.
COURSEWORK, General Studies, *Linfield College, McMinnville, Oregon*, 1981-1982.

Publications/ Presentations

Biochemical and Physical Factors Involved in the Application and Measurement of a Soil Bioremediation System. Biogeochemistry, Portland State University, 1996

LOREN E. PORTWOOD

1992 TO PRESENT

Columbia Analytical Services, Inc., 1317 S. 13th Avenue, Kelso, WA 98626 (360) 577-7222

Current Position

SCIENTIST IV, DRINKING WATER LABORATORY MANAGER– 2008 to Present

Responsibilities

Responsible for the overall operation and supervision of the Organic Drinking Water department, including oversight of UCMR2 analyses. Perform analyses and conduct data review. Perform method development. Work with project management of drinking water accounts. Development of Standard Operating Procedures for drinking water methods. Operation of Varian GC/MS, Agilent GC/ECD and Agilent HPLC.

Documentation of Demonstration of Capabilities is available for review.

Experience

Scientist IV, Drinking Water Laboratory, *Columbia Analytical Services, Inc., Kelso, Washington,* 2002-2008. Plan, conduct, and, as lead analyst, supervise analyses using advanced instrumentation such as HPLC with post column derivatization, GC/MS, and GC/ECD. Responsible for data interpretation, QC, and data reporting. Also responsible for preparation of SOPs; handling routine and advanced maintenance and troubleshooting of instrumentation; and assisting in the training of staff department analysts. Assists the department manager and/or other senior scientists in setting up more complex procedures.

Technical Manager I, Petroleum Hydrocarbon Laboratory Supervisor, Primary responsibilities included oversight of the PHC laboratory, including initiating new processes and staff development and training. Responsible for CAS QA compliance, routine system checks. Technical mentor to PHC staff. Also duties listed below under Scientist II and Scientist III.

Scientist III, Petroleum Hydrocarbon Laboratory, Columbia Analytical Services, Inc., Kelso, Washington, 1997-1998. Duties primarily as listed below.

Scientist II, Petroleum Hydrocarbon Laboratory, Columbia Analytical Services, Inc., Kelso, Washington, 1996-1997. Duties primarily as listed below, and including HPLC methods 8310, 8315, and 8330.

Scientist I, Petroleum Hydrocarbon Laboratory, Columbia Analytical Services, Inc., Kelso, Washington, 1993-1996. Primary responsibilities included the analysis, reporting, and archiving of water, soil, and product samples for semi-volatile petroleum hydrocarbons. Methods of analysis include EPA method 8015 and various state modifications thereof (OR, WA, CA, AK). Additional responsibilities include sample preparation, instrument maintenance, and assistance with other departmental analyses.

Bench Chemist I, Organic Extractions Laboratory, Columbia Analytical Services, Inc., Kelso, Washington, 1992-1993. Primary responsibilities included performing a wide range of organics extractions and cleanups for water, soil, and oil to be analyzed in the GC, GC/MS, and PHC laboratories.

Chemist, Treclen Laboratories, Spokane, Washington, 1990-1992. Primary responsibilities included inorganic water and soil testing by EPA methods. Developed testing which was accredited by the EPA, including metal digestions, phosphates, and TSS/ TDS.

Education

BS, Chemistry, Emphasis in Biochemistry, *Whitworth College, Spokane, Washington,* 1990.
Several vendor chromatography, GC, HPLC, and Quality training courses, 1993-2002.

EILEEN M. ARNOLD

1987 TO PRESENT

Columbia Analytical Services, Inc., 1317 S. 13th Avenue, Kelso, WA 98626 (360) 577-7222

Current Position

SCIENTIST IV, METALS LABORATORY, KELSO HEALTH AND SAFTEY OFFICER – 1994 to Present

Responsibilities

Duties include the operation and maintenance of the Inductively Coupled Argon Plasma (ICAP) Emission Spectrometer. This involves digestion, instrumental analysis, and report generation for environmental samples using approved EPA techniques. Health and Safety Officer responsibilities included development and implementation of the Kelso Health and Safety program, including accident investigation and incident review, maintenance of all safety related equipment and documents, and performance of monthly safety audits.

Documentation of Demonstration of Capabilities is available for review.

Experience

Project Chemist, Client Services Group, Kelso Health and Safety Officer, *Columbia Analytical Services, Inc., Kelso, Washington,* 1992-1994. Duties included technical project management and customer service. Responsible for meeting the clients' needs of timely and appropriate analyses, and to act as liaison for all client-related activities within Columbia Analytical Services, Inc. Health and Safety Officer responsibilities included development and implementation of the Kelso Health and Safety program, including accident investigation and incident review, maintenance of all safety related equipment and documents, and performance of monthly safety audits.

Scientist IV, Metals Laboratory, Health and Safety Officer, *Columbia Analytical Services, Inc., Kelso, Washington, 1987-1992.* Duties include the operation and maintenance of the Inductively Coupled Argon Plasma (ICAP) Emission Spectrometer. This involves digestion, instrumental analysis, and report generation for environmental samples using approved EPA techniques. Health and Safety Officer responsibilities included development and implementation of the Kelso Health and Safety program, including accident investigation and incident review, maintenance of all safety related equipment and documents, and performance of monthly safety audits.

Chemist, *Dow Corning Corporation, Springfield, Oregon,* 1986-1987. Responsibilities included ICP and atomic absorption work in silicon manufacturing. Methods development for ICP analysis of minor impurities found in silicon.

Chemist, *Ametek, Inc., Harleysville, Pennsylvania,* 1982-1985. Responsibilities included product research and development chemist involved in production of thin-film semiconductors for use as solar cells. Work involved AA and SEM techniques.

Chemist, *Janbridge, Inc., Philadelphia, Pennsylvania,* 1978-1982. Responsibilities included maintaining electroplating process lines through wet chemical analysis techniques, and performed Quality Assurance testing on printed circuit boards.

Education

BA, Chemistry, *Immaculata College, Immaculata, Pennsylvania,* 1977.

Affiliations

American Chemical Society, Member since 1987.

GREGORY G. SALATA

2003 TO PRESENT

Columbia Analytical Services™

Columbia Analytical Services, Inc., 1317 South 13th Ave., Kelso, WA 98626 360.577.7222

Current Position	**PROJECT/EXTRACTIONS MANAGER V** – 2003 to Present
Responsibilities	Responsibilities include Project Management, including quotation preparation and data reporting, as well as providing technical support to the laboratory as needed. Responsibilities also include oversight of the organic extractions lab, managing resources and providing technical support for all organic preparation work flows. 2003-Present.
Experience	**Project Manager,** *B&B Laboratories, College Station, Texas,* 1999-2003. Supervisor/responsible for analysis of TPH (waters, tissues, sediments), organotins (waters, tissues, sediments), Atterberg Limits (sediments), and total organic/inorganic carbon (sediments, waters). Also responsible for report generation on specific projects. Instrumentation operated included GCs with FID and FPD detectors, Combustion TOC, Water TOC, and Dionex Accelerated Solvent Extractor. **Graduate Student,** *Texas A&M University, College Station, Texas,* 1991-1999. While working toward MS in Oceanography, performed organic extractions for pesticides, PCBs, PAHs, and butyltins. While working toward Ph.D. in Oceanography determined stable carbon isotope ratios in sediments, waters, and bacterial phospholipid fatty acids. Other responsibilities included field sample collection, and operation/maintenance of FinniganMAT 252 isotope ratio MS. **Analytical Chemist,** *Science Applications International (SAIC), San Diego, California,* 1989-1990. Performed organic extraction and GC/FID analysis on sediment/rock samples for the Exxon Valdez oil spill. **GC Chemist,** *Analytical Technologies, San Diego, California,* 1987-1989. Responsible for analysis of volatile organics using purge and trap and GC/PID/ELCD.
Education	**Ph.D., Oceanography,** *Texas A&M University, College Station, Texas.* 1999 **MS, Oceanography,** *Texas A&M University, College Station, Texas.* 1993 **BA, Chemistry,** *University of California San Diego, Revelle College, La Jolla, California.* 1987
Publications/ Presentations	*Dr. Salata has a number of publications and published abstracts. For a list of these publications and published abstracts, please contact CAS.*
Affliations	American Chemical Society

LEE E. WOLF

1988 TO PRESENT

Columbia Analytical Services™

Columbia Analytical Services, Inc., 1317 South 13th Ave., Kelso, WA 98626 360.577.7222

Current Position

QUALITY ASSURANCE DIRECTOR AND CHIEF QUALITY OFFICER – 2008 to Present

Responsibilities

Directing the overall corporate-wide quality systems and ethics programs for all CAS facilities. Responsible for ensuring that CAS quality systems and data integrity standards are implemented at all facilities. Act as liaison with government entities involving quality, technical and operational issues. Provide QA input and policy as needed for operations, development initiatives, special projects, planning, and information technology implementation. Provide assistance to QA Program Managers.

Experience

Technical Manager IV, Quality Assurance Program Manager, *Columbia Analytical Services, Inc., Kelso, Washington* – 2002 to 2008. As part of the management team, responsibilities included the overall management and implementation of the laboratory QA program. This included maintaining accreditations and certifications, and maintaining all necessary documents (QA Manual, SOPs, and QA records). Acted as primary point of contact during laboratory audits and provided audit responses and corrective actions. Coordinated performance audits (PE/PT testing) and conducted internal audits.

Scientist IV, Quality Assurance Program Manager, *Columbia Analytical Services, Inc., Kelso, Washington,* 1996-2002. Duties primarily as listed above.

Project Chemist/Principal Organic Scientist, *Columbia Analytical Services, Inc., Kelso, Washington,* 1994-1996. Responsibilities included GC and GC/MS method development and special projects coordination. Acts as technical advisor to the GC and GC/MS laboratories and GC/MS interpretation specialist and CLP organics specialist. Also responsible for Project Chemist functions, including management of projects for clients, identifying client needs, and preparation of data reports.

Semivolatile Organics Department Manager, *Columbia Analytical Services*, 1988-1994. Responsibilities included overall management of the department. Supervised GC/MS analyses, data review, reporting and related QA/QC functions. Responsible for supervision of staff, training, and scheduling. Beginning in 1992, responsibilities included being a Project Chemist for organics EPA-SAS and other clients. This involved scheduling projects for clients, identifying client requirements, and preparing data reports.

GC/MS Chemist, *U.S. Testing Co., Richland, Washington*, 1985-1988. Responsibilities included GC and GC/MS analysis of water and soil samples for volatiles and semivolatiles by EPA protocol, including Methods 8240, 8270 and CLP. Coordinated extraction and GC-GC/MS areas to manage sample/data flow through the lab. Also performed HPLC analysis and pesticide analysis by GC using EPA Methods.

Laboratory Assistant, *Eastern Washington University, Cheney, Washington,* 1985. Responsibilities included supervision and instruction of organic chemistry labs. Experience with GC and IR operation. Responsible for lab safety.

Education

Pharmaceutical Laboratory Control Systems, *Univ. of Wisconsin Short Course, Las Vegas,* 2004
Test Method Validation in Pharmaceutical Development and Production, *Univ. of Wisconsin Short Course, Las Vegas,* 2004
Documenting Your Quality System, *A2LA Short Course, Las Vegas, Nevada*, 1998.
Internal Laboratory Audits, *A2LA Short Course, Las Vegas, Nevada,* 1998.
Mass Spectra Interpretation, *ACS Short Course, Denver, Colorado*, 1992.
BS, Chemistry, *Eastern Washington University, Cheney, Washington,* 1985.

Publications/ Presentations

Selected Ion Monitoring: Issues for Method Development, Panel Discussion, Association of Official Analytical Chemists, (AOAC) Pacific Northwest Regional Meeting, 1995.

Method Enhancement Techniques for Achieving Low level Detection of Butyl Tin in Marine Sediments and Tissues, Association of Official Analytical Chemists (AOAC) Pacific Northwest Regional Meeting, 1994.

The Determination of Low-Level Concentrations of Polynuclear Aromatic Hydrocarbons (PAHs) in Soil and Water Using Gas Chromatography/Mass Spectroscopy Selected Ion Monitoring (GC/MS SIM), HazMat West, Long Beach, California, 1992.

STEPHEN W. VINCENT

1986 TO PRESENT

Columbia Analytical Services, Inc., 1317 S. 13th Avenue, Kelso, WA 98626 (360) 577-7222

Current Position Responsibilities

PRESIDENT, CAS HOLDINGS INC. – 1986 to Present

Responsible for the overall growth and profitability of the CAS laboratory network. This includes establishing and implementing long-range objectives, plans, and policies, and representing the company with its major customers, technical community, and the public.

Experience

Laboratory Manager, *Weyerhaeuser Company, Federal Way, Washington,* 1979-1986. Responsibilities involved all phases of technical and administrative management. This included management of organic, inorganic, and microbiological analyses and management of capital; an annual operating budget of approximately $2 million; management of thirty staff members; contract procurement, and project management. Projects included an EPA Inorganic CLP contract; an EPA acid rain deposition contract; a contract with the Fish and Wildlife Service to measure trace organic contaminants in animal tissues; and others.

Analytical Chemist, *Weyerhaeuser Company, Longview, Washington,* 1975-1979. Responsibilities: Method development, routine analysis and supervision for the Weyerhaeuser Multi-Region Support Lab. Responsible for setting up a company-wide laboratory audit, round robin, and quality assurance program.

Education

Market Strategy for Technology Based Companies, *Executives Program, Stanford University.* 1994.

Advanced Technical Management Program, *University of California at Los Angeles, Department of Business, Engineering and Management,* 1991.

Completion of Coursework for MS, Pulp and Paper Technology, *University of Washington, Seattle, Washington,* 1984.

Post Graduate Coursework, Engineering and Management, *University of California at Los Angeles, Graduate School of Engineering and Applied Science, Los Angeles, California,* 1981.

BS, Oceanography, *University of Washington, Seattle, Washington,* 1974.

Publications/ Presentations

Mr. Vincent has a number of publications and presentations. For a list of these publications and presentations, please contact CAS.

Affiliations

American Chemical Society.
Technical Association of the Pulp and Paper Industry.

APPENDIX C

MAJOR ANALYTICAL EQUIPMENT

GENERAL CHEMISTRY/WATER CHEMISTRY LABORATORY			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
Analytical Balances (10):			
Precisa and Mettler models	1988-2008	MM	15
Autoclave - Market Forge Sterilmatic	1988	LM	5
Autotitrator – Thermo Orion 500	2007	LM	3
Calorimeters (2):			
Parr 1241 EA Adiabatic	1987	LM	4
Parr 6300 Isoparabolic	2005	LM	4
Centrifuge - Damon/IEC Model K	1992	LM	15
Colony Counter - Quebec Darkfield	1988	LM	4
Conductivity Meters (2):			
YSI Model 3200	2004	LM	4
VWR	2001	LM	4
Digestion Systems (5):			
COD (4)	1987, 1989	LM	5
Kjeldahl, Lachat 46-place (1)	1999	LM	3
Dissolved Oxygen Meter - YSI Model 58 (3)	1987, 1988, 1991	LM	5
Distillation apparatus (Midi) - Easy Still (2)	1996, 2000	LM	7
Drying Ovens (11):			
Shel-Lab and VWR models	1988 - 2003	LM	15
Flash Point Testers (2):			
ERDCO Setaflash Tester	1991	LM	4
Petroleum Systems Services	2005	LM	4
Flow-Injection Analyzers (2):			
Bran-Leubbe	2002	LM	4
Lachat 8500	2007	LM	4
Ion Chromatographs (4)			
Dionex 2000i with Peaknet Data Systems	1988	LM	3
Dionex DX-120 with Peaknet Data System	1998	LM	3
Dionex ICS-2500 with Chromchem Data System	2002	LM	3
Dionex ICS-2000 with Chromchem Data System	2006	LM	3
Ion Selective Electrode Meters (5)			
Fisher Scientific Accument Model 50	1997	LM	6
Fisher Scientific Accument Model 25	1993	LM	6
Fisher Scientific Accument Model 20	2000	LM	6
Orion Model 920A	1990	LM	6
Corning pH/ion Meter Model 135	1992	LM	6
Microscope - Olympus	1988	LM	1
Muffle Furnace- Sybron Thermolyne Model F-A1730	1991	LM	15
pH Meters (2):			
Fisher Scientific Accument Model 20	1993	LM	6
Fisher Scientific Accument Model AR25	2005	LM	6

GENERAL CHEMISTRY/WATER CHEMISTRY LABORATORY (continued)			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
Shatter Box - GP 1000	1989	LM	5
Sieve Shakers (2):			
CE Tyler - Portable RX 24	1990	LM	5
WS Tyler - RX 86	1991	LM	5
Thomas-Wiley Laboratory Mill, Model 4	1989	LM	7
Total Organic Carbon (TOC) Analyzers (2)			
Coulemetrics Model 5012	1997	LM	3
O-I Corporation Model 1010	2002	LM	3
Total Organic Halogen (TOX) Analyzers (3):			
Mitsubishi TOX-Sigma	1995	LM	4
Mitsubishi TOX-100 (2)	2001	LM	4
Turbidimeter - Hach Model 2100N	1996	LM	8
UV-Visible Spectrophotometers (3):			
Hitachi 100-40 Single Beam	1986	LM	5
Beckman-Coulter DU520	2005	LM	5
Perkin Elmer Lambda 25	2008	LM	5
Vacuum Pumps (2):			
Welch Duo-Seal Model 1376	1990	LM	13
Busch R-5 Series Single Stage	1991	LM	13
Water Baths/Incubators (6):			
Hach Model 15320 Incubator	1986	LM	15
Precision Model L-6 (2)	1989, 1990	LM	15
VWR 1540	1991	LM	15
Fisher 11-680-626M Incubator	1992	LM	15
Fisher Isotemp Incubator	2001	LM	15

METALS LABORATORY			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
Analytical Balance (6)			
Mettler AE 200 analytical balance	1990	MM	12
Various Mettler, Sartorius, and Ohaus models (5)	1988	MM	12
Atomic Absorption Spectrophotometers (5):			
Varian SpectrAA Zeeman/220 AA w/Data Systems (2)	2000	LM	3
CETAC Mercury Analyzer	2000	LM	2
Perkin Elmer AAnalyst 200 Flame AA	2005	MM	2
Atomic Fluorescence Spectrophotometer			
Brooks-Rand Model III (2)	1996, 2005	LM	3
Leeman Mercury Analyzer (1)	2006	LM	2
Centrifuge - IEC Model Clinical Centrifuge	1990	LM	12
Drying Oven - VWR Model 1370F	1990	LM	12
Freeze Dryers (2) - Labconco	1992, 2006	LM	5
Inductively Coupled Plasma Atomic Emission Spectrometer (ICP-AES) (3)			
Thermo Jarrell Ash Model 61E	1988	LM	4
Thermo Jarrell Ash, Model IRIS	2000	MM	4
Thermo Scientific Model iCAP 6500	2007	MM	3
Inductively Coupled Plasma Mass Spectrometers (ICP-MS):			
VG Excell	2001	MM	3
Thermo X-Series	2006	MM	2
Muffle Furnace - Thermolyne Furnatrol Model 53600 (2)	1991, 2005	LM	5
Shaker - Burrell Wrist Action Model 75	1990	LM	12
TCLP Extractors (3)	1989, 2002	LM	5

SEMIVOLATILE ORGANICS SAMPLE PREPARATION LABORATORY			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
Analytical Balance (4)			
Mettler PM480, AE166, BB300	1999 - 2005	MM	18
OHaus EP613	2006	MM	18
Centrifuge - Sorvall Model GLC-1	1988	LM	18
Drying Ovens (2)			
Fisher Model 655G	1991	LM	18
VWR Model 1305U	1999	LM	18
Evaporators (14):			
Organomation N-Evap (7)	1989-98, 2001, 2006	LM	18
Organomation S-Evap (7)	1989-1991, 2006	LM	18
Extractor Heaters: Lab-Line Multi-Unit Models for Continuous Liquid-Liquid and Soxhlet Extractions (102)	1987-1992, 2007	LM	12
Extractors (52):			
Branson Model 450 Sonifier (2)	1991	LM	6
Tekmar Sonicator	1994	LM	6
Fisher Scientific Sonicator	1994	LM	6
Soxhtherm (48)	2000, 2008	LM	8
Extractors, TCLP (10):			
Millipore TCLP Zero Headspace Extractors (10)	1987-1992	LM	2
TCLP Extractor - Tumbler (12 position)	1989	LM	2
Gel Permeation Chromatography (GPC) (5)			
ABC single column (3)	1998, 1999, 2007	LM	4
ABC Autoprep 1000	1995	LM	4
J2 Scientific	2005	LM	4
Muffle Furnace - 4	1994-2006	LM	4
Solid Phase Extractors (8) – Horizon SPE-Dex 4790	2003, 2006	LM	4
Ultrasonic Water Bath – VWR 550D	2007	LM	18
Vacuum Pump – Edwards	1992	LM	8

GC SEMIVOLATILE ORGANICS INSTRUMENT LABORATORY			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
Analytical Balance - Mettler AT 250	1989	MM	7
Chromatography Data Systems (12) HP Enviroquant (8) Thruput Target (4)	 1994-2002 1998-2000	 LM LM	7
Gas Chromatographs (11): Hewlett-Packard 5890 GC with HP 7673 Autosampler and Dual ECD Detectors (4) Hewlett-Packard 5890 GC with HP 7673 Autosampler and Dual FPD Detectors Agilent 6890 GC with Agilent 7683 Autosampler and Dual ECD Detectors (5) Agilent 6890 GC with Agilent 7683 Autosampler and Dual FPD Detectors Agilent 7890A Dual ECD Detectors Agilent 7683B autosampler	 1990 – 1995 1991 2001, 2005, 2007 2003 2008	 LM LM LM LM LM	 7 7 7 7 7

GC/MS SEMIVOLATILE ORGANICS INSTRUMENT LABORATORY			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
Accelerated Solvent Extractor - Dionex ASE 200	1996	LM	5
HP Enviroquant Chromatography Data Systems (9)	1994-2002	LM	5
Gas Chromatograph: Hewlett-Packard 5890 with HP 7673 autosampler and FID Detector	1994	LM	5
Semivolatile GC/MS Systems (9): Agilent 6890/5973 with ATAS Optic2 LVI and HP 7673 Autosampler (2) Agilent 5890/5970 and HP 7673 Autosampler Agilent 5890/5970 with ATAS Optic2 LVI and HP 7673 Autosampler Agilent 5890/5972 with ATAS Optic2 LVI and HP 7673 Autosampler (3) Agilent 6890/5973 with ATAS Optic3 LVI and 7683 Autosampler Agilent 6890/5973 with Agilent PTV Injector and 7683 Autosampler	 1997, 2001 1990 1994 1993, 1994, 1998 2004 2007	 LM LM LM LM LM LM	 5 5 5 5 5 4
Semivolatile GC/MS/MS – Waters Quattro Micro GC Micromass with Agilent 6890, Agilent PTV Injector, 7683B Autosampler	2008	MM	1

PETROLEUM HYDROCARBONS GC/HPLC LABORATORY			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
Analytical Balance - Mettler BB240	1994	MM	6
Aspirator pump – GAST	2004	LM	6
Drying Oven - Fisher Model 630F	1991	LM	6
Evaporator - Organomation N-Evap	1990	LM	6
HP Enviroquant Chromatography Data Systems (8)	1994-2002	LM	6
Gas Chromatographs (6):			
Hewlett-Packard 5890 Series II with PID/PID/FID(2)	1991	LM	4
EST-ENCON Purge and Trap Concentrator	1991	LM	4
Dynatech Archon 5100 Autosampler	1992	LM	4
Hewlett-Packard 5890 GC with HP 7673 Autosampler and FID Detector	1995	LM	4
Agilent 6890 with Dual FID Detectors and Agilent 7873 Autosampler (3)	2001, 2005	LM	4
High-Performance Liquid Chromatographs (2):			
HP 1090M Series II with Diode Array UV Detector	1999	LM	4
HP 1050/1100 Series with Fluorescence & Diode Array UV Detectors	2004	LM	4
High-Performance Liquid Chromatograph/Mass(2)			
Spectrometer - Thermo Electron TSQ Quantum LC/MS/MS and Autosampler	2005	MM	2
API 5000 LC/MS/MS and SIL-20AC Autosampler	2008	MM	2

VOLATILE ORGANICS LABORATORY			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
Analytical Balance - Mettler PE 160	1989	MM	5
Fisher Vortex Mixer	1989	LM	5
HP Enviroquant Chromatography Data Systems (10)	1994-2002	LM	5
Drying Ovens (2):			
Narco 420	1989	LM	5
VWR 1305 U	1991	LM	5
Sonic Water Bath - Branson Model 2200	1989	LM	5
Volatile GC/MS Systems (7):			
Agilent 5890/5970	1989	LM	5
Tekmar 3000 Purge and Trap Concentrator	1995	LM	5
Dynatech ARCHON 5100 Autosampler	1996	LM	5
Agilent 5890/5971	1991	LM	5
Tekmar 3000 Purge and Trap Concentrator	2001	LM	5
Dynatech ARCHON 5100 Autosampler	1995	LM	5
Agilent 5890/5972A	1993	LM	5
Tekmar 3000 Purge and Trap Concentrator	1995	LM	5
Dynatech ARCHON 5100 Autosampler	1996	LM	5
Agilent 6890/5973	2001	LM	5
Tekmar 3100 Purge and Trap Concentrator	2001	LM	5
Varian Archon Autosampler	2001	LM	5
Agilent 6890/5973	2005	LM	5
Tekmar Velocity Purge and Trap Concentrator	2005	LM	5
Tekmar Aquatech Autosampler	2005	LM	5
Agilent 6890/5973 (2)	2007	LM	5
Tekmar 3000 Purge and Trap Concentrator	2007	LM	5
Varian Archon 5100 Autosampler	2007	LM	5

DRINKING WATER ORGANICS LABORATORY			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
Analytical Balance - Mettler BB300	1991	MM	2
Extractors (10) – Horizon SPE-DEX Solid Phase Extractor	2003/2008	LM	2
Aglinet Enviroquant Chromatography Data Systems (2)	2003	LM	2
Varian Saturn Chromatography Data System	2003	LM	2
Evaporator - Organomation N-Evap	2003	LM	2
Agilent 1100 HPLC w/post-column derivitization:	2003	LM	2
UV/Fluoescence detectors	2003	LM	2
Pickering PCX-5200 Post-column derivitization unit	2003	LM	2
Agilent 6890N GC/Dual ECD system w/ autosamplers	2003	LM	2
Agilent 7890 GC/Dual ECD w/autosamplers	2008	LM	2
Varian Ion trap GC/MS:	2003	LM	2
Varian 3800 GC w/CP8400 autosampler	2006	LM	2
Varian Saturn 2100T mass spectrometer	2003	LM	2
Thremo Ion Trap GC/MS w/TriPlus autosampler	2008	LM	2

Metals Method Development Laboratory			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
Perkin-Elmer ICP/MS Elan 9000 w/ Perkin-Elmer AS-93+ Autosampler	2008	LM	2
Perkin-Elmer Series 200 IC	2008	LM	2
Brooks Rand III Atomic Fluoresence Spectrophotometer - 2	2008	LM	2
Oriel Atomic Fluoresence Spectrophotometer – Lab Designed	2008	LM	2
Balances - 4	2008	LM	2
Ovens - 2	2008	LM	2
Buck AA Spectrophotometer Model 205	2008	LM	2
Forma Scientific Bio Freezer	2008	LM	2
Digital Shaker SK-71	2008	LM	2

AUTOMATED DATA PROCESSING EQUIPMENT			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
1-WAN: LIMS Sample Manager using Oracle 10g DBMS running on Redhat Advanced Server 3.0 (Linux) platform connected/linked on a frame relay WAN environment	1994-2004	LM	NA
1 - Network Server Pentium 4 class, 1 for Reporting and Data Acquisition running Windows 2003 Advanced Server, 1 for Applications running Windows 2003 Advanced Server. Data acquisition capacity at 65GB with redundant tape and disk arrays.	2004	LM	NA
Approximately 50+ HP and Dell Laserjet printers (various types including models III, 4, 5, 8150, 4000, 4050, 4250, 8150, 1720dn, W5300)	1991 - 2007	LM	NA
Approximately 180 Gateway/Dell PC/Workstations running Windows 2000/XP on LAN connected via 10BT/100BT and TCP/IP for LIMs Terminal Emulation	1993 - 2004	LM	NA
Microsoft Office 2003 Professional as the base application for all PC/Workstations. Some systems using Office 2000/97.	1996 - 2004	LM	NA
E-Mail with link to SMTP for internal/external messaging. Web mail via Outlook Web Access interface. Microsoft Outlook 2003.	1994 - 2006	LM	NA
Standard Excel (R) reporting platform application linked to LAN/WAN for data connectivity and EDD generation.	1996 - 2004	LM	NA
Standard Excel (R) reporting platform application linked to LAN/WAN for data connectivity and EDD generation.	1996 - 2004	LM	NA
Facsimile Machines - Brother 4750e (2); Brother SuperG3 (1); Canon CFX-L4000 (1)	1991 - 2007	LM	NA
Copiers/Scanners: Konica BizHub 420 (1), BizHub 600 (1), BizHub 920 (2), BizHub Pro 1050 (3). The 920s and 1050s are accessible via LAN for network scanning.	2000 - 2007	LM	NA
Dot Matrix Epson FX-880, LQ-1050, LX-300	1991 - 2004	LM	NA
Thruput, MARRS, Stealth, Harold, Blackbird, EDDGE, StarLIMS reporting software systems.	1998 - 2004	LM	NA

NA: Not applicable. This equipment administered by IT staff but may be used by all staff.

APPENDIX D

PREVENTIVE MAINTENANCE PROCEDURES

Instrument	Activity	Frequency
Refrigerators and Coolers	Record temperatures	Daily
	Clean coils	Annually
	Check coolant	Annually or if temperature outside limits
Vacuum Pumps	Clean and change pump oil	Every month or as needed
Fume Hoods	Face velocity measured	Quarterly
	Sash operation	As needed
	Change filters	Annually
	Inspect fan belts	Annually
Ovens	Clean	As needed or if temperature outside lim.
	Record temperatures	Daily, when in use
Incubators	Record temperatures	Daily, morning and evening
Water Baths	Record temperatures	Daily, morning and evening
	Wash with disinfectant solution	When water is murky, dirty, or growth appears
Autoclave	Check sterility	Every month
	Check temperature	Every month
	Clean	When mold or growth appears
Analytical Balances	Check alignment	Before every use
	Check calibration	Daily
	Clean pans and compartment	After every use
Dissolved Oxygen Meter	Change membrane	When fluctuations occur
pH probes	Condition probe	When fluctuations occur
Fluoride ISE	Store in storage solution	Between uses
Ammonia ISE	Store in storage solution	Between uses
UV-visible Spectrophotometer	Wavelength check	Annually
Total Organic Carbon Analyzers	Check IR zero	Weekly
	Check digestion/condensation vessels	Each use
	Clean digestion chamber	Every 2000 hours, or as needed
	Clean permeation tube	Every 2000 hours, or as needed
	Clean six-port valves	Every 200 - 2000 hours, or as needed
	Clean sample pump	Every 200 - 2000 hours, or as needed
	Clean carbon scrubber	Every 200 - 2000 hours, or as needed
	Clean IR cell	Every 2000 - 4000 hours, or as needed

Instrument	Activity	Frequency
Total Organic Halogen Analyzers	Change cell electrolyte	Daily
	Change electrode fluids	Daily
	Change pyrolysis tube	As needed
	Change inlet and outlet tubes	As needed
	Change electrodes	As needed
Flow Injection Analyzer	Check valve flares	Each use
	Check valve ports	Each use
	Check pump tubing	Each use
	Check light counts	Each use
	Check flow cell flares	Quarterly
	Change bulb	As needed
	Check manifold tubing	Each use
	Check T's and connectors	Each use
Ion Chromatographs	Change column	Every six months or as needed
	Change valve port face & hex nut	Every six months or as needed
	Clean valve slider	Every six months or as needed
	Change tubing	Annually or as needed
	Eluent pump	Annually
Atomic Absorption Spectro-photometers - FAA and CVAA	Check gases	Daily
	Clean burner head	Daily
	Check aspiration tubing	Daily
	Clean optics	Every three months
	Empty waste container	Weekly
Atomic Absorption Spectro-photometers - GFAA	Check gases	Daily
	Check argon dewar	Daily
	Change graphite tube	Daily, as needed
	Clean furnace windows	Monthly
ICP - AES	Check argon dewar	Daily
	Replace peristaltic pump tubing	Daily
	Empty waste container	Weekly
	Clean nebulizer, spray chamber, and torch	Every two weeks
	Replace water filter	Quarterly
	Replace vacuum air filters	Monthly

Instrument	Activity	Frequency
ICP - MS	Check argon dewar	Daily
	Check water level in chiller	Daily
	Complete instrument log	Daily
	Replace peristaltic pump tubing	Daily
	Clean sample and skimmer cones	As needed
	Clean RF contact strip	As needed
	Inspect nebulizer, spray chamber, and torch	Clean as needed
	Clean lens stack/extraction lens	As needed
	Check rotary pump oil	Monthly
	Change rotary pump oil	Every six months
Gel-Permeation Chromatographs	Clean and repack column	As needed
	Backflush valves	As needed
High Pressure Liquid Chromatographs	Backflush guard column	As needed
	Backflush column	As needed
	Change guard column	As needed when back pressure too high
	Change column	Annually or as needed
	Change in-line filters	As needed
	Leak check	After column maintenance
	Change pump seals	As needed
	Change pump diaphragm	Annually
	Clean flow cell	As needed
	Fluorescence detector check	Daily
	Diode array absorbance check	Daily
Gas Chromatographs, Semivolatiles	Check gas supplies	Daily, replace if pressure reaches 50psi
	Change in-line filters	Quarterly or after 30 tanks of gas
	Change septum	Daily
	Change injection port liner	Weekly or as needed
	Clip first 6-12" of capillary column	As needed
	Change guard column	As needed
	Replace analytical column	As needed when peak resolution fails
	Check system for gas leaks	After changing columns and after any power failure
	Clean FID	Weekly or as needed
	Clean ECD	Quarterly or as needed
	Leak test ECD	Annually

Instrument	Activity	Frequency
Gas Chromatograph/Mass Spectrometers, Semivolatiles	Check gas supplies	Daily, replace if pressure reaches 50psi
	Change in-line filters	Annually or as needed
	Change septum	Daily, when in use
	Change injection port liner	Weekly or as needed
	Clip first 6-12" of capillary column	As needed
	Change guard column	As needed
	Replace analytical column	As needed when peak resolution fails
	Clean source	As needed when tuning problems
	Change pump oil	As specified by service specifications
Purge and Trap Concentrators	Change trap	Every four months or as needed
	Change transfer lines	Every six months or as needed
	Clean purge vessel	Daily
Gas Chromatographs, Volatiles	Check gas supplies	Daily, replace when pressure reaches 50 psi
	Change in-line filters	Quarterly or after 30 tanks of gas
	Change septum	Daily
	Clip first 6-12" of capillary column	As needed
	Change guard column	As needed
	Replace analytical column	As needed when peak resolution fails
	Check system for gas leaks	After changing columns and after any power failure
	Clean PID lamp	As needed
	Clean FID	As needed
	Change ion exchange resin	Every 60 days
	Replace nickel tubing	Quarterly or as needed
Gas Chromatograph/Mass Spectrometers, Volatiles	Check gas supplies	Daily, replace when pressure reaches 50 psi
	Change in-line filters	Annually or as needed
	Change septum	Daily
	Clip first foot of capillary column	As needed
	Change guard column	As needed
	Replace analytical column	As needed when peak resolution fails
	Clean jet separator	As needed
	Clean source	As needed when tuning problems
	Change pump oil	As specified by service specifications

APPENDIX E

LIST OF NELAC ACCREDITED METHODS

APPENDIX F

ADDITIONAL AGENCY-SPECIFIC DOCUMENTS

APPENDIX E

QUALITY ASSURANCE/ QUALITY CONTROL MANUAL FOR PACIFIC ECORISK

CONTENTS

This Appendix contains all the material pertinent to Pacific EcoRisk's Quality Assurance and Quality Control (QA/QC) program, both in general and specific to the particular studies required for accomplishing the data quality objectives of the Phase 2 Sediment Study. Specifically, this Appendix includes the following items:

1. **Pacific EcoRisk's Quality Assurance (QA) Manual** – this is Pacific EcoRisk's QA Manual that outlines their QA/QC program throughout the laboratory for any and all studies they conduct.
2. **Response to EPA's questions about Pacific EcoRisk** – this information was required by the U.S. Environmental Protection Agency as part of their laboratory quality review and approval; and includes data related to laboratory control studies (positive and negative), control sediments, sources of animals, etc. It also includes the U.S. Environmental Protection Agency's questions and specific responses prepared by Pacific EcoRisk.
3. **Study-specific Standard Operating Procedures (SOPs)** – these are four step-by-step SOPs developed by Pacific EcoRisk for use by their staff when conducting each of the four bioassays being conducted for the Phase 2 Sediment Study. They incorporate changes requested by the U.S. Environmental Protection Agency specifically for this project.
4. **Study-specific daily activity schedules** – these four schedules list the type of activity to be performed on each day for each of the four bioassays being conducted under this the Phase 2 Sediment Study. These schedules incorporate study-specific activities (such as peeper placement and withdrawal).

Pacific EcoRisk

Quality Manual

PACIFIC ECORISK
ENVIRONMENTAL CONSULTING & TESTING

Pacific EcoRisk

Quality Manual

Pacific EcoRisk, Inc.
2250 Cordelia Road
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(707) 207-7760

Revision 14

August 2012

Approved by:

R. Scott Ogle, CEO Special Projects Director Ph: 707-207-7760	Signature	Date 8/29/12
Jeffrey S. Cotsifas, President Special Projects Director Ph: 707-207-7760	Signature	Date 8/29/12
Stephen L. Clark, Vice President Special Projects Director /QA Officer Ph: 707-207-7760	Signature	Date 8/29/12

QA Policy Statement

Pacific EcoRisk (PER) maintains a Quality Manual that provides a detailed description of quality assurance (QA) and quality control (QC) policies and procedures for all toxicity testing and chemical analyses performed by PER. These policies and procedures apply to all aspects of toxicity testing that can potentially affect data quality and interpretation, including but not limited to sampling and handling of test materials, collection, holding and conditioning of test organisms, test conditions and procedures, calibration of instruments, experimental design, reference toxicant testing, record keeping, and statistical evaluation of data.

The primary objective of the PER management is to ensure that all of the data generated and reported are scientifically valid, legally defensible and of known accuracy, precision, representativeness, and comparability. In accordance with this objective, the PER Technical Directors require that:

- All personnel concerned with environmental testing are familiarized with this Quality Manual and implement the policies and procedures in their work;
- All personnel are free from undue pressures, which might adversely affect the quality of work;
- All data is reviewed relative to method requirements and the Quality Manual. Corrective actions are implemented when data fail to meet established quality control criteria;
- Standard operating procedures have been developed in accordance with test methods established by the U.S. Environmental Protection Agency (EPA), ASTM, and Standard Methods and are used in order to ensure that good quality data is collected; and
- All final reports are reviewed in order to meet the clients objectives with respect to quality and completeness.

The scientific staff is composed entirely of degreed professional scientists experienced in performing both routine regulatory testing, and many of the scientists have extensive expertise in research and methods development for more specific non-routine studies. Management and technical personnel have the authority and resources to carry out their duties and have procedures to identify and correct departures from the laboratory's management system. Personnel understand the relevance and importance of their duties as related to the maintenance of the laboratory's management system.

The experienced staff, the modern facility, and strict adherence to the policies and procedures described in the Quality Manual contribute to an overall commitment to timely production of the highest quality product and services in compliance with the TNI Standard. PER continually looks

to improve the effectiveness of the management system through regular reviews and revisions to the Quality Manual.

As a result of the exceptional quality of our data, PER is capable of providing technical support related to NPDES, Water Quality Criteria Development, 404 Certification (Dredging), Ecological Risk Assessment and product/chemical registration programs.

Revised 8/29/12

Table of Contents

Page

Appendices

List of Figures

Acronyms

ACOE	Army Corps of Engineers
ASTM	American Society for Testing Materials
CBI	Confidential Business Information
cm	centimeter
COC	chain of custody
CV	Coefficient of Variation
°C	degrees Celsius
DMR-QA	Discharge Monitoring Report – Quality Assurance
DO	dissolved oxygen
DOC	Demonstration of Capability
DTSC	Department of Toxic Substances Control
ECx	Effective concentration in X% of the population.
EDD	Electronic Data Deliverable
ELAP	Environmental Laboratory Accreditation Program
ELISA	Enzyme Linked Immunosorbent Assay
g/L	grams per liter
ICx	Inhibitory concentration in X% of the population.
ISO/IEC	International Organization for Standardization/International Electrochemical Commission
LCx	Lethal concentration in X% of the population.
mg	milligram
mg/L	milligram per liter
mL	milliliter
MSDS	Materials Safety Data Sheet
NELAC	National Environmental Laboratory Accreditation Conference
NELAP	National Environmental Laboratory Accreditation Program
NIST	National Institute of Standards and Technology
NPDES	National Pollutant Discharge Elimination System
PAR	Photosynthetically Active Radiation
PER	Pacific EcoRisk
PT	Proficiency Test(ing)
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
SAP	Sampling and Analysis Plan
SI	International System of Units

SOP	Standard Operating Procedure
SWAMP	Surface Water Ambient Monitoring Program
TIE	Toxicity Identification Evaluation
TNI	The NELAC Institute
μS	microsiemen
US EPA	United States Environmental Protection Agency

1. INTRODUCTION

This Quality Manual defines the policies, procedures, and documentation that assure PER's testing services continually meet a defined standard of quality that is designed to provide clients with data of known and documented quality and, where applicable, demonstrate regulatory compliance.

The Quality Manual sets the standard under which all laboratory operations are performed, including the laboratory's organization, objectives, and operating philosophy. The Quality Manual has been prepared to assure compliance with the 2009 TNI Environmental Laboratory Sector Standard – Volume 1 – Management and Technical Requirements for Laboratories Performing Environmental Analysis (EL-V1-M1 through M7-ISO-2009). It is also compliant for Pacific EcoRisk's accreditations through the California Department of Public Health's Environmental Laboratory Accreditation Program (ELAP) and the Washington Department of Ecology (Appendix A). This Standard is consistent with ISO/IEC 17025:2005 requirements that are relevant to the scope of environmental testing services and thus, the laboratory operates a quality system in conformance with ISO/IEC 17025:2005(E). In addition, the policies and procedures outlined are compliant with the various accreditation and certification programs that PER maintains. A glossary of terms used in this Quality Manual is provided in Appendix B.

The QA Officer is responsible for maintaining the currency of the Quality Manual. The Quality Manual is reviewed annually by the QA Officer and his/her designees to ensure it still reflects current practices and meets the requirements of any applicable regulations, certifications, accreditations, or client specifications.

The Quality Manual is considered confidential within PER and may not be altered in anyway except by approval of the Laboratory Director and QA Officer. If it is distributed to external users, it is for the purpose of reviewing PER's management system and may not be used for any other purpose without written permission.

PER's scope of testing services includes testing under the following regulatory programs/study areas: NPDES, Water Quality Criteria Development, 404 Certification (Dredging), Ecological Risk Assessment, ambient monitoring, and product/chemical registration programs. The scope of testing follows methods listed in Appendix C.

2. ORGANIZATION

PER is a commercial laboratory located in Fairfield, CA. The laboratory is a legally defensible organization and is responsible for carrying out toxicity testing activities that:

- Meet the requirements of the TNI Standard and the ISO/EIC 17025 Standard;

- Conform to the specifications and requirements of the methods and procedures for which the laboratory is certified to perform;
- Meet the requirements of the client, regulatory agencies (e.g., EPA, Regional Water Quality Control Boards, U.S. ACOE, DTSC, etc.), and accrediting bodies through application of the policies and procedures outlined in this Section and throughout the Quality Manual; and
- Ensure the protection of its clients' confidential information and proprietary rights.

The organizational structure of the company and the relationship between quality management, technical operations, and administrative support services is summarized below in Figure 2-1.

The job descriptions, roles, and responsibilities and authority of laboratory management are described in Section 3: "Management." The organizational chart specific to laboratory operations and job descriptions for all other staff can be found in Section 18 - "Personnel."

2.1 Conflict of Interest and Undue Pressure

The laboratory assures that it is impartial and that personnel are free from undue commercial, financial, or other undue pressures that might influence their technical judgment.

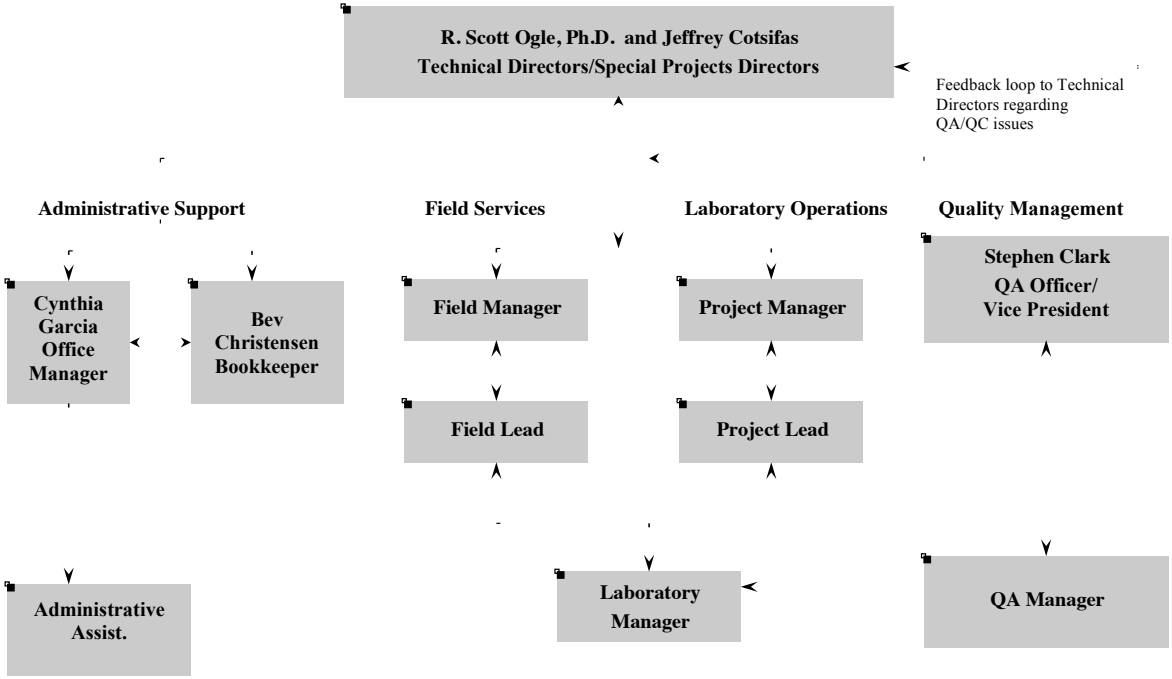
The company is organized in such a way that ensures conflicting or undue interests do not influence the technical judgment of analytical personnel. In addition, procedures are in place to prevent outside pressures or involvement in activities that may affect competence, impartiality, judgment, operational integrity, or the quality of the work performed at the laboratory.

Policies and procedures to prevent commercial, financial or other influences that may negatively affect the quality of the work or negatively reflect on competence, impartiality, judgment or operational integrity are described in depth in the Statement of Scientific Integrity and the Employee Handbook.

2.2 Client Confidentiality

All data, reports, and electronic deliverables generated by PER are considered confidential and proprietary to the client from whom the work has been contracted. It is the policy of PER that no employee shall share client information with any other party without expressed written guidance from the client. Electronic files are accessible on computers that require passwords from qualified PER staff. PER employees shall not participate in any activity that would compromise client confidentiality.

Figure 2-1. Company Organizational Chart



3. MANAGEMENT

PER has a well-defined management structure. Top management includes the Technical Directors/Special Project Directors and the QA Officer. Additional management staff includes the Project Manager(s), Laboratory Manager(s), Field Manager(s), the QA Manager, and the Office Manager.

Management has overall responsibility for the technical operations and the authority needed to generate the required quality of laboratory operations. Management ensures communication within the organization to maintain an effective management system and to communicate the importance of meeting client, statutory, and regulatory requirements. Management assures that the system documentation is known and available so that appropriate personnel can implement their part. When changes to the management system occur or are planned, managers ensure that the integrity of the system is maintained.

PER has appointed deputies for top managerial positions in the case when one of the managers is not in the office. Regarding the Technical Directors, Dr. Scott Ogle serves as the deputy for Jeff Cotsifas. Similarly, Jeffrey Cotsifas serves as deputy for Dr. Scott Ogle. Alison Briden, QA Manager, serves as the deputy for the QA Officer, Stephen Clark.

Management's commitment to good professional practice and to the quality of its products is defined in the QA Policy statement, which can be found on the first page of this document.

Management assures that testing activities meet the requirements of the TNI Standard, the ISO/IEC 17025 Standard, and that meet the needs of the client.

Management implements, maintains, and improves the management system, and identifies noncompliance with the management system of procedures. Managers initiate actions to prevent or minimize noncompliance.

Management defines the minimal level of education, qualifications, experience, and skills necessary for all positions in the laboratory and assures that technical staff have demonstrated capabilities in their tasks.

Management ensures technical competence of personnel operating equipment, performing tests, evaluating results, or signing reports, and limits authority to perform laboratory functions to those appropriately trained and/or supervised. This is achieved through hiring staff with minimum education requirements, providing in-house training by senior staff, and requiring staff to read appropriate manuals and SOPs for their job description. Training is kept up to date as

described in Section 18 – "Personnel" by periodic review of training records and through employee performance reviews.

3.1 Management Roles and Responsibilities

Responsibilities and job descriptions of administrative staff and personnel who manage, perform, or verify work affecting the quality of toxicity tests is document in this section and in Section 18: "Personnel." The job responsibilities for top PER management are as follows:

3.1.1 Technical Director/Special Project Director

The Technical Director/Special Projects Director (and designees) provides the resources necessary to implement an effective quality and data integrity program. The Technical Director/Special Projects Director is a full-time laboratory staff member and supervises laboratory operations and data reporting. The Technical Director meets the general and education requirements and qualifications found in Sections 4.1.7.2 and 5.2.6.1 of the TNI Standard - EL-V1M2-2009. The Technical Director's proof of experience in the fields of accreditation may be found in their employee files and resume/CV.

If the Technical Director is absent for fifteen (15) calendar days or more, a deputy with appropriate qualifications will perform the Technical Manager's duties. Beyond a thirty-five (35) calendar day absence, management will notify the primary accreditation body in writing of the absence of the Technical Manager and the appointment of the deputy.

PER Technical Directors are not the technical directors of more than one accredited environmental laboratory.

The Technical Director/Special Projects Director is responsible for:

- Design and overseeing performance of individual projects;
- Overseeing all laboratory scientists participating in the project;
- Adherence to SOPs and the Quality Manual;
- Data interpretation;
- Preparation of final reports;
- Consultation daily with the Lab Manager and QA Officer to evaluate lab operations;
- Oversee general operation of the laboratory, including monitoring performance data and validity of operations;
- Implementation any necessary corrective actions;
- Hiring of technical and administrative personnel;
- Procuring new clients;
- Reviewing invoices;

- Reviewing new contracts; and
- Annually reviewing staff performance.

3.1.2 QA Officer

The QA officer (and designees) is responsible for the oversight and review of quality control data and operates independently from the laboratory operations for which he/she has quality assurance oversight. The QA Officer's proof of experience in QA/QC procedures, knowledge of analytical methods, and the laboratory's management system may be found in their employee files and resumes/CV. The QA Officer has the following responsibilities:

- Develops, reviews, and implements quality control policies and programs, including statistical procedures and techniques for the maintenance of quality control standards;
- Revises and updates the Quality Manual on a regular basis, as needed;
- Monitors quality assurance activities to determine conformance with the guidelines established in the laboratory SOPs;
- Evaluates new ideas and current developments relative to the field of quality control and quality assurance, and recommends the means for their implementation;
- Has the authority to stop a project;
- Evaluates data quality and maintains records on related quality control charts and other pertinent information;
- Coordinates and/or conducts quality assurance investigations (*e.g.,* intra- and inter-laboratory programs);
- Reviews the overall QA/QC effort and reports issues to Technical Directors;
- Maintains a file of all laboratory accreditation information; and
- Ensures the technical competence of technical staff.

3.1.3 QA Manager

The QA Manager (and designees) is responsible for the daily review of the data generated by laboratory operations and generates QA/QC program reports for the QA manager to review to ensure compliance with the TNI Standard. The QA Manager is responsible for:

- Assessing laboratory performance through control charts and proficiency testing, as well as performing annual audits;
- Evaluating data objectively and performs assessment without outside (*e.g.,* managerial) influence;
- Consulting daily with QA Officer, Lab Manager, and Technical Directors to evaluate lab operations and reports deviations;
- Reviewing all internal QC charts and outside QC programs to ensure that the quality of the data is maintained over time. Makes recommendations based upon these trends in order to consistently provide data that is of the highest quality; and

- Managing non-conforming data evaluations, corrective action reports, and performance reports.

3.1.4 Project Manager

Project Managers (and designees) prepare project quotes and proposals, study plans, QAPPs, and SAPs. Is responsible for communicating with clients, reporting results, tracking project performance and costs, and assuring that client deliverables meet required turn around times. Project Managers contribute to staff performance evaluations. Project Managers represent PER at meetings, and are familiar with outside projects.

3.1.5 Field Manager

The Field Manager (and designees) is proficient in project-specific QAPPs, health, and safety requirements, as well as the regulatory framework for the project. The Field Manager is expert in following field sampling SOPs, including the operation of field equipment and vehicles/vessels, and is responsible for maintaining properly functioning field equipment. The Field Manager is responsible for coordination of sample receipt with both PER and subcontract laboratories, and manages scientists participating in field sampling. The Field Manager possesses the skills of the Scientist I and II positions, at a minimum.

3.1.6 Laboratory Manager

The Lab Manager (and designees) oversees daily operation of the laboratory. The Lab Manager coordinates activities of Project Managers, and consults daily with Technical Director and QA Officer to evaluate lab operations and review of new project requirements to assure appropriate facilities and resources are available. The Lab Manager provides direction and guidance to Scientists and Lab Assistants regarding planning of day and task completion. The Lab Manager Limits authorization to perform laboratory functions to those appropriately trained and/or supervised, and performs training of laboratory staff.

3.2 Documentation of Management/Quality System

The management system is defined through the policies and procedures provided in this Quality Manual and written laboratory Standard Operating Procedures (SOPs) and policies.

3.2.1 Quality Manual

The Quality Manual contains the following required items:

- Document title;
- Laboratory's full name and address;
- Name, address (if different from above), and telephone number of individual(s) responsible for the laboratory;

- Identification of all major organizational units that are to be covered by this quality manual and the effective date of the version;
- Identification of the laboratory's approved signatories;
- Signed and dated concurrence (with appropriate names and titles), of all responsible parties including the quality manager(s), technical manager(s), and the agent who is in charge of all laboratory activities, such as the laboratory director or laboratory manager;
- Objectives of the management system and contain or reference the laboratory's policies and procedures;
- Laboratory's official quality policy statement, which shall include management system objectives and management's commitment to ethical laboratory practices and to upholding the requirements of this Standard; and
- Table of contents, and applicable lists of references, glossaries and appendices.

This Quality Manual contains or references all required elements as defined by the TNI Standard - V1:M2, Section 4.2.8.4.

3.2.2 Standard Operating Procedures (SOPs)

A Standard Operating Procedure (SOP) is available for all laboratory procedures that require specific knowledge and/or adherence to a specific sequence of procedural steps. This includes, but is not restricted to, the following:

- Sample collection, preservation, and holding time;
- Sample custody, receipt, and document control;
- Analytical methods;
- Instrument calibration and maintenance;
- Test methods;
- Safety; and
- Hazardous waste holding and disposal.

All laboratory personnel participating in, or performing, any testing-related activity in the lab must be fluently familiar with the relevant SOPs. A copy of each SOP shall be maintained in each of the following:

- Office, in clearly-labeled binder(s); and
- Laboratory in clearly labeled binder(s), or posted above workstations.

3.2.3 Order of Precedence

In the event of a conflict or discrepancy between policies, the order of precedence is as follows unless otherwise noted:

- Quality Manual;

- SOPs and Policies; and
- SAP, Study Plan, and Client Communications.

4. DOCUMENT CONTROL

All documents that are part of the document control system of the laboratory (*e.g.,* SOPs) include a date after which the procedure was effective, and electronic copies are write protected to prohibit unauthorized revisions. The QA/QC documents are periodically reviewed and revised as necessary to ensure continuing suitability with the applicable method; old records are moved to the management server which can only be accessed by management, and where the documents will be retained as historical records. Technical Director(s) or the QA Officer must approve any revision to any QA/QC documentation. All old document control system documents have a revision number, a date that the document was put into effect, and a date that the document was no longer in effect.

A master list of all QA/QC documents related to the PER Quality Manual is maintained so as to identify the current revision status of each document. Copies of the approved QA/QC documents are available in the office and laboratory; obsolete versions of the hard copy documents are promptly removed from all points of use and shredded, and obsolete electronic copies are placed on the Management Server (see above). Revised QA/QC documents have altered text clearly identified in the document, and are reviewed by the QA Officer; approved documents are re-issued as soon as practicable. Approved copies of documents are available to staff at all locations where operations are essential to the effective functions of the laboratory.

5. REVIEW OF REQUESTS, TENDERS AND CONTRACTS

Prior to accepting a new project, the Technical Director(s) review the scope of the project to determine if it is consistent with the services provided by PER, including a review of the requested methods, certifications/accreditation, requirements for laboratory facilities, and available laboratory and staff resources. Should the review indicate any potential conflict or deficiency, the Technical Director will discuss such limitations with the requesting party. The use of non-standard methods is subject to an agreement between PER and the client, and will include a written request (*e.g.,* contract or scope of work) from the client prior to the use of non-standard methods. Any differences between the request for services and a formal contract are resolved prior to initiation of the project, and must be acceptable to both parties in writing. Records of all conversations and email related to requests for services are maintained by the Technical Director and are placed in the contract/client file when appropriate. Clients are to be informed of any deviations from a contract. Only those projects that can be properly completed will be accepted. Records are maintained for every contract or work request, when appropriate.

Following the review of a request for services, the Technical Director(s), Project Manager, or Project Lead prepares a "Test Order Form," and a project number and test folder are generated for the project. The project number is used to track all project-associated data. The Technical Director(s), Project Manager, or Project Lead prepares all of the necessary data sheets for the testing required for the project, assures that sample collection and delivery are coordinated with the client, orders test organisms when necessary, and transfers the test to the laboratory.

All project-related communications with the client, including e-mails, fax, and telephone conversation, are maintained by the Technical Director(s), Project Manager, or Project Lead in one or more of the following locations:

- E-mail program files on the Technical Director, Project Manager, or Project Lead's computer;
- Telephone conversations are documented in phones logs or laboratory notebooks; and
- Hard copies of fax or e-mail communications are maintained in the project folder.

6. SUBCONTRACTING OF ENVIRONMENTAL TESTS

A subcontract laboratory is defined as a laboratory external to Pacific EcoRisk, or at a different location than the address indicated on the front cover of this manual, that performs analyses for this laboratory. Toxicity tests for which Pacific EcoRisk is certified are generally not subcontracted; only analytical samples in support of toxicity tests or monitoring programs PER oversees are subcontracted.

When subcontracting analytical services, Pacific EcoRisk assures that work requiring accreditation is placed with an appropriately accredited laboratory or one that meets applicable statutory and regulatory requirements for performing the tests. When Pacific EcoRisk has the flexibility to select the subcontractor, preference is given to NELAP accredited laboratories. Technical Directors maintain a list of subcontract laboratories, as does the Office Manager. On an annual basis, the subcontract laboratories are required to submit the following documentation that is maintained on the Pacific EcoRisk server:

- Quality Manual;
- Results of recent proficiency testing;
- Results of their most recent audit; and
- Laboratory accreditation certificate, including fields of testing/analysis.

The Technical Director or their designees notifies the client of the intent to subcontract the work in writing. When possible, the laboratory gains the approval of the client to subcontract their work prior to implementation, preferably in writing. The laboratory performing the subcontracted work is identified in the final report. Pacific EcoRisk assumes responsibility to the

client for the subcontractor's work, except in the case where a client or a regulating authority specified which subcontractor is to be used.

7. PURCHASING SERVICES AND SUPPLIES

The laboratory ensures that purchased supplies and services that affect the quality of environmental tests are of the required or specified quality, by using approved suppliers and products.

The laboratory has procedures for purchasing, receiving, and storage of supplies that affect the quality of environmental tests. The Office Manager maintains the list of approved suppliers of services and supplies and the QA Officer or his/her designees approves technical content of purchasing documents prior to ordering.

Policies for receipt of supplies are documented in the "Incoming Supplies and Equipment Approval Checklist." The purchased supplies and reagents must be identical with those noted on the packing slip (e.g., class, grade, and amount) are inspected or otherwise verified on this checklist as complying with requirements defined in the test method. Chemicals are further checked for storage conditions on the MSDS sheet and stored accordingly in the laboratory. The checklist and supporting manufacturers documentation are maintained in the "Incoming Supplies and Equipment Approval Checklist" binder in the laboratory.

Records for equipment maintenance, calibration, or certificates of analyses are stored with the appropriate equipment log.

8. SERVICE TO THE CLIENT

PER provides clients or their representatives with full cooperation when a request is made to clarify a clients testing request, and to monitor the laboratory's performance in relation to the work performed, provided that confidentiality is maintained for testing performed for other clients.

8.1 Client Confidentiality

The laboratory confidentiality policy is to not divulge or release any information to a third party without proper authorization. Third party requests for data and information are referred to the client. Data and records identified as proprietary, privileged, or confidential are exempt from disclosure. All electronic data (storage or transmissions) are kept confidential, based on

technology and laboratory limitations, as required by client or regulation. When necessary, confidentiality statements are used on e-mails and documents.

8.2 Client Support

Communications with the client, or their representative, are maintained to provide proper instruction and modification for testing. Technical staff are available to discuss any technical questions or concerns the client may have. The client, or their representative, may be provided reasonable access to laboratory areas for witnessing testing.

The Technical Director or Project Manager communicate delays or major deviations to the testing to the client immediately.

The Technical Director or Project Manager will provide the client with all requested information pertaining to the analysis of their samples. An additional charge may apply for additional data/information that was not requested prior to the time of sample analysis or previously agreed upon.

8.3 Client Feedback

The laboratory seeks both negative and positive feedback following the completion of projects and periodically for ongoing projects. Feedback provides acknowledgement, corrective actions where necessary, and opportunities for continuous improvement. Client feedback is solicited via email and a Client Survey.

9. COMPLAINTS

PER's policy is to document and respond to any complaints filed by a client or other parties about the laboratories activities. Where a complaint, or any other circumstance, raises doubt concerning the laboratory's compliance with the laboratory's policies or procedures, or with NELAP requirements or concerning the quality of the laboratory testing, the Technical Director(s) ensure that those areas of activity and responsibility involved are promptly audited. At a minimum, this includes tracking of quality checks, internal audits, and a quality control assessment, and the problem is corrected. In addition, a "Preventative Action" form may be completed to minimize a future occurrence. Records of the complaint and subsequent actions are maintained in the QA/QC Program files in the laboratory, as well as in the client's file.

10. CONTROL OF NON-CONFORMING ENVIRONMENTAL TESTING WORK

Non-conforming work is work that does not meet acceptance criteria or requirements. Non-conformances can include departures from standard operating procedures or test methods or unacceptable quality control results (see Section 23 – "Quality Assurance for Environmental Testing"). Identification of non-conforming work can come through client complaints, quality control, instrument calibration, evaluating consumable materials, staff observation, final report review, management reviews and internal and external audits.

10.1 Exceptionally Permitting Departures from Documented Policies and Procedures

Requests for departures from laboratory procedures are approved by the Technical Director, confirmed with the QA Officer, and are documented in the same fashion as other client communications as outlined in Section 5 – "Review of Requests, Tenders and Contracts." Planned departures from procedures or policies do not require audits or investigations.

10.2 Non-Conforming Work

Pacific EcoRisk's policy for control of non-conforming work is to identify the non-conformance, determine if it will be permitted, and take appropriate action. All employees have the authority to stop work on samples when any aspect of the process does not conform to laboratory requirements. The QA Manager and his/her designees oversee proper communication of non-conforming work and implementation of the applicable procedures associated with non-confirming work.

The investigation and associated corrective actions of non-conforming work involving alleged violations of the company's Data Integrity and Ethics Program follow the procedures outlined in Section 17 – "Data Integrity and Ethics Program."

Corrective actions for routine, one-time non-conformances, such as transcription errors, may be documented on raw datasheets, logbooks, e-mail, or deviation from protocol sheets. The QA Manager documents more serious corrective actions (non-conforming work that could reoccur or where there is doubt that the laboratory is in compliance with its own policies or procedures) by using a more formal corrective action form. The procedure for investigating and taking appropriate corrective actions of non-conforming work are described in Section 12 – "Corrective Action."

Pacific EcoRisk evaluates the significance of the non-conforming work, and takes corrective action immediately. The client is notified if their data has been impacted. The laboratory allows

the release of non-conforming data only with approval by the Technical Director on a case-by-case basis. Reports reflect any non-conforming work that is deemed conditionally acceptable based on the "Best Professional Judgment" of the Technical Director(s) when the degree of departure did not affect the outcome of the test.

The discovery of a non-conformance for results that have already been reported to the client must be immediately evaluated for significance of the non-conformance, its acceptability to the client, and determination of the appropriate corrective action.

10.3 Stop Work Procedures

For any non-conforming testing, it is PERs policy that the Lab Manager and/or QA Manager must immediately notify the QA Officer and Technical Directors so that the significance of the non-conforming work can be evaluated and work can be stopped if deemed appropriate by the QA Officer and Technical Directors. After work has been stopped, the QA Officer and Technical Director(s) authorize the resumption of work. The evaluation of the issue, root cause, and resolution of the corrective action are documented in an "Evaluation of Non-Conforming Data" report.

11. IMPROVEMENT

Improvement in the overall effectiveness of the laboratory management system is a result of the implementation of the various aspects of Pacific EcoRisk's management system: quality policy and objectives (Section 3 – "Management"); internal auditing practices (Section 15 – "Audits"); the review and analysis of data (Section 23 – "Quality Assurance for Environmental Testing"); the corrective action (Section 12 – "Corrective Action") and preventive action (Section 13 – "Preventive Action") process; and the annual management review of the quality management system (Section 16 – "Management Reviews") where the various aspects of the management/quality system are summarized, and evaluated and plans for improvement are developed.

12. CORRECTIVE ACTION

Corrective action is the action taken to eliminate the causes of an existing non-conformity, defect, or other undesirable situation in order to prevent recurrence. Deficiencies cited in external assessments, internal quality audits, data reviews, client feedback/complaints, control of non-confirming work or managerial reviews are documented and are followed by corrective action. Corrective actions taken are appropriate for the magnitude of the problem and the degree of risk.

Sample data associated with a failed quality control (*i.e.*, failed to meet test acceptability criteria, etc.) are evaluated for the need to be reanalyzed or qualified. Unacceptable quality control results are documented and an evaluation is performed and documented in a "Evaluation of Non-Conforming Data" report. If a corrective action is determined to be necessary based on the results of this investigation, it is implemented following the procedures outlined in this section. Technical Directors and the QA Officer review "Evaluation of Non-Conforming Data" reports and suggest improvements, alternative approaches, and procedures where needed. If the data reported are affected adversely by the non-conformance, the affected data is clearly identified in the report and the client is notified.

Procedures for corrective actions associated with audits are discussed in Section 15. – "Audits" but follow the same general procedures outlined here.

12.1 General Procedure

Corrective actions start with assessment of the cause of the problem. PER uses an "Evaluation of Non-Conforming Data" report to document and track investigations of non-confirming work, and where necessary, documentation of implementation and monitoring of corrective actions. The QA Manager and his/her designees is responsible for initiating corrective action on routine data reviews where a non-conformance is found that could reoccur or where there is doubt about the compliance of the laboratory to its own policies and procedures. All deficiencies are investigated and a corrective action plan is developed and implemented if determined to be necessary. The QA Manager and his/her designees monitor the effectiveness of corrective actions.

12.1.1 Cause Analysis

When failures due to systematic errors have been identified, the first step of the corrective action process starts with the initial investigation and determination of root cause(s) of the problem. Records are maintained of non-conformances requiring corrective action to show that the root cause(s) was investigated, and includes the results of the investigation. These evaluations are documented in a "Evaluation of Non-Conforming Data" report and are maintained by the QA Manager and his/her designees (See Section 10 - "Control of Non-Conforming Environmental Testing Work"). They are located on the management server, which can only be accessed by management.

Where there may be non-systematic errors and as such the initial cause is readily identifiable or expected random failures (e.*g.*, failed quality control), a formal root cause analysis is not performed and the process begins with selection and implementation of corrective action.

12.1.2 Selection and Implementation of Corrective Actions

Where uncertainty arises regarding the best approach for analysis of the cause of exceedances that require corrective action, appropriate personnel (*e.g.*, QA Manager, Laboratory Manager) will recommend corrective actions that are appropriate to the magnitude and risk of the problem and that will most likely eliminate the problem and prevent recurrence. The Technical Directors and their designees ensure that the corrective actions are discharged within the agreed upon time frame.

12.1.3 Monitoring of Corrective Actions

The QA Manager will monitor implementation and documentation of the corrective action to assure that the corrective actions were effective. Monitoring of corrective actions may include an audit, where necessary (see Section 15. – "Audits").

13. PREVENTATIVE ACTION

Pacific EcoRisk promotes a workplace environment that encourages critical thinking and observation skills by its scientists and assistants. As part of the Pacific EcoRisk QA/QC program, we encourage scientists and assistants to be pro-active and complete a Preventative Action form to propose changes to our QA/QC program that will result in improvements in the quality of work or to reduce sources of non-conformance with the current QA/QC program. The Technical Director(s) and QA Officer review any submitted Preventative Action form during their weekly Management Meeting, and work with individual scientist or assistant to develop an action plan to implement the proposed preventative action should it be compatible with NELAP certification and have an acceptable cost for the proposed benefit. The QA Officer tracks the revision to the QA/QC program to assure that they are effective.

14. CONTROL OF RECORDS

The laboratory maintains a record system appropriate to its needs, records all laboratory activities, and complies with applicable standards or regulations as required. The record system is designed to produce unequivocal, accurate records that document all laboratory activities. Records allow for the historical reconstruction of laboratory activities related to sample handling and analysis and help establish factors affecting the uncertainty of the test and enable test repeatability under conditions as close as possible to the original. Data is recorded immediately and legibly in permanent black ink. Corrections are initialed and dated with the reason noted for corrections other than transcription errors, which only require initials. A single line strikeout is used to make corrections so that the original record is not obliterated.

14.1 Records Maintained

At minimum, the QA Officer, QA Manager or the designees maintain the following records:

- Original observations;
- Sample receiving and storage records (COCs, sample ID codes, etc);
- Instrument and support equipment logbooks;
- Proficiency testing results;
- Calibration records;
- Demonstrations of capability;
- Project–specific correspondence relating to laboratory activities;
- Corrective action records including evaluations of non-confirming data;
- Preventative action records;
- Management reviews;
- Internal and external audits;
- Data review and verification records;
- Personnel qualification, experience and training records;
- A record of names, initials, and signatures for all individuals who are responsible for signing or initialing any laboratory record; and
- A copy of each project report.

14.2 Records Management and Storage

All records are retained for a minimum of five years, which allows for a historical reconstruction of all laboratory activities. Hard copies of client reports containing original test data are filed alphabetically by client for each year, and electronic copies are stored by client on the PER server and accessible only by staff with authorized passwords for the server and desktop computers; the PER server is automatically backed up daily and electronic files can only be accessed by scientists through password-protected computers. Hard copies of all QA/QC files (*e.g.*, old log books, audits, management reviews, corrective actions, etc.) are stored in the "QA/QC Program" filing cabinets and/or electronically on the server in the "QA/QC Program" folder. Following the minimum five-year holding period for all files, the Technical Director(s) must approve the disposal, via shredding, of any file, and the administrative staff maintains a master list of such files.

Records, including electronic records, are easy to retrieve, legible, and protected from deterioration or damage; held secure and in confidence; and are available to accrediting bodies for a minimum of five years or as required by regulation or contract. Records that are stored only on electronic media are supported by the hardware and software necessary for their retrieval.

Access to protected records is limited to management and their designees to prevent unauthorized access or amendment.

Additional information regarding control of data is included in Section 20 – "Environmental Methods and Method Validation."

14.3 Legal Chain of Custody Records

All samples that arrive at Pacific EcoRisk are treated as though the data generated using the sample may be used as legal evidence. Therefore, all samples are required to have a Chain of Custody (COC) record that includes the client, client contact, sample ID, collected date and time, sample type (*e.g.,* freshwater, stormwater, sediment, etc.), sample volume, sample container type/size, tests required, and custody of the sample [*i.e.,* the signature of the person collecting/releasing the sample (and date and time collected) and the signature of the person receiving the sample (and date and time received)].

15. AUDITS

Audits measure laboratory performance and verify compliance with accreditation/certification and project requirements. Audits specifically provide management with an on-going assessment of the management system. They are also instrumental in identifying areas where improvement in the management/quality system will increase the reliability of data. Audits are of four main types: internal, external, performance, and system. Section 15.3 discusses the handling of audit findings.

15.1 Internal Audits

Pacific EcoRisk follows a schedule of internal audit tasks designed to be performed throughout the year such that all elements are audited on an annual basis. These audits verify compliance with the requirements of the management/quality system, including testing methods, SOPs, the Quality Manual, ethics policies, data integrity, other laboratory policies, and the TNI Standard. It is the responsibility of the QA Officer (and his/her designees) to plan and organize audits as required by the schedule and requested by management. Wherever resources permit, trained and qualified personnel who are independent of the activity to be audited carry out these audits. The area audited, the audit findings, and corrective actions are recorded. Audits are reviewed after completion to assure that corrective actions were implemented and effective.

15.2 External Audits

It is the laboratory's policy to cooperate and assist with all external audits, whether performed by clients or an accrediting body. Management ensures that all areas of the laboratory are accessible to auditors as applicable and that appropriate personnel are available to assist in conducting the audit. Findings of external audits are responded to within the time frame agreed to at the time of the audit.

15.2.1 Confidential Business Information (CBI) Considerations

During on-site audits, on-site auditors may come into possession of information claimed as business confidential. A business confidentiality claim is defined as "a claim or allegation that business information is entitled to confidential treatment for reasons of business confidentiality or a request for a determination that such information is entitled to such treatment." When information is claimed as business confidential, Pacific EcoRisk places on (or attach to) the information at the time it is submitted to the auditor, a cover sheet, stamped or typed legend or other suitable form of notice, employing language such as "trade secret," "proprietary," or "company confidential." Confidential portions of documents otherwise non-confidential are clearly identified. CBI may be purged of references to client identity by the responsible laboratory official at the time of removal from the laboratory. However, sample identifiers may not be obscured from the information.

15.3 Audit Findings and Corrective Actions

Internal or external audits may result in findings that cast doubt on the effectiveness of the laboratory operation to produce data of known and documented quality or that question the correctness or validity of sample results an investigation is performed. If corrective action is needed, the implementation of the corrective action and follow-up tracking of the effectiveness of the corrective action is documented. The findings require an investigation and appropriate corrective actions to be implemented. The responsibility for developing and implementing corrective actions to findings is the responsibility of the QA Officer and his/her designees. Corrective actions are documented through the corrective action process described in Section 12 – "Corrective Action." The QA Officer (and his/her designees) prepare monthly audit reports that outline any internal audit findings, corrective actions, and monitoring of the effectiveness of the corrective actions. Documentation may also be in the form of a memo or an "Evaluation of Non-Conforming Data " report. Responses to comments and findings of external audits are communicated to the auditor.

Should the findings of an audit cast doubt on the quality of testing performed for a client, the client is notified in writing within 30 days of discovering the issue, and informed of the

corrective action(s) that were implemented to address the problem; records of such client communications are retained in the affected project folders. Management ensures that this notification is carried out within the specified time frame.

Should an audit indicate that inappropriate actions were taken by Pacific EcoRisk staff that resulted in vulnerabilities related to data integrity (see Section 17. – "Data Integrity and Ethics Program"), the issue is handled in a confidential manner by the Technical Director(s) and will include a full investigation, appropriate corrective action(s), documentation of the issue (signed and dated), a follow-up evaluation, and appropriate notification to affected client(s).

15.4 Additional Audits

In addition to the scheduled internal audits, it may sometimes be necessary to conduct special audits as a follow-up to corrective actions, PT results, complaints, regulatory audits, alleged data integrity issues, or when requested by the Technical Director. This can also be done when a serious issue or risk to the laboratory has been identified.

Where the identification of non-conformances or departures from normal lab procedures cast doubt on the laboratory's compliance with its own policies and procedures, or on its compliance with the TNI Standard, the laboratory ensures that the appropriate areas of activity are audited as soon as possible. These audits address specific issues. The area audited, the audit findings, corrective actions, and monitoring of corrective actions are recorded.

The Laboratory's management system is audited though annual management reviews. Refer to Section 16 – "Management Reviews" for further discussion of management reviews.

16. MANAGEMENT REVIEWS

Pacific EcoRisk top management (as defined in Section 3 – "Management") performs an Annual Management Review during the last quarter of each year. This program includes a review of the laboratory management and quality systems and environmental testing activities to ensure continuing suitability and effectiveness in achieving NELAP standards, and implements any necessary changes to improve on the quality of testing and client services. The program consists of an evaluation of:

- The suitability of policies and procedures;
- Reports from managerial and supervisory personnel;
- Outcomes of internal audits, external audits and assessments by external bodies;
- A review of corrective and preventative actions;
- Results of inter-laboratory comparison and proficiency testing;

- Changes in the volume and type of work;
- Client feedback;
- Client complaints;
- Recommendations for improvement; and
- Other relevant factors, such as quality control activities, resources, and staff training.

The Management Review is documented with a Management Review Report, for which a hard copy is maintained in the QA/QC Program filing cabinets and an electronic copy is stored in the QA/QC Program folder on the PER server. Any actions recommended in the Management Review Report are implemented within 60 days of the completion of the report.

Findings and follow-up actions from management reviews are recorded in the "Management Review" report. Management will determine appropriate completion dates for action items and ensure they are completed within the agreed upon time frame.

17. DATA INTEGRITY AND ETHICS PROGRAM

Pacific EcoRisk is committed to ensuring the integrity of our data and providing valid data and documented quality to our clients. Upon hiring and during an annual staff meeting, each employee is required to read, acknowledge and understand their personal ethical responsibilities and legal responsibilities, including potential punishment and penalties for improper, unethical or illegal actions.

17.1 Ethics and Integrity Training

PER maintains a Data Integrity Training Program for which each new employee must attend during their orientation, and all employees must attend on an annual basis. The program is documented in writing, and includes an overview of the company mission, relationship to the critical need for honesty and full disclosure in reporting results, how and when to report data integrity issues, and a description of the record keeping required under the program. The QA Manager performs a daily assessment of data integrity during the daily lab review. Employees are informed that any infractions of the program can result in immediate termination, and may result in civil/criminal prosecution. Attendance for both the orientation and annual meetings are documented via a signed certification from each staff member that they understand their obligations related to data integrity. Records of this training are maintained both in each employee's file and in the Data Integrity Program file in the QA/QC Program filing cabinets. The Technical Director(s) fully support these procedures and are integrally involved with the implementation of the program.

17.2 Improper Actions

Improper actions are defined as deviations from contract-specified or method-specified practices and may be intentional or unintentional. Unethical or illegal actions are defined as the deliberate falsification of analytical or quality assurance results, where failed method or contractual requirements are made to appear acceptable. Prevention of laboratory improper, unethical, or illegal actions begins with the zero-tolerance policy established by the PER Technical Directors.

17.3 Prevention and Detection Program for Improper, Unethical, or Illegal Actions

The PER management maintains a proactive program for the prevention and detection of improper, unethical, or illegal activities. The program includes:

- An ethics policy that is read and signed by all personnel;
- Initial and annual ethics training;
- Internal audits;
- Inclusion of anti-fraud language in subcontracts;
- Analyst notation and sign-off on manual integration changes to data; and
- "no-fault" policy that encourages laboratory personnel to come forward and report ethical, data integrity, or fraudulent activities.

17.4 Investigation of Ethics Violations or Data Integrity Violations

The QA Officer serves as the PER Data Integrity Officer, to whom laboratory personnel can report improper, unethical, or illegal practices. The PER Technical Directors and QA Officer will perform a full investigation should any ethical or data integrity violations occur. The outcome of the investigation may result in immediate termination, and may result in civil/criminal prosecution. Clear documentation of the investigation is maintained, and the need for any further detailed investigation (e.g., civil/criminal prosecution) is clearly documented.

17.5 Annual Review of Data Integrity Program

The Data Integrity Program is reviewed annually by the Technical Directors during the Annual Management Review, and modified as necessary.

17.6 Client Notification

A Technical Director would notify a client in writing in all cases when data quality is impacted by non-conformance to testing protocols, and re-testing would be performed, if necessary. Furthermore, a Technical Director would notify the client in writing when any aspect of the

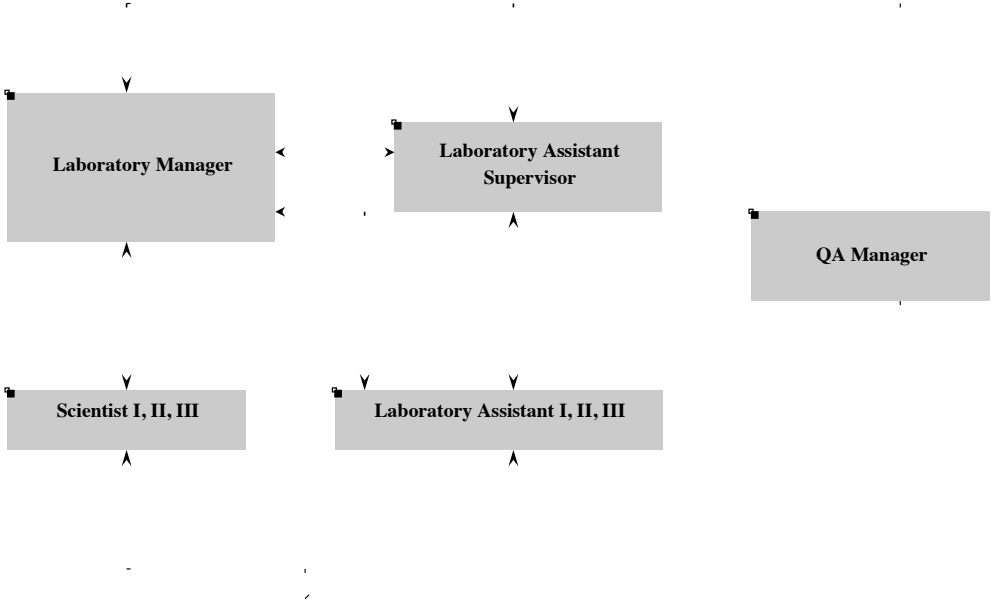
environmental testing work, or the results of the work, do not conform to the agreed requirements specified by the client.

18. PERSONNEL

Pacific EcoRisk employs competent personnel based on education, training, professional experience and demonstrated skills, as required. All personnel are responsible for complying with all quality assurance/quality control requirements that pertain to their organizational/technical function. All personnel who are involved in activities related to sample analysis, evaluation of results, or who sign test reports, must demonstrate competence in their area of responsibility. Appropriate supervision is given to any personnel in training and the trainer is accountable for the quality of the trainees work. Personnel are qualified to perform the tasks they are responsible for based on education, training, experience and demonstrated skills as required for their area of responsibility.

Key laboratory operations positions include the QA Manager, Project Manager, Project Lead, Laboratory Manager, Laboratory Assistant Supervisor, Scientist I, II, and III (possess academic or work background in the field of aquatic toxicology), and Lab Assistant I, II, and III; an outline of the laboratory operations organizational chart is depicted as a flow-chart in Figure 18-1. Individuals filling these jobs have the required training, degree and/or professional experience to meet the job responsibilities (*e.g.,* Scientist I, II, and III are required to possess a minimum of a BS degree). In the event that contracted support staff are used, they are trained in the method and related laboratory control system, and supervised by a trained scientist at a higher job level and/or the Laboratory Manager.

Figure 18-1. Laboratory Operations Organizational Chart



18.1 Personnel Roles and Responsibilities

The job responsibilities for each member of Pacific EcoRisk management are outlined Section 3 – "Management." An outline of the company organization is presented in Section 2. – "Organization" and is depicted as a flowchart in Figure 2-1. Job responsibilities for administrative, field and laboratory staff are as follows:

18.1.1 Office Manager

The Office Manager (and designees) provides administrative support for all projects. The Office Manager also manages personnel files and business operations files. The Office Manager activities are coordinated by the Technical Directors.

18.1.2 Administrative Assistant

The Administrative Assistant provides administrative support for all projects, assists Office Manager in maintenance of records, and prepares reports for delivery to clients. The Office Manager coordinates the Administrative Assistant activities.

18.1.3 Bookkeeper

The Bookkeeper prepares all accounts receivable and accounts payable records. The Bookkeeper prepares all client invoices, maintains client contracts/quotes, and provides contract support.

18.1.4 Lab Assistant I

Lab Assistant I staff are responsible for sample pick up and log in, completion of chain of custody records, shipping, cleaning of all glassware, and performance of routine test solution water quality analyses. Lab Assistant I staff maintain unencumbered laboratory work areas through regular cleaning and organization.

18.1.5 Lab Assistant II

Lab Assistant II staff are responsible for the preparation of synthetic waters, advanced water chemistry analyses (*e.g.*, ammonia, alkalinity, and hardness), weight determinations, overlying water exchange for sediment tests, processing sediment samples, and maintenance of water quality meters. Possesses the skills of the Laboratory Assistant I position.

18.1.6 Lab Assistant III

Lab Assistant III staff are responsible for assisting scientists with zeolite treatment, preparation of samples for TIE treatments, porewater extraction, and preparing sediment elutriates. Lab Assistant III staff may provide maintenance of *Ceriodaphnia* and daphnid cultures, and may participate in scoring of freshwater algae tests and embryo development tests. Possesses the skills of the Laboratory Assistant II position.

18.1.7 Lab Assistant Supervisor

The Lab Assistant Supervisor assigns daily tasks to lab assistants, oversees training of lab assistants, and possesses the skills of the Laboratory Assistant III position. The Lab Assistant Supervisor also manages laboratory supplies, including oversight of stocking, organization, and ordering.

18.1.8 Scientist I

Scientist I staff are responsible for the daily performance of the following tests: acute and chronic freshwater and estuarine/marine invertebrates and fish. Scientist I staff are responsible for the daily performance of these tests, including data acquisition, recording, review, and analyses. When necessary, Scientist I staff are provide sample manipulations (*e.g.*, pH adjustment, zeolite treatment, de-chlorination, and porewater exchange) necessary to perform testing. Scientist I staff perform the statistical analyses of test results and prepare electronic data deliverables (EDDs). Scientist I staff write reports for the methods/tests that they are certified to perform. Scientist I staff participates in field sampling project and are familiar with field sampling procedures and operation of field equipment. Scientist I staff possess the skills of the Assistant I, II, and III positions.

18.1.9 Scientist II

Scientist II staff are responsible for the daily performance of the following tests: embryo development, freshwater sediment, and marine sediments. Scientist II staff are responsible for the daily performance of these tests, including data acquisition, recording, review, and analyses. When necessary, Scientist II staff provide more technical sample manipulations (e.g. TIE manipulations) necessary to perform testing. Scientist II staff perform the QA review of statistical analyses of test results. Scientist II staff write reports for the methods/tests that they are certified to perform. Scientist II staff manage analytical samples that are submitted to subcontract labs. Scientist II staff possess the skills of the Scientist I position.

18.1.10 Scientist III

Scientist III staff are responsible for technical testing, including the performance of Toxicity Identification Evaluations (TIE), enzyme-linked immunosorbant assay (ELISA) analyses, and water effects ratio testing. Scientist III staff provide proactive planning with Field and Lab Managers, logistical support for planning testing, and coordinates activities with Laboratory Assistants. Scientist III staff write reports for the methods/tests that they are certified to perform. Scientist III staff possess the skills of the Scientist II position.

18.1.11 Project Lead

The Project Leads:

- Prepare project folder and test data sheets;

- Ship sample containers to clients;
- Prepare sample pickup schedules;
- Order organism;
- Prepare test orders and communicate testing schedules to Lab Manager;
- Provide oversight of client tests;
- Ensure that statistical analyses are completed to facilitate client communications and reporting within required turnaround times;
- Prepare draft reports from existing templates; and
- Participate in project-specific management tasks assigned by Project Manager.

18.1.12 Field Lead

Field Leads are familiar with SAPs for field sampling projects and participates in, oversee, and organizes field-sampling events. They lead sampling teams in the field with oversight from Project Manager and Field Manager. Field Leads possess, at a minimum, the skills of the Scientist I position.

18.2 Training

Based on the job descriptions described above, Pacific EcoRisk hires laboratory assistants and scientists that have appropriate academic and/or professional experience to perform the tasks for their given job classification. The Office Manager (and designees) maintains these records in the employee files. In addition, Pacific EcoRisk has an extensive training program to assure that each assistant and scientist is trained in the specific methods necessary to perform their job under the QA/QC Program. Prior to participation in any testing or analyses, the Scientists and Assistants are required to read the SOPs and EPA manuals that describe tasks that are part of their job description; all staff members must also read and be familiar with the Quality Manual.

Hands-on training involves an experienced staff member demonstrating the method for the new staff member. New staff members are then required to demonstrate capability in performing a test or analyses with oversight by an experienced staff member. Their initial Demonstration of Capability (DOC) is documented in their training log. The date on which authorization and/or competence is confirmed is included. The training program is viewed as an ongoing process as staff continues to take on additional responsibilities as they develop professionally.

Since the duration of many toxicity tests is greater than the standard workweek (*i.e.*, staff do not solely perform a toxicity test from test initiation to termination), ongoing demonstrations of capability by staff must focus on individual adherence to the QA/QC Program. In order to maintain their ongoing DOC, staff members with <3 years of experience in their job position at PER are required to maintain their continued proficiency through yearly participation in test initiation, test maintenance, and test termination for each test that the scientist is certified to

perform. Scientists document continued proficiency training in their continued proficiency log. This information is used to establish the DOC for each method at the beginning of each year. Scientists with ≥3 years of experience with the methods are not required to participate in each test method on a yearly basis given their advanced level of experience with the methods; such scientists are expected to review the SOPs prior to participating in the testing that they have not performed for some time (*i.e.*, 12 months).

Toxicity tests used to document initial and ongoing DOC must meet all test acceptability criteria specified in the EPA testing manuals in order to be considered acceptable for continued proficiency training.

"Group training workshops" are provided, as necessary, by a Laboratory Manager, QA Manager, QA Officer, or Technical Directors, and are documented, both in terms of content and attendance. These workshops may focus on a review of a given method, an introduction of a new method, or on the use of new equipment.

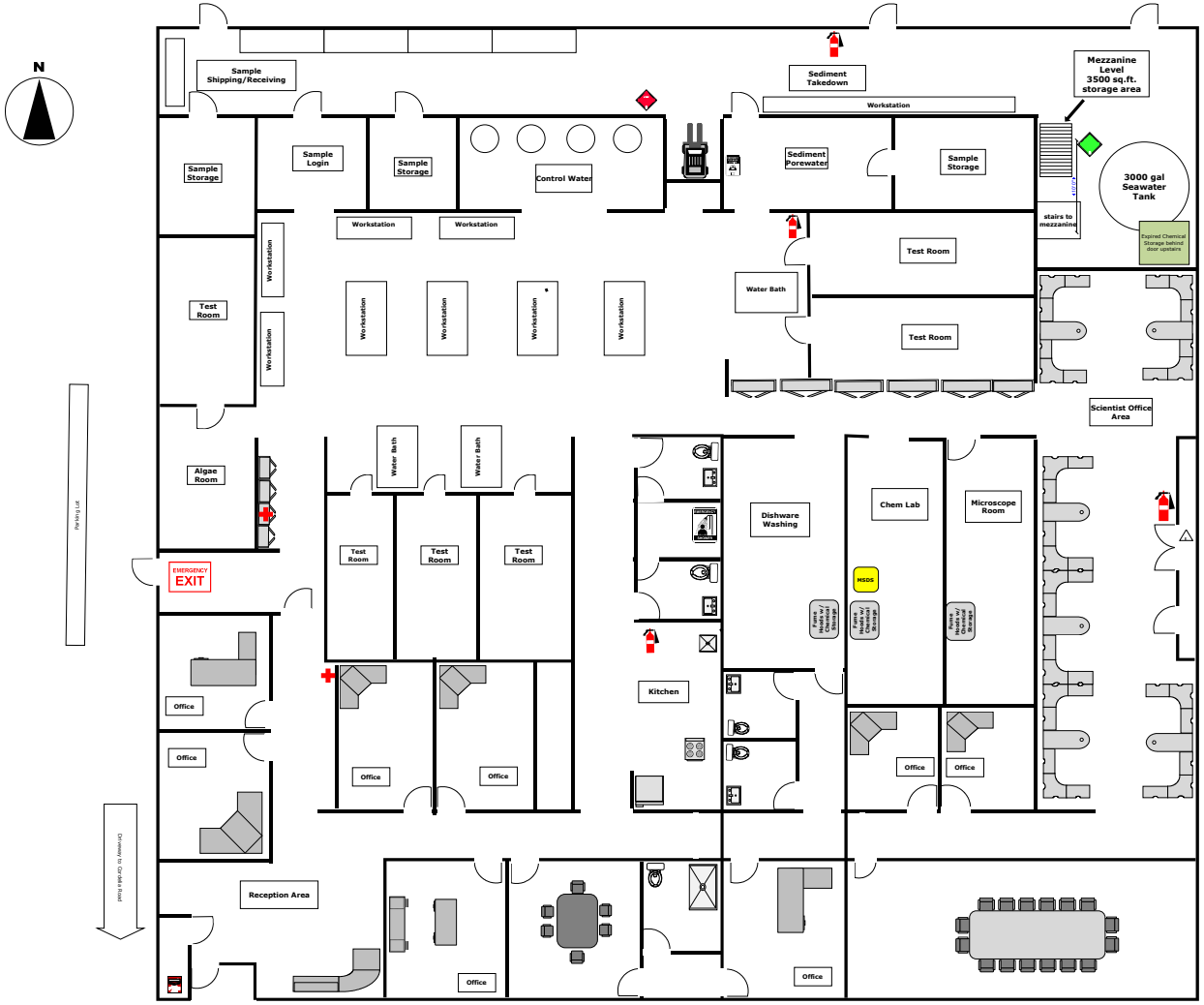
The QA Manager maintains the training logbook. The training logbook serves as the official record of capabilities for each staff member. The Technical Director(s) and/or QA Officer are responsible for completing the training log for each staff member by signing the DOC sheets. Staff are required to initial and date that they have completed the initial and ongoing DOC for a given method in their toxicity test training and proficiency logs. Detailed instructions related to completion of toxicity test training and proficiency logs are provided in Section 20 - "Environmental Methods and Method Validation."

19. ACCOMODATIONS AND ENVIRONMENTAL CONDITIONS

Successful evaluation of contaminated waters and sediments by Pacific EcoRisk is due in no small part to our state-of-the-art laboratory facilities. The laboratory, located in Fairfield, provides over 3,000 ft^2 of office and conference facilities and over 8,000 ft^2 of actual laboratory space for conducting bioassays, culturing test organisms, storing and preparing water, effluent and sediment samples for use in the tests, routine chemical analyses, and TIE fractionations. The facility also has an additional 3,500 ft^2 of storage for supplies, laboratory equipment, and field equipment.

The laboratory facility is designed and organized to facilitate testing of environmental samples. The various laboratory rooms comprising our facility are all designed for efficient and optimal performance of the testing services we provide, and include a total of 6 large walk-in constant temperature rooms, 3 walk-in refrigerators, and 6 water baths. A figure depicting the floor plan of the facility is provided as Figure 19-1.

Figure 19-1. Floorplan



Laboratory space is arranged to minimize cross-contamination between incompatible areas of the laboratory. For example, the organism culturing areas are separated from the testing areas and the sediment processing area is separated from the rest of the work areas. Some of the different laboratory work areas include:

- Sample receipt;
- Sample storage;
- Wet chemistry and analysis;
- Chemical storage;
- Toxicity testing;
- Organism culturing; and
- Sediment sample processing.

Environmental conditions (*e.g.*, temperature and light) are monitored to ensure that conditions do not invalidate results or adversely affect the required quality of any measurement.

The laboratory is kept secure during off hours with locks, an alarm system, and video surveillance. Laboratory personnel accompany all visitors in the facility.

20. ENVIRONMENTAL METHODS AND METHOD VALIDATION

Methods and/or procedures are available for all activities associated with the analysis of the sample including preparation and testing. For purposes of this Section, "method" refers to the toxicity test method. A table of the test methods PER performs is attached in Appendix C.

Before being put into use, a test method is confirmed by a demonstration of capability or method validation process. All methods are published or documented. Deviations from the methods are allowed only if the deviation is documented, technically justified, authorized by management and accepted by the client.

20.1 Method Selection

Pacific EcoRisk will use methods that meet the needs of our clients. Such methods will be based on the latest edition of the method unless it does not meet the needs of the client.

20.2 Laboratory-Developed Methods

For non-standard sampling and analysis methods, sample matrices, or other unusual situations, appropriate method validation study information shall be documented to confirm the performance of the method for the particular need. The purpose of this validation method is to

assess the potential impact on the representativeness of the data generated. For example, if a non-standard method is used, rigorous validation of the method may be necessary. Such validation studies may include round-robin studies performed by USEPA or other organizations. If previous validation studies are not available, some level of single-user validation study should be performed during the project and included as part of the project's final report. The process of designing and validating the method is carefully planned and documented. All personnel involved in the method design, development and implementation will be in constant communication during all stages of development. Approval of non-standard methods ultimately is the responsibility of the QA Officer.

20.3 Method Validation

Validation is the confirmation, by examination and objective evidence, that the particular requirements for a specific intended use are fulfilled. At a minimum, all methods are validated by performing an initial demonstration of capability.

Non-standard methods may require additional validation documentation. The validation is designed so that the laboratory can demonstrate that the method is appropriate for its intended use. All records (e.g., planning, method procedure, raw data and data analysis) shall be retained while the method is in use. Based on the validation process, the laboratory will make a statement in the method or SOP of the intended use requirements and whether or not the validated method meets the use requirements.

20.4 Demonstration of Capability

Due to the following limitations, Pacific EcoRisk has established DOC documentation that separates the DOC documentation for scientist staff from the method itself:

- The duration of many toxicity tests occurs during a greater duration than the standard work week (*i.e.,* staff do not solely perform a toxicity test from test initiation to termination);
- The duration of toxicity tests (i.e. one test can have a duration of more than 50 days for some methods) are too long for each scientist to demonstrate their capability by successful performance of five tests. The cost of training all scientist staff would be prohibitive due to the time requirements alone;
- The cost of test organisms makes ordering a separate batch of organisms for five tests for each test method for each scientist is prohibitive; and
- The cost of test organisms and PT samples for five tests for each scientist for each test method is cost prohibitive.

20.4.1 Demonstration of Capability for Scientist Staff

The Demonstration of Capability for scientist staff is a procedure for scientists to become part of the work cell for a particular test method though demonstration of their ability to generate toxicity test results that meet the quality control requirements of the method. A summary of the scientists that have established their initial DOC and have maintained their ongoing DOC for each test method (or "work cell") is summarized on the "Scientific Demonstration of Capability Master List" that is posted in the laboratory. The process for scientists to develop their initial and ongoing DOC is established in Section 18.2 – "Training."

20.4.2 Demonstration of Capability for Toxicity Testing Methods

A satisfactory initial Demonstration of Capability is required prior to acceptance and institution of any method for data reporting. It is also required to validate a non-standard method. DOC for a toxicity test method is a procedure to establish the ability of the work cell for a particular method to generate analytical results of acceptable accuracy and precision. A minimum of five acceptable reference toxicant tests, using the same test conditions, age of test organisms, feeding, etc. but different batches of test organisms are required for an initial DOC. The %CV for those five tests must be within the acceptable range specified in the test method in order to be considered a satisfactory initial DOC. The data is documented in the reference toxicant test database for that particular test method. When more that 20 tests have been performed an ongoing DOC will satisfy this requirement. The documentation of ongoing laboratory performance (*i.e.,* ongoing DOC) is outlined in the corresponding toxicity test method manuals and includes documentation with Control charts. Pacific EcoRisk evaluates these regularly as part of the data review process (Section 23.4 – "Data Review") and internal audits (Section 15.1 – "Internal Audits").

20.5 Control of Data

To ensure that data are protected from inadvertent changes or unintentional destruction, the laboratory uses procedures to check calculations and data transfers (both manual and automated).

20.5.1 Computer and Electronic Data Requirements

Pacific EcoRisk assures that computers, automated equipment, or microprocessors used for the acquisition, processing, recording, reporting, storage, or retrieval of environmental test data are:

- Documented in sufficient detail and validated as being adequate for use;
- Protected for integrity and confidentiality of data entry or collection, data storage, data transmission and data processing;
- Maintained to ensure proper functioning and are provided with the environmental and operating conditions necessary to maintain the integrity of environmental test data; and

- Held secure including the prevention of unauthorized access to, and the unauthorized amendment of, computer records. Data archive security is addressed in Section 14 – "Control of Records" and building security is addressed in Section 19- "Accommodations and Environmental Conditions."

The laboratory controls access to all programs that are used to acquire, process, record or report data. All programs are password-protected. Each employee is granted access only to those programs that he or she uses. The password is unique to the individual, and cannot be shared. The company server is automatically backed up on a daily basis.

20.5.2 Data Reduction

As a part of the management system, Pacific EcoRisk ensures that another individual checks all manual calculations. In addition, all data transfers (data entry, transcribing raw or calculated data, etc.) are checked for accuracy. If any of the checked values are found to be incorrect, corrections are made to assure that the calculations are correct. All raw data calculations are maintained in the appropriate project folder, or where appropriate (as described in Section 14 – "Control of Records."

20.5.3 Data Review Procedures

Data review procedures are located in Section 23.4 – "Data Review."

21. LABORATORY EQUIPMENT

Pacific EcoRisk provides all the necessary equipment required for the performance of toxicity testing and field sampling. A list of the equipment used in the performance of the toxicity testing is provided in Appendix D. All equipment and software used for testing and sampling are capable of achieving the accuracy required for complying with the specifications of the environmental test methods as specified in the laboratory SOPs. Authorized and trained personnel operate equipment (see Section 18. – "Personnel"*).* All equipment is calibrated or verified before being placed in use to ensure that it meets laboratory specifications and relevant standard specifications.

Equipment and supply purchases are approved by a Technical Director and ordered by administrative staff (and designees). Supplies and equipment are ordered from a supplier on the "Approved Suppliers List." Following receipt of supplies and equipment, shipping manifests are given to administrative staff to ensure the correct items were received. Upon receipt, supplies and equipment are inspected and documented in the "Incoming Supplies and Equipment Approval Checklist" in order to ensure the supplies and equipment received comply with specifications prior to use in the laboratory.

The laboratory staff informs the administrative staff when consumable supplies or supplies with an expiration date (*e.g.*, chemicals and pH standards) need to be re-ordered, and in time to assure that an adequate amount of supplies are available at all times.

21.1 Support Equipment Maintenance Program

Pacific EcoRisk considers all laboratory equipment to be support equipment. The Support Equipment Maintenance Program is overseen by the QA Manager (and designees) and includes:

- A comprehensive list of laboratory support equipment;
- Support equipment maintenance and repair records;
- The specified frequency of maintenance tasks; and
- Support equipment maintenance and documentation task assignments.

The Support Equipment Maintenance Program includes but is not limited to: balances, ovens, refrigerators, freezers, incubators, water baths, temperature measuring devices, volumetric dispensing devices, pumps, fume hoods, microscopes, spectrophotometers, and a Type 1 water system. All equipment and instruments are maintained according to the requirements of the test method, the 2009 TNI Standard, and manufacturer recommendations. Regular maintenance of laboratory equipment is performed at least annually. Each piece of equipment is uniquely identified and all maintenance and repair information for each piece of equipment is recorded in an equipment maintenance log.

Equipment maintenance records include the following:

- Identity of the equipment and its software;
- Manufacturer's name, type identification, serial number or other unique identifier;
- Check that equipment complies with specifications of applicable tests;
- Current location;
- Manufacturer's instructions, if available, or a reference to their location;
- Dates, results and copies of reports and certificates of all calibrations, adjustments, acceptance criteria, and the due date of next calibration (See Section 21.2 – "Instrument Calibration and Standardization");
- Maintenance plan where appropriate, and maintenance carried out to date; documentation on all routine and non-routine maintenance activities and reference material verifications; and
- Any damage, malfunction, modification or repair to the equipment.

Equipment that is no longer used or maintained, has been subject to overloading, mishandling, given suspect results, or shown to be defective or outside specifications is taken out of service. The equipment is isolated to prevent its use or clearly labeled as being out of service until it has

been shown to function properly. Before placing equipment back in service, maintenance and repair information is documented in the equipment maintenance log and the equipment must meet the requirements of the test method, the 2009 TNI Standard, and manufacturer recommendations. In and out of service dates are recorded for each piece of equipment.

If it is shown that previous tests are affected by equipment outside of specifications, then procedures for non-confirming work are followed and results are documented (see Section 10 – "Control of Non-confirming Environmental Testing Work" and Section 12 – "Corrective Action").

When equipment is used that is outside of permanent control of the laboratory, the lab ensures the equipment meets the requirements of this manual prior to its use by inspecting or otherwise testing it.

All equipment and supplies purchased for laboratory use, including general supplies, must either be pre-cleaned or undergo laboratory cleaning before use in the toxicity tests.

21.2 Instrument Calibration and Standardization

Support equipment such as balances, ovens, refrigerators and freezers are verified, each day prior to use, to ensure operation is within the expected range for the application for which the equipment is to be used. Verifications are performed with a NIST traceable reference or equipment calibrated with a NIST traceable reference. Volumetric dispensing devices (except Class A glassware and Glass microliter syringes) are checked for accuracy on a quarterly basis.

All support equipment is calibrated or verified annually over the entire range of use using NIST traceable references, where available. The results of the calibration of support equipment are within method or manufacturer specifications. If correction factors are used this information is clearly marked on or near the equipment. Calibration of NIST traceable reference materials is outlined in Section 21.3 – "Measurement Traceability."

Requirements for instrument calibration and standardization for use in toxicity tests and routine water quality analyses are briefly described below. Detailed descriptions of the analyses are described in laboratory SOPs. Each instrument calibration or verification is recorded in an instrument-specific logbook and are verified to be within method specifications prior to use each day.

Temperature - Temperature is measured to the nearest 0.1˚C using digital thermometers, alcohol thermometers, or continuous temperature measuring devices. All temperature measuring devices are verified semi-annually against a NIST traceable thermometer (See Section 21.3 –

"Measurement Traceability"). Correction factors are assigned as needed. NIST traceable thermometers are re-calibrated every five years.

Conductivity/Salinity - Conductivity is measured to the nearest $\mu S/cm^2$ and salinity is measured to the nearest ppt or g/L using a verified and calibrated meter. The meter and probe are used and maintained according to factory specifications. Standards are stored in accordance with the manufacturers recommendations, method requirements, and the requirements of the Pacific EcoRisk Health and Safety Program. Handling of standards is minimized by using sub-samples for multiple calibrations. Calibrations are performed when verification values fall outside specifications.

pH - pH is measured to the nearest 0.01 pH unit using an appropriately-calibrated meter and probe. The meter and probe are used and maintained according to factory specifications. Each pH probe/meter is calibrated daily using buffer solutions that bracket the pH range of the samples (typically, pH buffers at pH4, pH 7 and pH 10).

Dissolved Oxygen - Dissolved oxygen (DO) is measured to the nearest 0.1 mg/L with an appropriately calibrated meter and probe. The meter and probe are used and maintained according to factory specifications. Each probe/meter is calibrated as specified in the method or manufacturers instructions.

Irradiance (Light) - Irradiance is measured using an appropriate meter and an irradiance sensor that measures photosynthetically active radiation (PAR, photons) in units of foot-candles or lux. Each meter is factory-calibrated at intervals recommended by the manufacturer.

Total Ammonia - Ammonia is measured to the nearest 0.01 mg/L using a spectrophotometer. The spectrophotometer is maintained according to factory specifications. Each water sample is added to a vial containing reagents and measured on the spectrophotometer using the factory-installed method for ammonia analyses.

Total Residual Chlorine - Chlorine is measured to the nearest 0.1 mg/L colorimetrically using an appropriate colorimeter. Each water sample is prepared for analysis using commercial reagents. The colorimeter is used and maintained according to factory specifications, and is calibrated before each use in accordance to manufacturers instructions.

Weights and Volumes - Calibration of the balances is checked daily before use with weights traceable to NIST standards. Each balance is certified annually by a service representative, and is used and maintained according to factory specifications. Calibration weights are inspected at each calibration and discarded if corroded or otherwise suspect. Liquid volumes contained or

delivered by pipetes/pipettors are verified quarterly by weighing volumes of distilled water on an analytical balance. Calibrations are performed at a minimum of annually.

21.3 Measurement Traceability

Measurement quality assurance comes in part from traceability of standards to certified materials. All equipment used affecting the quality of test results are calibrated prior to being put into service and on a continuing basis (see Section 23 – "Quality Assurance for Environmental Testing"). These calibrations are traceable to national standards of measurement where available.

If traceability of measurements to SI units is not possible or not relevant, evidence for correlation of results through inter-laboratory comparisons, proficiency testing, or independent analysis is provided.

The laboratory handles and transports reference standards and materials in a manner that protects the integrity of the materials. Reference standard and material integrity is protected by separation from incompatible materials and/or minimizing exposure to degrading environments or materials. Reference standards and materials are stored according to manufacturer's recommendations, method SOP requirements and separately from samples.

21.3.1 Reference Standards

The following reference standards are sent out for calibration to a national standard as indicated in Section 21.2 – "Instrument Calibration and Standardization":

- Class 1 weights; and
- NIST traceable reference thermometers.

The Class 1 weights are used for daily balance verification and are calibrated annually. The NIST traceable reference thermometer, used to calibrate all other thermometers and continuous temperature monitoring devices, is calibrated every five years.

21.3.2 Reference Materials

Reference materials are substances that have concentrations that are sufficiently well established to use for calibration or as a frame of reference. Reference materials, where commercially available, are traceable to national standards of measurement, or to Certified Reference Materials, usually by a Certificate of Analysis.

Purchased reference materials require a Certificate of Analysis where available. If a reference material cannot be purchased with a Certificate of Analysis, it is verified by analysis and

comparison to a certified reference material and/or demonstration of capability for characterization.

Internal reference materials, such as reference toxicant stock solutions, working standards or intermediate stock solutions, are checked as far as is technically and economically practical and are documented as outlined in Section 21.4 – "Standards, Reagents and Reference Materials."

21.4 Standards, Reagents, and Reference Materials

The laboratory has procedures for purchase, receipt, distribution and storage of standards, reagents and reference materials as described in Section 7 – "Purchasing Services and Supplies" and the Pacific EcoRisk Health and Safety Program.

Expiration dates can be extended if the reference standard or material's integrity is verified. The extended date may not be beyond the expiration date of the referenced standards used to re-verify.

All containers of prepared standards, reagents, or materials are labeled with the material (e.g., KCl), data prepared, and concentration (i.e., this information constitutes our unique ID).

Prepared reagents are verified to meet the requirements of the test method through traceability to purchased stock or neat chemicals. Purchased reagent quality is verified to meet the requirements of the test method upon receipt following procedures in the "Incoming Supplies and Equipment Approval Checklist." If the original container does not have an expiration date provided by the manufacturer or vendor it is not required to be labeled with an expiration date. If an expiration date is provided, the original containers and container and any standards or reagents prepared from it must be labeled with the expiration date.

21.4.1 Purchased Standards, Reagents, Reference Materials and Media

Records for all standards, reagents, reference materials, and media are recorded in the chemical inventory and include the:

- Manufacturer/vendor name (or traceability to purchased stocks or neat compounds);
- Manufacturer's Certificate of Analysis or purity (if supplied);
- Date of receipt; and
- MSDS.

In methods where the purity of reagents is not specified, reagent grade is used. If the purity is specified, that is the minimum acceptable grade. Purity is verified and documented according to Section 7 – "Purchasing Services and Supplies."

21.4.2 Prepared Standards, Reagents, Reference Materials and Media

Records for preparation of standards, reagents, reference materials, and media should include:

- Traceability to purchased stock or neat compounds;
- Reference to the method of preparation;
- Date of preparation;
- Expiration date after which the material shall not be used (unless its reliability is verified by the laboratory); and
- Preparer's initials.

22. SAMPLE COLLECTION AND HANDLING

PER provides sampling services on a project specific basis. For these projects, sampling SOPs can be found in the corresponding QAPP or SAP. The laboratory uses sampling plans provided by clients or prepared in consultation with the client. The plan must include any factors that must be controlled to ensure the validity of the test. Sampling plans and written sampling procedures are used for collecting environmental samples, substances, materials or products for testing. The QAPP or SAP are made available at the sampling location. When the client requests any deviations from the sampling plan or sampling procedures the deviations are documented and included in the final report. All field measurements, records, and notes (e.g., temperature, salinity, etc.) are logged in bound field notebooks when samples are collected by PER staff. Sufficient information is recorded in detail in the field notebook to completely reconstruct the sampling event(s).

Precautions are taken to ensure that methods for collection and storage of samples (including materials used) do not contribute to sample toxicity (*i.e.,* use appropriately cleaned sample containers, etc.); this may include the use of field blanks, which will be specified in project Quality Assurance Project Plan (QAPP). Samples may be shipped in glass or plastic (*e.g.,* polyethylene or polypropylene) bottles, or in disposable cubitainers. All samples should be shipped on ice, under chain of custody with a temperature blank.

For projects for which PER does not provide sampling services, the laboratory provides the sampler with the necessary coolers, sample containers, COC forms, and packing materials required to properly preserve, pack, and ship samples to the laboratory.

22.1 Sampling Containers

The laboratory offers clean sampling containers for use by clients. Containers are obtained following procedures outlined in Section 7 – "Purchasing Services and Supplies" and meet the requirements of the test methods. Containers are provided to the client upon request.

22.2 Chain of Custody

The purpose of using a chain of custody (COC) record is to maintain an accurate written record that can be used to trace the custodianship (possession) of the sample from it's collection through it's receipt at the PER testing laboratory. COC documentation begins in the field. The sample collector is responsible for the care and custody of the sample(s) until they are received at the appropriate laboratory or relinquished to an assigned custodian.

Samples must be accompanied by a COC record that includes the name of the study, a unique sample ID for each sample, location of collection (or station number and location), date and time of collection, type of sample, number of containers, analysis required, and the collectors' signatures. The COC can act as an order for laboratory services in the absence of a formal contract. When turning over possession of samples, the person relinquishing the sample(s) *and* the recipient must *both* record the date and time of the transfer, and sign their name to verify the transaction. For certain projects, an additional sample transfer sheet is initiated to track the sample through the laboratory during storage, sample preparation, and generation of raw data. Samples are discarded only when it is certain that all tests and analyses have been properly performed and recorded. An example COC is provided in Appendix E. Chain of custody and any additional records received at the time of sample submission are maintained by the laboratory in the project folder and is provided in the final report.

22.3 Sample Receipt, Handling, Storage, and Disposal

Upon receipt, ensure each sample has an identification label or tag securely attached to the sample container. If PER is collecting the samples, ensure the sample is labeled at the time of collection. The sample label, included any subsamples for auxiliary analyses, and typically contains the following information:

- Name of the client and project;
- Sampling station name/location;
- Sample date, time, and possibly duration of sample collection;
- Type of sample (*i.e.,* grab vs. composite); and
- Unique identifying number.

Samples are delivered to the laboratory via shipment, courier (either PER staff or contracted), or the client. Procedures for picking up samples by PER staff are outlined in the "Sample Pickup SOP." Samples that are transported under the responsibility of the laboratory, where necessary, are done so safely and according to storage conditions. This includes moving bottles within the laboratory. Sample shipping procedures are described in the "Sample Shipment SOP."

The laboratory has sample acceptance, storage, and disposal procedures that are provided in "Sample Receipt, Handling, Storage, and Disposal SOP." Upon receipt at the laboratory, all samples from a given project are assigned a unique sample ID number. This number is used throughout the project. For effluent and receiving/ambient water samples, measurement of initial temperature, pH, D.O. salinity, conductivity, and total ammonia, as well as the initials of the person that recorded the data, are recorded on the sample login sheets. Total residual chlorine is also measured for effluents collected from facilities that use chlorination in their disinfection process. The remaining sample is stored at 0-6˚C until needed for test initiation. PER maintains SOPs for all required analyses that are available staff.

Sample hold time requirements can be found in the applicable toxicity testing SOP(s) and the requirements are adhered to. If preservation or holding time requirements outlined in the SOP or test method are not met, the procedures in Section 10 – "Control of Non-Confirming Environmental Testing Work" are followed. In general, if these conditions are not met, the client is contacted prior to any further processing, then the sample is rejected as agreed with the client, or the decision to proceed is documented and agreed upon with the client. The condition is noted on the COC form and/or lab receipt documents, and the data are qualified in the report.

23. QUALITY ASSURANCE FOR ENVIRONMENTAL TESTING

Pacific EcoRisk has procedures for monitoring the validity of the testing it performs. To evaluate the quality of toxicity test results, the laboratory utilizes standard toxicity testing QA/QC procedures to ensure that the test results are valid. Standard QA/QC procedures include the use of negative controls, positive controls (reference toxicant tests), reference sediment samples, replicates, and measurements of water quality during testing.

Toxicity testing results are analyzed and, when found to be outside pre-defined criteria, action is taken to correct the problem and to prevent incorrect results from being reported. Data associated with quality control data outside of criteria and still deemed reportable will be qualified so the end user of the data may make a determination of the usability of the data. The corrective actions taken are dependent upon the magnitude of the problem.

23.1 Essential Quality Control Procedures

Laboratory personnel follow the quality control procedures specified in test methods.
For test methods that do not provide acceptance criteria for an essential quality control element or where no regulatory criteria exist, acceptance criteria are developed.

Written procedures to monitor routine quality controls including acceptance criteria are located in the test method SOPs, except where noted, and include such procedures as:

23.1.1 Source and Condition of Organism

All test organisms are obtained from reputable suppliers who have provided PER with organisms in the past. Normally, all test organisms are maintained in the laboratory for acclimation to test conditions (exceptions are bivalves). If mortality in excess of 10% is noted in the holding stock, the animals are discarded and a new batch ordered. All organism suppliers must provide taxonomic identification documentation yearly.

23.1.2 Maintenance of Test Conditions and Corrective Actions

Each of the biological tests has a set of specific test conditions that are defined in the standard testing. For example, water quality measurements are monitored to ensure that test conditions are within the prescribed limits for each test procedure. The limits for various test condition parameters are noted in the section on the acceptability of each test.

23.1.3 Reference Toxicant Testing and Data Accuracy and Precision

Reference toxicant tests are used to assess accuracy (*i.e.,* to establish that the test organisms are responding to toxic stress in a typical fashion). For instance, acceptable accuracy is defined as a calculated reference toxicant dose-response value (*i.e.,* statistically-derived point estimate such as the EC50 or IC25) that is within the "typical test organism response" range established by the mean $\pm$ 2 standard deviations of the 20 most-recently performed tests; this information is maintained in the PER reference toxicant database and can be quickly assessed by reviewing the reference toxicant control charts. Reference toxicant testing performance is determined by reviewing the data against the PER Reftox Acceptance/Rejection Policy.

PER performs toxicity testing with species for which a minimum of 5 reference toxicant tests have been completed with different batches of organisms. Unless a specific project does not require the performance of a reference toxicant test, reference toxicant testing is performed concurrently for each batch of animals obtained from an outside source; reference toxicant testing is performed monthly for species cultured in-house. For species tested on a seasonal basis, reference toxicant tests are conducted each month the method is used. In addition, a reference toxicant test is performed for each species at least on an annual basis.
The precision of toxicity tests is assessed via measures of variability (*e.g.,* coefficient of variation [CV] for a given test treatment). While there are no "acceptability limits" placed on the CV for most test responses, these can be evaluated using "Best Professional Judgment" to characterize whether or not the test response at a given treatment is subject to too much variability for use in a given test.

23.2 Internal Quality Control Practices

The following procedures are performed as internal quality control checks to ensure that all infrastructural functions and generation of data in the laboratory are within acceptable performance ranges:

- Test temperature monitoring;
- Type 1 water quality monitoring;
- Review of test data;
- Instrumentation calibration log entries and reviews;
- Test organisms log-in and husbandry log;
- Sample acquisition log;
- Calibration of equipment according to SOP's;
- Continual training of laboratory personnel, including their ethical and legal responsibilities; and
- All QC data is assessed and evaluated on an on-going basis, so that trends are detected.

23.3 Proficiency Test Samples or Inter-laboratory Comparisons

Pacific EcoRisk participates in applicable proficiency testing or inter-laboratory comparisons (e.g., DMR_QA). The proficiency standard testing program consists of a yearly toxicant test regulated by external agencies. Toxicity testing is performed on all available and applicable PT samples. PT results are made available and clients are notified of results and any related corrective actions.

The laboratory does not share PT samples, communicate results or attempt to obtain the assigned values or results from other laboratories or PT providers. PT samples are treated as standard testing samples and processed using standard procedures.

23.4 Data Review

Throughout testing, as well as upon completion of a project, a thorough data review is performed. The data review consists of the following procedures:

- Determinations of whether the results of testing, examining, or analyzing the sample meet the accepted protocols for interpretation;
- Checks to determine the accuracy of any calculations;
- Checks for transcription errors, omissions, or mistakes;
- Checks to determine consistency with project-specific measurement quality objectives;

- Checks to ensure that the appropriate preparatory and analytical SOPs and standardized methods were followed, and that the chain of custody is completed and that holding times were met;
- Checks to ensure that requirements for equipment calibrations were met; and
- A tiered system of verification/review, consisting of the Scientist performing the testing, Laboratory Manager, and a Technical Director or the QA Officer.

24. REPORTING RESULTS

The result of each test performed is reported accurately, clearly, unambiguously, and objectively and complies with all specific instructions contained in the test method.

Laboratory results are reported in a test report that includes all the information requested by the client and necessary for the interpretation of the test results and all information required by the method used.

24.1 Test Reports

The report format has been designed to accommodate each type of test performed and to minimize the potential for misunderstanding or misuse. Each test report generated contains the following information:

- Title;
- Name and address of the laboratory;
- Unique project identification number for the test report and a pagination system that ensures that each page is recognized as part of the test report and a clear identification of the end of the report, such as 3 of 10;
- Name and address of the client;
- Identification of the method used;
- Description of, the condition of, and unambiguous identification of the sample(s) tested, including the client identification code;
- Date of sample receipt when it is critical to the validity and application of the results, date and time of sample collection, dates the tests were performed, the time of sample preparation and analysis if the required holding time for either activity is less than or equal to 72 hours;
- Reference to the sampling plan and procedures used by the laboratory where these are relevant to the validity or application of the results;
- Test results, an indication of when failures are identified, and an identification of the statistical package used to analyze the data;
- Name, function, and signature or an equivalent electronic identification of the person authorizing the test report, and the date of issue;

- Where relevant, a statement to the effect that the results relate only to the samples;
- Any non-accredited tests or parameters are clearly identified as such to the client; and
- Statement that the report shall not be reproduced except in full without written approval of the laboratory.

24.2 Supplemental Test Report Information

When necessary for interpretation of the results or when requested by the client, test reports include the following additional information:

- Deviations from, additions to, or exclusions from the test method, information on specific test conditions, such as environmental conditions, and any non-standard conditions that may have affected the quality of the results, and any information on the use and definitions of data qualifiers;
- Statement of compliance/non-compliance when requirements of the management system are not met, including identification of test results that did not meet the laboratory and regulatory sample acceptance requirements, such as holding time;
- Where applicable and when requested by the client, a statement on the estimated uncertainty of the measurement;
- Where appropriate and needed, opinions and interpretations. When opinions and interpretations are included, the basis upon which the opinions and interpretations are documented. Opinions and interpretations are clearly marked as such in the test report; and
- Additional information that may be required by specific methods or client.

In addition to the items above, for test reports that contain the results of sampling, the following is provided when necessary for the interpretation of the results:

- Date of sampling;
- Unambiguous identification of the material sampled;
- Locations of the sampling, including diagrams, sketches, or photographs;
- Reference to the sampling plan and procedures used;
- Details of any environmental conditions during sampling that may affect the interpretations of the test results; and
- Any standard or other specification for the sampling method or procedure, and deviations, additions to or exclusions from the specification concerned.

24.3 Environmental Testing Obtained from Subcontractors

Test results obtained from tests performed by subcontractors are clearly identified on the test report by subcontractor name and/or accreditation number. The subcontractors report their results

in writing or electronically. A copy of the subcontractors report is provided as an appendix to the client's report.

24.4 Electronic Transmission of Results

All test results transmitted by telephone, fax, telex, e-mail, or other electronic means comply with the requirements of the TNI Standard and associated procedures to protect the confidentiality and proprietary rights of the client.

24.4.1 Electronic Data Deliverables

Electronic data deliverables (EDD) include PDF copies of toxicity reports and Surface Water Ambient Monitoring Program (SWAMP) EDDs. The SWAMP EDDs are generated via a cross walk from the CETIS statistical software, and are then populated with additional information (*e.g.*, pH, dissolved oxygen, conductivity) that are not included in the CETIS entry. Scientist III or Project Managers review all SWAMP EDDs and assure that they conform to the SWAMP data entry requirements.

24.5 Amendments to Test Reports

Material amendments to a test report after it has been issued are made only in the form of a "supplemental" report, with the revisions being clearly identified in the report cover letter. An electronic version of each supplemental report is saved with a suffix that includes the letter "S" for supplemental and a number (e.g., "1") for the number of the supplement so as to clearly distinguish it from the initial version of the report. All supplemental reports meet all the requirements for the initial report and the requirements of this Quality Manual.

Appendix A

Laboratory Accreditation/Certification/Recognition

Pacific EcoRisk maintains the following certifications and accreditations with numerous state and national entities:

Organization	Certification	Certificate Number
California Department of Public Health	NELAP	04225CA
California Department of Public Health	ELAP	2085
Washington Department of Ecology	ELAP	C848

The certificates and parameter lists (which may differ) for each organization are provide on the Fields of Accreditation include with the accreditation certificate, which are stored in the QA/QC Program folder on the Pacific EcoRisk server.

Should accreditation be terminated or suspended, Pacific EcoRisk would immediately cease to use the certificate number reference in any way and inform clients impacted by the change.

Appendix B

Glossary

Glossary

Accuracy	Degree of agreement between an analytical result and the true value. Accuracy is affected by both random error (imprecision) and systematic error (bias), but is sometimes used improperly to denote only systematic error.
Analytical Method	Written instructions describing an analytical procedure followed to obtain a numerical estimate of the chemical (analyte) in a sample or samples.
Blank	A sample expected to contain none of the analyte or chemical of interest. *Field blanks* are used to obtain information on contamination introduced during sample collection, transport, or storage. *Method blanks* are most commonly used to reveal contamination in the laboratory (as opposed to in the sampling process) or as an assessment of the effects of a given treatment in a TIE study.
Control Chart	A graphical representation of the precision of QC test results indicating whether the measurement system is in statistical control. For repeated analyses of standards, the chart is usually based on the average result of those analyses (20 results is generally accepted as the minimum to assure valid statistics), and upper and lower control limits based on the standard deviation of the results. (See *Control Limits*)
Control Limits	Statistical warning and action limits calculated for control charts, used to make decisions on acceptability of control test results. *Warning limits* usually established at two standard deviations above and below the mean of repeated analyses of a standard. *Action limits* are established at three standard deviations.
Holding Time	The allowed time from when a sample was taken or extracted until it must be analyzed. For composite samples, the holding time starts when the last composite aliquot is collected.
Precision	A measure of the variability (spread) in the results for replicate measurements caused by random error. Also referred to as *imprecision*. Precision is usually measured as *standard deviation, percent relative standard deviation* (%RSD), or *relative percent difference* (RPD).
Quality Assurance	The total integrated program for ensuring the reliability of monitoring and measurement data.
Quality Control	The routine application of statistically based procedures to evaluate and control the accuracy of results from analytical measurements.
Standard Operating Procedure	A detailed written description of a procedure designed (SOP) to systematize performance of the procedure.

Appendix C

Test Methods

Methods Used for Aquatic Effluent & Receiving Water Toxicity Testing Ambient Water Quality/Toxicity Monitoring

Author	Method Number	Title
U.S. EPA	EPA-821-R-02-012	Methods for measuring the acute toxicity of effluents to freshwater and marine organisms, Fifth Edition
U.S. EPA	EPA-821-R-02-013	Short-term methods for estimating the chronic toxicity of effluents and receiving waters to freshwater organisms, Fourth Edition
U.S. EPA	EPA-821-R-02-014	Short-term methods for estimating the chronic toxicity of effluents and receiving waters to marine and estuarine organisms, Third Edition
U.S. EPA	EPA/600/R-95/136	Short-term methods for estimating the chronic toxicity of effluents and receiving waters to West Coast marine and estuarine organisms
ASTM	E729-96	Guide for conducting acute toxicity tests with fishes, macroinvertebrates, and amphibians
ASTM	E1218-04	Guide for conducting acute toxicity tests with four species of microalgae
ASTM	E724-98	Guide for conducting acute toxicity tests with four species of bivalves
CDFG	Polisini and Miller	Static acute bioassay procedures for hazardous waste samples

Toxicity Identification Evaluations / Toxicity Reduction Evaluations (TIEs / TREs)

- Methods for Aquatic Toxicity Identification Evaluations: Phase 1 Toxicity Characterization Procedures (Second Edition). EPA-600/6-91/003. U.S. EPA, Environmental Research Laboratory, Duluth, MN.
- Methods for Aquatic Toxicity Identification Evaluations: Phase II Toxicity Identification Procedures for Samples Exhibiting Acute and Chronic Toxicity. EPA/600/R-92/080. U.S. EPA, Office of Research and Development, Washington, D.C.
- Methods for Aquatic Toxicity Identification Evaluations: Phase III Toxicity Confirmation Procedures for Samples Exhibiting Acute and Chronic Toxicity. EPA/600/R-92/081. U.S. EPA, Office of Research and Development, Washington, D.C.
- Toxicity Reduction Evaluation Protocol for Municipal Wastewater Treatment Plants. EPA/600/2-88/062. U.S. EPA, Water Engineering Research Laboratory, Cincinnati, OH.
- Sediment Toxicity Identification Evaluation (TIE): Phase 1, Phase II, and Phase III Guidance Document. EPA-600/R-07/080. U.S. EPA, Office of Research and Development, Washington, D.C.

Revised 8/29/12

Methods Used for Sediment Toxicity & Bioaccumulation Testing Evaluations of Ambient Sediments, Dredged Materials, and Dredging Operations

Author	Method Number	Title
U.S. EPA	EPA-821-R-02-012	Methods for measuring the acute toxicity of effluents to freshwater and marine organisms, Fifth Edition
U.S. EPA	EPA-821-R-02-013	Short-term methods for estimating the chronic toxicity of effluents and receiving waters to freshwater organisms, Fourth Edition
U.S. EPA	EPA-821-R-02-014	Short-term methods for estimating the chronic toxicity of effluents and receiving waters to marine and estuarine organisms, Third Edition
U.S. EPA	EPA/600/R-95/136	Short-term methods for estimating the chronic toxicity of effluents and receiving waters to West Coast marine and estuarine organisms
U.S. EPA	EPA 600/R-99/064	Methods for measuring the toxicity and bioaccumulation of sediment –associated contaminants with freshwater invertebrates, Second Edition
U.S. EPA	EPA/600/R-94/025	Methods for assessing the toxicity of sediment-associated contaminants with estuarine and marine amphipods
U.S. EPA	EPA/600/R-01/020	Methods for assessing the chronic toxicity of marine and estuarine sediment-associated contaminants with the amphipod *Leptocheirus plumolosus*
ASTM	E729-96	Guide for conducting acute toxicity tests with fishes, macroinvertebrates, and amphibians
ASTM	E1367-03	Standard test method for measuring the toxicity of sediment-associated contaminants with estuarine and marine invertebrates
ASTM	E724-98	Guide for conducting acute toxicity tests with four species of bivalves
ASTM	E1688-10	Guide for determination of the bioaccumulation of sediment-associated contaminants by benthic invertebrates
ASTM	E1611-00	Guide for conducting sediment toxicity tests with polychaeteous annelids

- Long-term management strategy (LTMS) for the placement of dredged material in the San Francisco Bay Region. U.S. EPA Region 9, U.S. Army Corps of Engineers, San Francisco Bay Conservation and Development Commission, San Francisco Bay Regional Water Quality Control Board, California State Water Resources Control Board.

- Evaluation of dredge material proposed for ocean disposal - Testing Manual. EPA-503/8-91/001. U.S. EPA-U.S. Army Corps of Engineers, Washington, D.C.

- Evaluation of dredged material proposed for discharge in waters of the U.S. - Inland Testing Manual. EPA-823/B-94/002. U.S. EPA-U.S. Army Corps of Engineers, Washington, D.C.

- QA/QC guidance for sampling and analysis of sediments, water, and tissues for dredged material evaluations. Phase 1 - Chemical evaluations. EPA 823-B-95-001. U.S. EPA, Office of Water, Washington, D.C.

- Methods for measuring the toxicity of sediment-associated contaminants with estuarine and marine amphipods. EPA-600/R-94/025. U.S. EPA, Env. Research Laboratory, Narragansett, RI.
- Guidance manual: bedded sediment bioaccumulation tests. EPA-600/X-89/302. U.S. EPA Environmental Research Laboratory, Newport, OR.

- Methods for measuring the toxicity and bioaccumulation of sediment-associated contaminants with freshwater invertebrates, second edition. EPA/600/R-99/064. U.S. EPA, Office of Research and Development, Washington, D.C.

- Standard test method for measuring the toxicity of sediment-associated contaminants with freshwater invertebrates. ASTM E1706-05. American Society for Testing and Materials, Philadelphia, PA.

- Standard guide for collection, storage, characterization, and manipulation of sediments for toxicological testing and for selection of samplers used to collect benthic invertebrates. ASTM E1391-03. American Society Testing & Materials, Philadelphia, PA.

- Sediment toxicity identification evaluation: Phase 1 (characterization), Phase II (identification), and Phase III (confirmation). Modifications of effluent procedures. EPA-600/6-91/007. U.S. EPA, Environmental research Laboratory, Duluth, MN.

Appendix D

Laboratory Equipment

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Laboratory Equipment

Laboratory Equipment - Pacific EcoRisk has all of the equipment necessary to successfully perform the EPA and ASTM water, effluent, and sediment tests. All of our testing and analytical equipment is maintained and calibrated as per our QA Manual. All of our plastic and glass labware is cleaned according to EPA guidelines, and is stored in clean, dust-free cabinets until used. A selected list of our Laboratory testing equipment is provided on the accompanying pages.

Toxicity Testing

American	25X	Electric Autoclave
Burrell	75	Wrist Action Shaker
Universal	UTCH-1	Digital Chiller/Heater Units
Testrite	PC1512DY	Light Boxes
Testrite	N/A	Temperature Control Baths
VWR	N/A	Desiccators
Rio	2100	Circulation Pumps
Hagen	N/A	Air Pumps
Otto	TC300H	Submersible Heaters
Aquaclear	150	Power Filters
Emperor	1600	Bio-Wheel Power Filter
Coulter Counter	#10	Particle Counter

Microscopy

Leica	BA120	Galen III Microscopes
Wolfe		Stereo Microscope
Zeiss	AxialVert 25	Inverted Microscope
Leica	DMIL	Inverted Microscope
Hausser Sci.	3800	Sedgewick-Rafter Chamber
Reichert	N/A	Hemacytometers

Balances and Weights

Ohaus	AP250D	Analytical Balance
Mettler/Toledo	PB3002	High Capacity Balance
VWR	Class S	Calibration Weights

Water Quality Analyses

Varian	SD-2000	HPLC
Alpkem	CN Solution 3000	Cyanide Ligand Exchange Analyzer
Orion	3-Star	D.O. Meter
Orion	5-Star	Conductivity/Salinity meter
Beckman	255	pH meter
Orion	710A	pH/ISE meter
VWR	Model 2000	pH/ISE meter

Water Quality Analyses (cont.)

Hach	DR/4000	Spectrophotometer
Hach	DR/3800	Spectrophotometer
Hach	Pocket II	Colorimiter
Universal Ent.	DLM2	Light Meter
Hach	16900-01	Digital Titrator
ERTCO	NIST	NIST Thermometer
Supco	CR-87	Temperature Chart Recorders

Sample Storage/Manipulation/Preparation

ScienceWare	E-34790	Containment Glove Box
Hotpoint	CTX18L	Laboratory Refrigerator
True	H-74	Industrial Refrigerator
ASTM	Various mesh	ASTM Stainless Steel Sediment Sieves
Corning	PC-310	Magnetic Stirplates
Nalgene	N/A	Filtration Units

Centrifuge Systems

IEC	HN-SII	Centrifuge
Forma Scientific	GP-8R	High-G, High Volume Centrifuge
IEC	B22-M	Ultra-G, High Volume Centrifuge

General Lab Equipment

VWR Scientific	1305	Gravity Oven
Kent Marine	TFC	Reverse Osmosis/D.I. Unit
MasterFlex	L/S	Peristaltic Pumps
Eppendorf	N/A	Automatic Pipettors
Labconco	Basic 47	Fume/Ventilation Hood
Pyrex	Class A	Volumetric Pipettes/Flasks
Pyrex/Nalgene	Miscellaneous Griffin beakers	
Pyrex/Nalgene	Miscellaneous Erlenmeyer Flasks	
Pyrex/Nalgene	Miscellaneous Graduated Cylinders	

Appendix E

Chain of Custody Form

Pacific EcoRisk
2250 Cordelia Rd., Fairfield, CA 94534
(707) 207-7760 FAX (707) 207-7916

CHAIN-OF-CUSTODY RECORD

							REQUESTED ANALYSIS											
Client Name:																		
Client Address:																		
Phone:	**FAX:**																	
Project Manager:																		
Project Name:																		
Project # / P.O. Number:																		
	Client Sample ID	**Sample Date**	**Sample Time**	**Sample Matrix***	**Container Number**	**Container Type**												
1																		
2																		
3																		
4																		
5																		
6																		
7																		
8																		
9																		
10																		
12																		
Samples collected by:																		

Comments/Special Instruction:	**RELIQUINSHED BY:**	**RECEIVED BY:**
	Signature:	**Signature:**
	Print:	**Print:**
	Organization:	**Organization:**
	Date: **Time:**	**Date:** **Time:**
	RELIQUINSHED BY:	**RECEIVED BY:**
	Signature:	**Signature:**
	Print:	**Print:**
	Organization:	**Organization:**
	Date: **Time:**	**Date:** **Time:**

***Example Matrix Codes**: (**FW** = Freshwater); (**SW** = Saltwater); (**WW** = Wastewater); (**STRMW** = Stormwater); (**SED** = Sediment); or other

Dr. Anne Fairbrother
Exponent
15375 SE 30th Place, Suite 250
Bellevue, WA 98007

May 7, 2012

Dear Dr. Fairbrother:

I have attached for your review a quality assurance (QA) summary containing the information requested by the U.S. EPA (EPA) for the following test protocols:

- *Hyalella azteca* 28-day survival and growth test;
- *Hyalella azteca* 42-day survival, growth, and reproduction test;
- *Chironomus dilutus* 10-day survival and growth test; and
- *Chironomus dilutus* 50-65-day life-cycle test.

Our format for this QA summary is based on the 5 items requested by the EPA:

1. *Hyalella* and *Chironomus* data from reference toxicant tests – 96 hr water exposures.
    a. At least 5 tests during the past year; more test results, if available, would be appreciated.
2. *Hyalella* and *Chironomus* data from control sediments from at least 5 tests that were run during the past year:
    a. This should include data from both shorter term (growth) and full life cycle tests.
3. A description of the types of control sediment that you use.
    a. Its composition, if you make it in-house or purchase (from whom), etc.
4. A description of your test water.
    a. Its source, and any analytical data (hardness, pH, any routine monitoring for metals and contaminants).
5. The source (supplier) or your test organisms (*Hyalella* and *Chironomus*).

In addition and at your request, our response has been expanded to address Dr. David Mount's EPA Memorandum to Dr. Scott Ireland at the Great Lakes National Program Office "Suggested requirements and performance criteria for laboratories conducting toxicity tests" dated November 23, 2011." We also received this memorandum in an email distribution for discussion for the most recent *Hyalella azteca* Advisory Group conference call.

As you are aware, our laboratory maintains National Environmental Laboratory Accreditation Conference (NELAC) certification and we are fully committed to implementing this program to produce high-quality, legally-defensible test results with the goal of exceeding the minimum expectations for all testing methods. I look forward to answering any questions you or others may have regarding this submittal.

1. Reference Toxicant Test Database Control Charts

Our laboratory's most recent 20 acute (96-hr) LC_{50} reference toxicant test results were extracted from our Comprehensive Environmental Toxicity Information System™ (CETIS) database and are presented in Attachments A and B for *H. azteca* and *C. dilutus*, respectively. Please note that the 21st data points presented on the respective control charts are for the most recent reference toxicant test, and are not used in the calculation of the 20-test limits. The mean, coefficient of variation (CV), 2s (= 2 standard deviations), and 3s (= 3 standard deviations) control limits are based on the first 20 tests.

It should be noted that the August 3, 2011 *H. azteca* reference toxicant LC_{50} and the March 17, 2011 *C. dilutus* reference toxicant LC_{50} were both just *slightly* below the lower thresholds of their respective "typical response" ranges, indicating those particular test organisms may have been slightly more sensitive than is typical. The U.S. EPA guidelines state that at the $p<0.05$ level, it is to be expected that 1 out of 20 reference toxicant tests will fall outside of the "typical response" range due to statistical probability regardless of how well a laboratory performs, so our observation of these "outliers" is not unexpected nor cause for undue concern. Nevertheless, any time a reference toxicant test LC_{50} falls outside of the mean ± 2SD range, we evaluate the test as per our NELAC certification and EPA guidance (EPA 2000) to determine if the test was performed in an acceptable fashion. Both of these tests were performed as per test methods and met all Test Acceptability Criteria (TAC), and were determined to be valid and acceptable.

Table 1. Reference Toxicant Testing Summary

Species	Reference Toxicant	Control Chart Mean EC_{50} (mg/L)	CV (%)	Typical Response Range (mean ± 2SD)
Hyalella azteca	KCl	0.467	17.4	(0.338 – 0.643)
Chironomus dilutus	NaCl	7.94	25.1	(5.08-12.42)

2. Control Sediment Performance Data

2.1 *Hyalella azteca* 28-day Short Term Survival and Growth Testing

A summary of our Control sediment survival and growth performance data is presented below in Tables 2 and 3, respectively. Briefly, survival and growth in our Control sediment is routinely well above EPA Test Acceptability Criteria (TAC), and is also is within the proficiency standards currently being proposed (EPA 2011). Control sediment performance data for 28-day tests extracted from our CETIS database are presented in Attachment C.

Table 2. *Hyalella azteca* 28-day Test Control Sediment Survival Performance Summary for Last 9 Tests.

PER Mean % Survival	Current EPA TAC (% Survival)	Comparison to EPA Suggested Standards[A]			
		% of Tests with Control Survival <80%		Overall Mean Control Survival	
		EPA	PER	EPA	PER
92.9	80	≤15%	0	≥85%	92.9%

A – EPA 2011.
TAC – Test Acceptability Criteria.

Table 3. *Hyalella azteca* 28-day Test Control Sediment Growth Performance Summary for Last 9 Tests.

PER Mean Dry Weight @ Test Initiation (mg)	PER Mean Dry Weight @ Test Termination (mg)	Current EPA TAC	Comparison to EPA Suggested Standards[A]			
			% of Tests with Mean Weight Increase <8x		Mean Weight Increase	
			EPA	PER	EPA	PER
0.054	0.59	≥0.15[B]	≤15%	0	10x	11.5x

A – EPA 2011.
B – Performance criteria from Hyalella 42-day survival growth and reproduction test.
TAC – Test Acceptability Criteria.

2.2 *Chironomus dilutus* 10-day Survival and Growth Testing

A summary of our Control sediment survival and growth performance data is presented below in Tables 4 and 5, respectively. Briefly, survival and growth in our Control sediment is routinely well above EPA Test Acceptability Criteria, and is also is within the proficiency standards currently being proposed (EPA 2011). Control sediment performance data for 10-day *C. dilutus* tests extracted from our CETIS database are presented in Attachment D.

Table 4. *Chironomus dilutus* Control Sediment Performance Summary for Last 9 Tests

PER Mean % Survival	Current EPA TAC (% Survival)	Comparison to EPA Suggested Standards[A]			
		% of Tests with Control Survival <80%		Overall Mean Control Survival	
		EPA	PER	EPA	PER
91.8	70	≤15%	11%[A]	≥85%	93.4%

A - One out of the 9 tests performed (i.e., 11%) was performed with an exceptionally small volume of sediment due to sample volume constraints for the site samples; the lower survival exhibited in that Control treatment met TAC (i.e., was >70%), but is believed to have been lower than we typically see due to the small sediment volume.
TAC – Test Acceptability Criteria.

Table 5. *Chironomus dilutus* Control Sediment Performance Summary for Last 9 Tests

PER Mean Ash-Free Dry Weight @ Test Initiation (mg)	PER Mean Ash-Free Dry Weight @ Test Termination (mg)	Current EPA/ASTM Mean Ash-Free Dry Weight @ Test Termination TAC (mg)	Comparison to EPA Suggested Standards[A]			
			% of Tests with Mean Mean Ash-Free Dry Weight <0.6 mg		Overall Mean Ash-Free Dry Weight mg/ Individual	
			EPA	PER	EPA	PER
0.15[A]	0.79	0.45	≤15%	0	≥0.8	0.8

TAC – Test Acceptability Criteria.

A – Consistent with EPA test guidelines, we initiate our 10-day *C. dilutus* tests with 2nd-to-3rd instar organisms with at least 50% of the organisms at 3rd instar.

2.3 *Hyalella azteca* 42-day Survival, Growth, and Reproduction Test

We have had the opportunity to participate in studies that used the *H. azteca* 42-day survival, growth, and reproduction test and have performed over 14 of these tests. A considerable amount of research into water types and feeding regimes for longer-term *H. azteca* testing is currently underway in the academic, resource agency and private sector; we are active participants in the *Hyalella azteca* Assessment Group (HAGG) which consists of researchers from academia, private, and public organizations working to refine and improve not only the *H. azteca* 42-day survival, growth, and reproduction test method and performance, but also the *C. dilutus* life-cycle test method. As research is made available, we will continue to modify and optimize our methods within EPA method guidance to reflect the latest improvements to ensure the highest quality testing and results are obtained by our lab. A summary of our Control sediment performance for this test is presented in Attachment E.

Please note that as we were focusing on improving the reproduction endpoint for the *H. azteca* test, the growth endpoint was not evaluated in some of our "in-house" 42-day tests. However, 28-day growth in our Control sediment can be determined by evaluation of the 28-day survival and growth Control sediment performance summary provided in Attachment C and summarized in Table 3.

Demonstration of Food/Water Suitability Testing

Because we continually strive to maximize Control treatment survival, growth, and reproduction, we routinely perform research on all aspects of our test methods. We have performed long-term, water-only studies with *H. azteca* to optimize survival and reproduction in control water. We compared the U.S. EPA recommended *H. azteca* Control water (moderately hard water) + YCT with a reconstituted water designated "SAM-5S" (Borgman 1996) + YCT amended with *Spirulina*. The "SAM-5S" water, which included bromine as a constituent, provided improved survival and reproduction and is currently being used as the overlying water for all *H. azteca*

testing performed in our laboratory. Quite a bit of research into water types and feeding regimes for both *H. azteca* and *C. dilutus* testing is being performed by numerous research labs, and our laboratory continues to evaluate this evolving data to make sure that we are using the optimal Control water and feeding for our testing while being compliant with the current EPA methods. As new research findings are made available, we will continue to modify our test method to reflect the latest information and ensure the highest quality testing and results are obtained by our organization. Summary results for our water only exposure testing are provided in Attachment E.

2.4 *Chironomus dilutus* Life-Cycle Test

We have had the opportunity to participate in a unique study that used this test protocol. We have also performed additional "in-house" tests. We currently maintain a *C. dilutus* culture in our lab and routinely train staff on all procedures and endpoints associated with this method. A summary of our Control sediment (including silica) test performance is presented in Attachment E.

3. Description of Types of Control Sediment Used

A description of the Control sediment that we currently use at our lab is provided below. However, it is important to note that the proposed study will be using a reference envelope approach with which to evaluate test organism responses in the site sediments.

Pacific EcoRisk currently uses a mixture of "reference site" sediments collected from two reference site areas in San Francisco Bay (near Alcatraz Island and in Paradise Cove [Tiburon, CA]). For use in freshwater sediment tests, the mixture of reference site sediments (~80% Alcatraz and 20% Paradise Cove) is thoroughly mixed with freshwater and allowed to settle, after which the overlying water is decanted off and replaced with new freshwater. This process is repeated a minimum of three times. After this, the sediment is incubated in large tanks of freshwater at 23˚C for a minimum of one month to allow a freshwater microbial community to develop. Our performance evaluation of these sediments has consistently resulted in excellent survival and growth. We are in the process of performing a full suite of analytical chemistry on our Control sediment and will provide that data when available.

Evaluation of Quartz Sand (= Silica) Control

We also have data comparing our Control sediment mixture to fine-grained quartz sand (= "silica") as a Control medium for our *C. dilutus* testing. A comparative evaluation of performance in our current Control sediment and in the silica is presented below in Table 6. The results of this assessment indicated that growth in the Control sediment did not exceed that of the silica control by the recommend maximum <20% increase. The test results used to make this evaluation are presented in Attachment G.

Table 6. Comparison of *Chironomus dilutus* Control Sediment Growth to Quartz Sediment Growth

Control Media	PER Mean Ash-Free Dry Weight @ Test Initiation (mg)	PER Mean Ash-Free Dry Weight @ Test Termination (mg)	Current EPA Mean Ash-Free Dry Weight TAC (mg)
Silica	0.15	0.80	0.45
Sediment	0.15	0.83	
% increase relative to silica =		4%	Recommended <20%

TAC – Test Acceptability Criteria.

4. Description of Test Water

The Control water for our tests varies by species; however, the "base" water for all reconstituted waters is obtained from a Type I Milli-Q equivalent system. The Type I Milli-Q equivalent system delivers ultrapure water directly from tap water, free of particulates, organic carbon, and all inorganic/organic pollutants in conformance with the quantitative specifications of Type I water as described in ISO 3696, ASTM D1193. We have performed chemical analysis on this base water; the most recent results are presented in Attachment H. We are in the process of performing a more extensive analysis of our source water and will provide that data when available. All reconstituted or synthetic waters are prepared via gravimetric addition of ACS reagent-grade chemicals to this Type 1 lab water. A brief description of each of our reconstituted waters used for *H. azteca* and *C. dilutus* testing are provided below.

Hyalella azteca

We are currently using 'SAM-5S' water (Borgman 1996) as our Control water for all *H. azteca* sediment and water-only testing. The general alkalinity and hardness are 66 mg/L and 175 mg/L (as $CaCO_3$), respectively; the pH is ~8.

Chironomus dilutus

We currently use EPA reconstituted moderately hard water (EPA 2000) as our Control water for all *C. dilutus* sediment testing. The general alkalinity and hardness are 53 mg/L and 86 mg/L (as $CaCO_3$), respectively; the pH is ~7.80.

5. Source of Test Organisms

Hyalella azteca

We have found that test organism suppliers are fairly consistent with the quality of *H. azteca* that they can supply and that shipping stress appears to be minimal for this test species; we typically obtain our organisms from Chesapeake Cultures (Hayes, VA) and use Aquatic Biosystems (Fort Collins, CO) as a back-up supplier. We have cultured *H. azteca* in-house in the past, but prefer the flexibility of using commercial suppliers. While concurrent reference toxicant control charts

for testing performed in our laboratory provide the best assessment of test organism sensitivity, we have requested the suppliers' reference toxicant control charts.

Chironomus dilutus

We currently obtain *C. dilutus* egg cases from Environmental Consulting and Testing (Superior, WI) and rear offspring to the appropriate age for use in 10-day survival and growth testing; we have found removing the stress of shipment on post-hatch organisms leads to better Control treatment survival and growth. For the life-cycle *C. dilutus* test, we will culture the organisms in-house and obtain egg cases from our in-house cultures for use in testing. While concurrent reference toxicant control charts for testing performed in our laboratory provide the best assessment of test organism sensitivity, we have requested the suppliers' reference toxicant control charts.

6. References

Borgman U (1996) Systemic analysis of aqueous ion requirements of *Hyalella azteca*: A standard medium including the essential bromide ion. Arch. Environ. Contam. Toxicol. 30:356-363.

USEPA (2000) Methods for Measuring the Toxicity and Bioaccumulation of Sediment-Associated Contaminants with Freshwater Invertebrates, Second Edition. EPA/600/R-99/064, Duluth, MN.

USEPA (2011) November 23, 2011 Memorandum from David R. Mount to D. Scott Ireland (Great Lakes National Program Office). SUBJECT: Suggested requirements and performance criteria for laboratories conducting sediment toxicity tests.

Please feel free to call my colleague Dr. Scott Ogle or myself at (707) 207-7760 if you have any questions.

Regards,

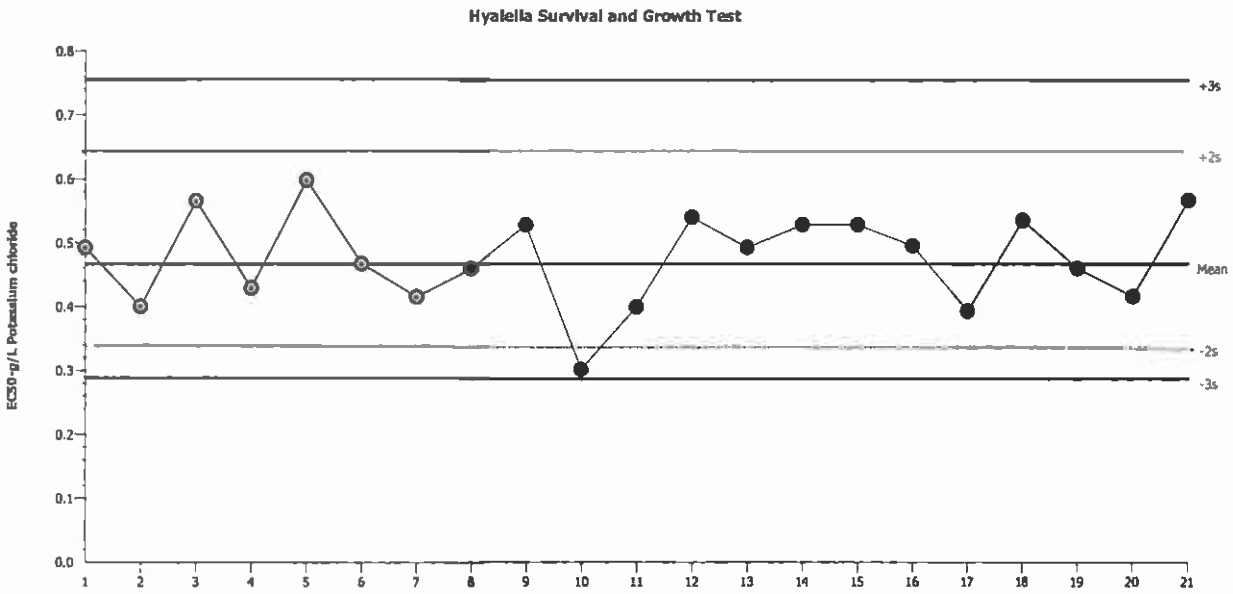
Jeffrey Cotsifas
Principal & Special Projects Director

Attachment A

Summary of Reference Toxicant Database for *Hyalella azteca*

Hyalella Survival and Growth Test — All Matching Labs

Test Type:	Survival (96h)	**Organism:**	Hyalella azteca (Freshwater Amphip	**Material:**	Potassium chloride
Protocol:	All Protocols	**Endpoint:**	96h Survival Rate	**Source:**	Reference Toxicant-REF



Mean:	0.4666	**Count:**	20	**-2s Warning Limit:**	0.3384	**-3s Action Limit:**	0.2882
Sigma:	N/A	**CV:**	17.40%	**+2s Warning Limit:**	0.6434	**+3s Action Limit:**	0.7555

Quality Control Data

Point	Year	Month	Day	QC Data	Delta	Sigma	Warning	Action	Test ID	Analysis ID	Laboratory
1	2011	May	2	0.4925	0.02582	0.3353			15-6336-5031	11-6998-1535	Pacific EcoRisk
2			2	0.4	-0.06664	-0.9595			10-6938-2747	09-5576-5747	Pacific EcoRisk
3			5	0.5657	0.09905	1.199			09-2873-3258	01-5144-9905	Pacific EcoRisk
4			10	0.4287	-0.03793	-0.5279			15-1904-6495	08-5780-0033	Pacific EcoRisk
5			21	0.598	0.1313	1.544			10-3859-4919	01-4001-7843	Pacific EcoRisk
6		Jun	7	0.4672	0.000593	0.007907			06-9948-5492	14-9793-6727	Pacific EcoRisk
7			7	0.415	-0.05159	-0.7295			21-2189-7393	05-2711-3387	Pacific EcoRisk
8			25	0.4595	-0.00716	-0.09627			07-2650-8697	10-2585-6465	Pacific EcoRisk
9		Jul	12	0.5278	0.06116	0.7669			00-6108-8408	12-0427-2915	Pacific EcoRisk
10		Aug	3	0.3031	-0.1635	-2.686	(-)		12-6978-6237	00-3434-2485	Pacific EcoRisk
11			9	0.4	-0.06664	-0.9595			11-9830-1116	07-2045-7475	Pacific EcoRisk
12			13	0.5393	0.07264	0.9009			01-4188-1474	03-6909-8369	Pacific EcoRisk
13		Sep	13	0.4925	0.02582	0.3353			14-3207-7082	07-5294-0792	Pacific EcoRisk
14		Oct	11	0.5278	0.06116	0.7669			17-1931-3662	02-2933-9534	Pacific EcoRisk
15			15	0.5278	0.06116	0.7669			07-5732-7868	16-8031-9938	Pacific EcoRisk
16		Nov	10	0.495	0.02831	0.3668			14-8360-1388	00-7304-0419	Pacific EcoRisk
17		Dec	8	0.3931	-0.07351	-1.067			05-9947-4634	10-7293-5666	Pacific EcoRisk
18	2012	Jan	22	0.5345	0.06787	0.8455			10-5811-8584	02-6353-5566	Pacific EcoRisk
19			23	0.4595	-0.00716	-0.09627			06-7774-6212	19-3054-0667	Pacific EcoRisk
20			24	0.416	-0.05069	-0.716			15-9455-7923	07-8211-3070	Pacific EcoRisk
21		Feb	2	0.5658	0.09916	1.2			05-0652-6460	08-8846-6473	Pacific EcoRisk

Attachment B

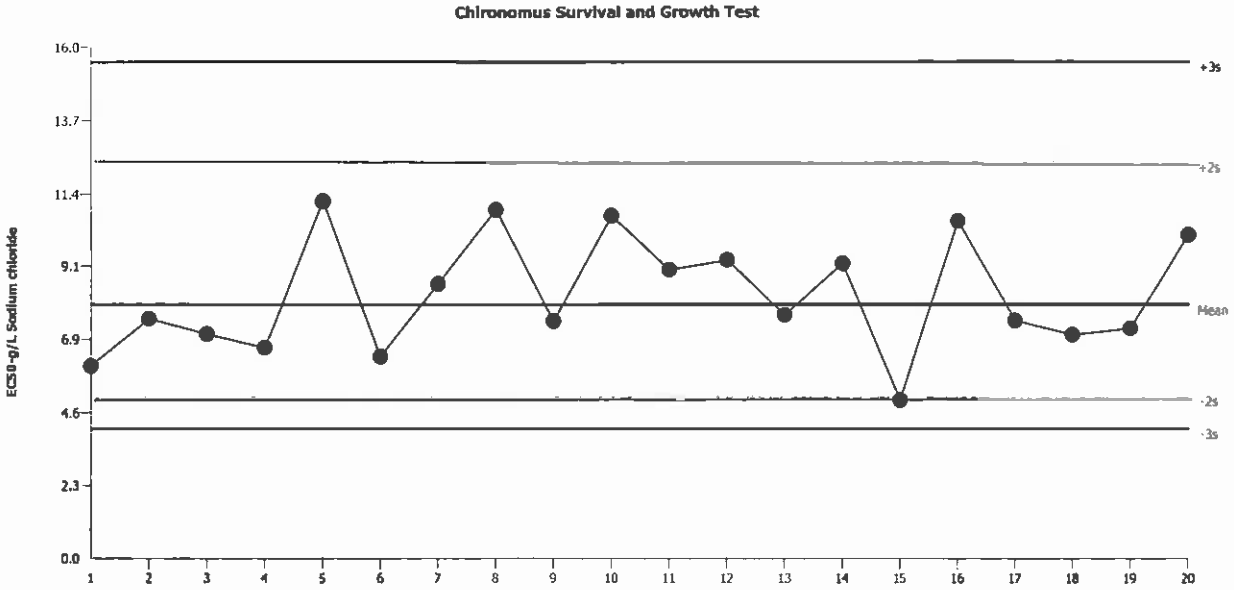
Summary of Reference Toxicant Database for *Chironomus dilutus*

CETIS QC Plot

Report Date: 02 May-12 17:22 (1 of 1)

Chironomus Survival and Growth Test — All Matching Labs

Test Type:	Survival (96h)	**Organism:**	Chironomus tentans (Midge)	**Material:**	Sodium chloride
Protocol:	USEPA Freshwater Sediment (	**Endpoint:**	96h Survival Rate	**Source:**	All SampleID Sources



Mean:	7.941	**Count:**	19	**-2s Warning Limit:**	5.075	**-3s Action Limit:**	4.058
Sigma:	N/A	**CV:**	25.10%	**+2s Warning Limit:**	12.42	**+3s Action Limit:**	15.54

Quality Control Data

Point	Year	Month	Day	QC Data	Delta	Sigma	Warning	Action	Test ID	Analysis ID	Laboratory
1	2008	Mar	6	6.028	-1.913	-1.231			07-2917-5732	16-1217-3547	Pacific EcoRisk
2			25	7.496	-0.4446	-0.2575			20-6411-0883	05-3355-7366	Pacific EcoRisk
3			27	7.014	-0.927	-0.5547			07-9765-6788	09-7593-2253	Pacific EcoRisk
4		Apr	10	6.588	-1.352	-0.8343			06-2222-3732	07-9538-2675	Pacific EcoRisk
5			18	11.18	3.239	1.528			19-1768-8672	01-0123-6048	Pacific EcoRisk
6			18	6.311	-1.629	-1.026			00-1483-0084	02-7807-8913	Pacific EcoRisk
7			30	8.589	0.6481	0.3506			05-5061-5408	13-5731-3103	Pacific EcoRisk
8			30	10.91	2.964	1.417			09-0901-8242	11-9379-2132	Pacific EcoRisk
9		May	10	7.417	-0.5234	-0.3047			20-1954-1317	10-8548-9022	Pacific EcoRisk
10			10	10.72	2.777	1.34			07-7493-6800	00-7500-9661	Pacific EcoRisk
11	2009	Dec	16	9.019	1.078	0.569			17-8448-1238	19-0415-8648	Pacific EcoRisk
12	2011	Mar	2	9.33	1.39	0.7206			00-4774-3950	20-3489-3874	Pacific EcoRisk
13			5	7.603	-0.3376	-0.1941			16-6952-6543	19-9982-1948	Pacific EcoRisk
14			8	9.223	1.282	0.6687			13-3678-5588	15-8549-1862	Pacific EcoRisk
15			17	4.954	-2.986	-2.108	(-)		11-5873-9727	03-7303-4919	Pacific EcoRisk
16	2012	Jan	11	10.55	2.613	1.271			14-4453-0186	09-5355-0935	Pacific EcoRisk
17			17	7.43	-0.5105	-0.2969			14-0682-4769	07-9663-3151	Pacific EcoRisk
18			28	6.987	-0.9536	-0.5717			03-7767-8311	01-3873-6723	Pacific EcoRisk
19		Feb	10	7.186	-0.7545	-0.4461			19-2853-4419	09-0038-4744	Pacific EcoRisk
20			29	10.12	2.18	1.084			10-7884-4200	07-1565-7409	Pacific EcoRisk

Attachment C

Summary of Survival and Growth in Control Sediment for the 28-day *Hyalella azteca* Test

Table C-1. 28-day *Hyalella azteca* Control Sediment Survival and Growth Performance Summary

Test Date	Test Media	Initial Weight (mg)	Mean % Survival	Growth (mg)	Weight Increase (x-fold)
3/1/11	Sediment	0.037	88.8	0.558	15.0
3/2/11	Sediment	0.051	86.3	0.493	9.6
3/5/11	Sediment	0.040	85.0	0.631	15.6
3/9/11	Sediment	0.055	93.8	0.503	9.1
3/9/11	Sediment	0.055	93.8	0.644	11.6
3/16/11	Sediment	0.055	97.5	0.489	8.9
3/17/11	Sediment	0.042	98.8	0.648	15.3
12/8/11	Sediment	0.079	96.3	0.770	9.7
2/7/12	Sediment	0.073	96.3	0.607	8.4
	Mean =	**0.054**	**92.9**	**0.593**	**11.5**

Attachment D

Summary of Survival and Growth in Control Sediment for the 10-day *Chironomus dilutus* Test

Table D-1. 10-day *Chironomus dilutus* Control Sediment Survival and Growth Performance Summary

Test Date	Test Media	Initial AFDW Weight (mg)	Mean % Survival	Growth (Mean Final AFDW) (mg)	Emergence
12/16/09	Sediment	0.16	95.0	0.76	None
2/27/11	Sediment	0.06	92.5	0.77	None
2/28/11	Sediment	0.14	100	0.89	None
3/3/11	Sediment	0.19	95.0	0.57	None
3/5/11	Sediment	0.15	91.3	0.97	None
3/6/11	Sediment	0.15	87.5	0.78	None
3/8/11	Sediment	0.11	100	0.78	None
3/17/11	Sediment	0.23	72.5[B]	0.77	None
2/10/12	Sediment	0.13	92.5	0.83	None
	Mean =	**0.15[A]**	**91.81**	**0.79**	-

AFDW = Ash-free Dry Weight

A – Consistent with EPA test guidelines, we initiate our 10-day *C. dilutus* tests with 2nd-to-3rd instar organisms with at least 50% of the organisms at 3rd instar.

B – This test was performed with an exceptionally small volume of sediment due to sample volume constraints for the site samples; the lower survival exhibited in that Control treatment met TAC (i.e., was >70%), but is believed to have been lower than we typically see due to the small sediment volume.

Attachment E

Summary of Survival, Growth, and Reproduction in Control Sediment for the 42-day *Hyalella azteca* Test and the *Chironomus dilutus* Life-Cycle Test

Table E-1. 42-Day *Hyalella azteca* Control Sediment Test Data.

Test Date	Control Type	Mean 28-Day % Survival	Mean 28-Day Growth: Dry Weight (mg/surviving organism)	Mean 35-Day % Survival	Mean 42-Day % Survival	Mean 42-Day Growth: Dry Weight (mg/surviving organism)	Mean Day 28-42 Reproduction (# offspring per female)
2/16/12	Sediment Control[2]	93.8	0.62	88.8	88.8	0.68	15.0
9/28/2011	Sediment Control[2]	92.5	0.68	92.5	91.3	0.85	14.4
12/21/2010	Sediment Control[1]	87.5	nm[A]	88.8	88.8	nm	8.3
12/21/2010	Sediment Control[2]	93.8	nm[A]	91.3	91.3	nm	5.8
10/21/2010	Sediment Control[1]	95.0	0.47	92.5	92.5	0.54	3.8
12/10/2009	Sediment Control[1]	98.8	nm[A]	98.8	97.5	nm	8.6
Test Acceptability Criteria		>80	>0.15				>2

nm = not measured
A – More information on 28-day growth can be obtained in Attachment C, Table C-1.
[1] EPA Hyalella Water used as overlying water + YCT
[2] SAM-5S Water used as overlying water + YCT amended with *Spirulina*

Table E-2 42-Day *Hyalella azteca* Test Water Only Exposure Control Water Data (Comparison of EPA Hyalella Water + YCT *vs* SAM-5S Water + YCT amended with *Spirulina*).

Test Date	Control Type	Mean 28-Day % Survival	Mean 28-Day Growth: Dry Weight (mg/surviving organism)	Mean 35-Day % Survival	Mean 42-Day % Survival	Mean 42-Day Growth: Dry Weight (mg/surviving organism)	Mean Day 28-42 Reproduction (# offspring per female)
12/21/2010	Water Control[1]	73.8	nm	57.5	50.0	nm	0.1
12/21/2010	Water Control[2]	97.5	nm	97.5	97.5	nm	7.5

[1] EPA Hyalella Water + YCT
[2] SAM-5S Water + YCT amended with *Spirulina*
nm – not measured

Table E-3. *Chironomus dilutus* Life Cycle Sediment Test Control Data.

Test Date	10/26/2010	10/26/2010	12/4/2009	2004	2004	Test Acceptability Criteria
Control Sediment Type	Sediment Control	Silica Control	Sediment Control	Silica Control[4]	Silica Control[4,5]	
Mean 20-Day % Survival	83.3	60.4	98.0	85.4	89.6	
Mean Pupae % Survival	88.9	88.4	86.1	47.6	53.0	Typically >83%
Mean Adult % Survival	100	100	98.4	93.3	100	Typically >96%
20-Day Growth: Mean Dry Weight (mg/surviving organism)	2.00	1.48	1.97	1.02	1.40	Must be >0.6
20-Day Growth: Mean AFDW (mg/surviving organism)	1.40	1.29	1.38	0.67	0.76	Must be >0.48
Mean % Emergence	60.4	68.8	65.0	42.7	51.0	Should be >50%
Reproduction (Mean # eggs per case)	954	1178	1407	655	534	Should be >800
Hatch Rate (Mean % hatch per case)	77.8[1]	95.2[2]	97.6[3]	-	-	Should be >80%

[1] Fungus observed on 5 out of 13 egg cases (38%); affected egg cases were not evaluated.

[2] Fungus observed on 1 out of 18 egg cases (6%); affected egg cases were not evaluated.

[3] Fungus observed on 4 out of 18 egg cases (22%); affected egg cases were not evaluated.

[4] Testing performed as part of a 10-treatment water exposure test assessing toxicity of a metal (silica used as test substrate).

[5] Reference site water used as overlying water.

Attachment F

Control Sediment:
Control Sediment Analytical Chemistry Data

Calscience Environmental Laboratories, Inc.

CALSCIENCE

WORK ORDER NUMBER: 12-05-0618

The difference is service

AIR | SOIL | WATER | MARINE CHEMISTRY

Analytical Report For

Client: Pacific Ecorisk

Client Project Name: QAQC

Attention: Jeff Cotsifas
2250 Cordelia Road
Fairfield, CA 94534-1912

Approved for release on 05/22/2012 by:
Danielle Gonsman
Project Manager

ResultLink

Email your PM

Calscience Environmental Laboratories, Inc. (Calscience) certifies that the test results provided in this report meet all NELAC requirements for parameters for which accreditation is required or available. Any exceptions to NELAC requirements are noted in the case narrative. The original report of subcontracted analyses, if any, is attached to this report. The results in this report are limited to the sample(s) tested and any reproduction thereof must be made in its entirety. The client or recipient of this report is specifically prohibited from making material changes to said report and, to the extent that such changes are made, Calscience is not responsible, legally or otherwise. The client or recipient agrees to indemnify Calscience for any defense to any litigation which may arise.

Calscience Environmental Laboratories, Inc.

Contents

Client Project Name: QAQC
Work Order Number: 12-05-0618

Calscience Environmental Laboratories, Inc.

ACCREDITED IN ACCORDANCE WITH nelac

CASE NARRATIVE

Calscience Work Order No.: 12-05-0618
Project ID: QAQC

Provided below is a narrative of our analytical effort, including any unique features or anomalies encountered as part of the analysis of the sediment samples.

Sample Condition on Receipt

One sediment sample (housed in 16-oz glass containers and a poly bag) was received for this project on May 5, 2012. The sample was transferred to the laboratory in an ice-chest with wet ice, following strict chain-of-custody (COC) procedures. The temperature of the samples upon receipt at the laboratory was 5.1°C. The sample was given laboratory identification numbers, logged into the Laboratory Information Management System (LIMS) and then stored under refrigeration pending sediment chemistry testing.

Tests Performed

Trace Metals by EPA 6020/7471A
Chlorinated Pesticides by EPA 8081A
PAHs by EPA 8270C SIM
PCB Congeners by EPA 8082A (M) GC/ECD
TOC by EPA 9060A
Organotins by Krone et al.
Total Solids by SM 2540B
Grain Size by ASTM D4464M

Data Summary

The sample results and reporting limits were dry weight corrected.

All samples were homogenized prior to preparation and analysis.

Holding times

All holding times were met.

Calibration

Frequency and control criteria for initial and continuing calibration verifications were met.

Reporting Limits

All Method Detection Limits were met. The results were evaluated to the MDL, and where applicable, “J” flags were reported.

Return to Contents

Blanks

Concentrations of target analytes in the method blank were found to be below reporting limits for all testing with the following exceptions.

Nickel was found in the EPA 6020 Method Blank (below the RL, but above the MDL). The sample results have been flagged with a B-qualifier and are released with no further action since the sample results exceeded the Method Blank results by ten times or more.

Laboratory Control Samples

A Laboratory Control Sample (LCS) analysis was performed at the required frequencies, and unless otherwise noted, all parameters were within the established control limits.

Matrix Spikes

Matrix spike analyses were performed for each applicable analysis on project sample PER Control Sed and non-project samples. All parameters for the project sample were within the established control limits with the following exceptions.

The RPD for Endrin Aldehyde (by EPA 8081A) fell outside the established control limits. The results have been flagged with the appropriate qualifiers and are released with no further action since the LCS/LCSD RPD was within the established control limits.

Surrogates

Surrogate recoveries for all applicable tests and samples were within the established control limits.

Acronyms

LCS/LCSD- Laboratory Control Sample/Laboratory Control Sample Duplicate
PDS/PDSD- Post Digestion Spike/Post Digestion Spike Duplicate
ME- Marginal Exceedance
MS/MSD- Matrix Spike/Matrix Spike Duplicate
RPD- Relative Percent Difference

Return to Contents

Calscience Environmental Laboratories, Inc.

Analytical Report

Pacific Ecorisk		Date Received:	05/08/12
2250 Cordelia Road		Work Order No:	12-05-0618
Fairfield, CA 94534-1912		Preparation:	N/A
		Method:	EPA 9060A

Project: QAQC

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
PER Control Sed.	**12-05-0618-1-A**	**05/05/12 12:00**	**Sediment**	**TOC 5**	**05/10/12**	**05/10/12 15:11**	**C0510TOCL1**

Comment(s): -Results were evaluated to the MDL (DL), concentrations >= to the MDL (DL) but < RL (LOQ), if found, are qualified with a "J" flag.
-Results are reported on a dry weight basis.

Parameter	Result	RL	MDL	DF	Qual	Units
Carbon, Total Organic	0.17	0.066	0.016	1		%

Method Blank	099-06-013-719	N/A	Solid	TOC 5	05/10/12	05/10/12 15:11	C0510TOCL1

Comment(s): -Results were evaluated to the MDL (DL), concentrations >= to the MDL (DL) but < RL (LOQ), if found, are qualified with a "J" flag.

Parameter	Result	RL	MDL	DF	Qual	Units
Carbon, Total Organic	ND	0.050	0.012	1		%

Return to Contents

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Analytical Report

ACCREDITED IN ACCORDANCE WITH nelac

Pacific Ecorisk		Date Received:	05/08/12
2250 Cordelia Road		Work Order No:	12-05-0618
Fairfield, CA 94534-1912		Preparation:	N/A
		Method:	SM 2540 B

Project: QAQC

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
PER Control Sed.	**12-05-0618-1-A**	**05/05/12 12:00**	**Sediment**	**N/A**	**05/10/12**	**05/10/12 16:20**	**C0510TSB1**

Comment(s): -Results were evaluated to the MDL (DL), concentrations >= to the MDL (DL) but < RL (LOQ), if found, are qualified with a "J" flag.

Parameter	Result	RL	MDL	DF	Qual	Units
Solids, Total	75.6	0.100	0.100	1		%

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
Method Blank	**099-05-019-1,922**	**N/A**	**Solid**	**N/A**	**05/10/12**	**05/10/12 16:20**	**C0510TSB1**

Comment(s): -Results were evaluated to the MDL (DL), concentrations >= to the MDL (DL) but < RL (LOQ), if found, are qualified with a "J" flag.

Parameter	Result	RL	MDL	DF	Qual	Units
Solids, Total	ND	0.100	0.100	1		%

Return to Contents

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Analytical Report

ACCREDITED IN ACCORDANCE WITH nelac

Pacific Ecorisk
2250 Cordelia Road
Fairfield, CA 94534-1912

Date Received: 05/08/12
Work Order No: 12-05-0618
Preparation: EPA 3545
Method: EPA 8081A
Units: ug/kg

Project: QAQC

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
PER Control Sed.	**12-05-0618-1-A**	**05/05/12 12:00**	**Sediment**	**GC 51**	**05/14/12**	**05/17/12 15:09**	**120514L15**

Comment(s): -Results were evaluated to the MDL (DL), concentrations >= to the MDL (DL) but < RL (LOQ), if found, are qualified with a "J" flag.
-Results are reported on a dry weight basis.

Parameter	Result	RL	MDL	DF	Qual	Parameter	Result	RL	MDL	DF	Qual
Aldrin	ND	1.3	0.42	1		Endosulfan I	ND	1.3	0.35	1	
Alpha-BHC	ND	1.3	0.43	1		Endosulfan II	ND	1.3	0.37	1	
Beta-BHC	ND	1.3	0.35	1		Endosulfan Sulfate	ND	1.3	0.45	1	
Delta-BHC	ND	1.3	0.34	1		Endrin	ND	1.3	0.47	1	
Gamma-BHC	ND	1.3	0.46	1		Endrin Aldehyde	ND	1.3	0.32	1	
Chlordane	ND	13	4.3	1		Endrin Ketone	ND	1.3	0.46	1	
Dieldrin	ND	1.3	0.44	1		Heptachlor	ND	1.3	0.43	1	
Trans-nonachlor	ND	1.3	0.38	1		Heptachlor Epoxide	ND	1.3	0.47	1	
2,4'-DDD	ND	1.3	0.45	1		Methoxychlor	ND	1.3	0.43	1	
2,4'-DDE	ND	1.3	0.40	1		Toxaphene	ND	26	8.4	1	
2,4'-DDT	ND	1.3	0.40	1		Alpha Chlordane	ND	1.3	0.42	1	
4,4'-DDD	ND	1.3	0.42	1		Oxychlordane	ND	1.3	0.37	1	
4,4'-DDE	ND	1.3	0.40	1		Gamma Chlordane	ND	1.3	0.42	1	
4,4'-DDT	ND	1.3	0.44	1		Cis-nonachlor	ND	1.3	0.39	1	

Surrogates:	REC (%)	Control Limits	Qual	Surrogates:	REC (%)	Control Limits	Qual
2,4,5,6-Tetrachloro-m-Xylene	88	50-130		Decachlorobiphenyl	88	50-130	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
Method Blank	**099-12-858-142**	**N/A**	**Solid**	**GC 51**	**05/14/12**	**05/17/12 14:26**	**120514L15**

Comment(s): -Results were evaluated to the MDL (DL), concentrations >= to the MDL (DL) but < RL (LOQ), if found, are qualified with a "J" flag.

Parameter	Result	RL	MDL	DF	Qual	Parameter	Result	RL	MDL	DF	Qual
Aldrin	ND	1.0	0.31	1		Endosulfan I	ND	1.0	0.26	1	
Alpha-BHC	ND	1.0	0.32	1		Endosulfan II	ND	1.0	0.28	1	
Beta-BHC	ND	1.0	0.26	1		Endosulfan Sulfate	ND	1.0	0.34	1	
Delta-BHC	ND	1.0	0.26	1		Endrin	ND	1.0	0.36	1	
Gamma-BHC	ND	1.0	0.35	1		Endrin Aldehyde	ND	1.0	0.24	1	
Chlordane	ND	10	3.3	1		Endrin Ketone	ND	1.0	0.35	1	
Dieldrin	ND	1.0	0.33	1		Heptachlor	ND	1.0	0.32	1	
Trans-nonachlor	ND	1.0	0.29	1		Heptachlor Epoxide	ND	1.0	0.36	1	
2,4'-DDD	ND	1.0	0.34	1		Methoxychlor	ND	1.0	0.32	1	
2,4'-DDE	ND	1.0	0.31	1		Toxaphene	ND	20	6.3	1	
2,4'-DDT	ND	1.0	0.30	1		Alpha Chlordane	ND	1.0	0.32	1	
4,4'-DDD	ND	1.0	0.32	1		Oxychlordane	ND	1.0	0.28	1	
4,4'-DDE	ND	1.0	0.30	1		Gamma Chlordane	ND	1.0	0.32	1	
4,4'-DDT	ND	1.0	0.33	1		Cis-nonachlor	ND	1.0	0.29	1	

Surrogates:	REC (%)	Control Limits	Qual	Surrogates:	REC (%)	Control Limits	Qual
2,4,5,6-Tetrachloro-m-Xylene	99	50-130		Decachlorobiphenyl	96	50-130	

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Return to Contents

Calscience Environmental Laboratories, Inc.

Analytical Report

ACCREDITED IN ACCORDANCE WITH nelac

Pacific Ecorisk
2250 Cordelia Road
Fairfield, CA 94534-1912

Date Received: 05/08/12
Work Order No: 12-05-0618
Preparation: EPA 3545
Method: EPA 8082A (M)/ECD
Units: ug/kg

Project: QAQC

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
PER Control Sed.	**12-05-0618-1-A**	**05/05/12 12:00**	**Sediment**	**GC 41**	**05/17/12**	**05/21/12 16:41**	**120517F02**

Comment(s): -Results were evaluated to the MDL (DL), concentrations >= to the MDL (DL) but < RL (LOQ), if found, are qualified with a "J" flag.
-Results are reported on a dry weight basis.

Parameter	Result	RL	MDL	DF	Qual	Parameter	Result	RL	MDL	DF	Qual
PCB008	ND	0.66	0.27	1		PCB126	ND	0.66	0.38	1	
PCB018	ND	0.66	0.43	1		PCB128	ND	0.66	0.32	1	
PCB027	ND	0.66	0.32	1		PCB132	ND	0.66	0.33	1	
PCB028	ND	0.66	0.34	1		PCB137	ND	0.66	0.26	1	
PCB029	ND	0.66	0.50	1		PCB138/158	ND	1.3	0.33	1	
PCB031	ND	0.66	0.24	1		PCB141	ND	0.66	0.28	1	
PCB033	ND	0.66	0.28	1		PCB149	ND	0.66	0.27	1	
PCB037	ND	0.66	0.45	1		PCB151	ND	0.66	0.22	1	
PCB044	ND	0.66	0.37	1		PCB153	ND	0.66	0.29	1	
PCB049	ND	0.66	0.28	1		PCB156	ND	0.66	0.30	1	
PCB052	ND	0.66	0.31	1		PCB157	ND	0.66	0.44	1	
PCB056	ND	0.66	0.21	1		PCB167	ND	0.66	0.24	1	
PCB060	ND	0.66	0.42	1		PCB168	ND	0.66	0.26	1	
PCB066	ND	0.66	0.29	1		PCB169/199	ND	1.3	0.25	1	
PCB070	ND	0.66	0.33	1		PCB170	ND	0.66	0.33	1	
PCB074	ND	0.66	0.34	1		PCB174	ND	0.66	0.25	1	
PCB077	ND	0.66	0.33	1		PCB177	ND	0.66	0.32	1	
PCB081	ND	0.66	0.27	1		PCB180	ND	0.66	0.41	1	
PCB087	ND	0.66	0.26	1		PCB183	ND	0.66	0.29	1	
PCB095	ND	0.66	0.23	1		PCB184	ND	0.66	0.24	1	
PCB097	ND	0.66	0.27	1		PCB187	ND	0.66	0.29	1	
PCB099	ND	0.66	0.29	1		PCB189	ND	0.66	0.28	1	
PCB101	ND	0.66	0.34	1		PCB194	ND	0.66	0.31	1	
PCB105	ND	0.66	0.32	1		PCB195	ND	0.66	0.29	1	
PCB110	ND	0.66	0.43	1		PCB200	ND	0.66	0.24	1	
PCB114	ND	0.66	0.25	1		PCB201	ND	0.66	0.29	1	
PCB118	ND	0.66	0.33	1		PCB203	ND	0.66	0.26	1	
PCB119	ND	0.66	0.23	1		PCB206	ND	0.66	0.29	1	
PCB123	ND	0.66	0.27	1		PCB209	ND	0.66	0.30	1	

Surrogates:	REC (%)	Control Limits	Qual
2,4,5,6-Tetrachloro-m-Xylene	96	25-200	

Return to Contents

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Analytical Report

ACCREDITED IN ACCORDANCE WITH nelac

Pacific Ecorisk
2250 Cordelia Road
Fairfield, CA 94534-1912

Date Received: 05/08/12
Work Order No: 12-05-0618
Preparation: EPA 3545
Method: EPA 8082A (M)/ECD
Units: ug/kg

Project: QAQC

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
Method Blank	**099-15-202-16**	**N/A**	**Solid**	**GC 41**	**05/17/12**	**05/21/12 16:07**	**120517F02**

Comment(s): -Results were evaluated to the MDL (DL), concentrations >= to the MDL (DL) but < RL (LOQ), if found, are qualified with a "J" flag.

Parameter	Result	RL	MDL	DF	Qual	Parameter	Result	RL	MDL	DF	Qual
PCB008	ND	0.50	0.20	1		PCB126	ND	0.50	0.29	1	
PCB018	ND	0.50	0.33	1		PCB128	ND	0.50	0.24	1	
PCB027	ND	0.50	0.24	1		PCB132	ND	0.50	0.25	1	
PCB028	ND	0.50	0.26	1		PCB137	ND	0.50	0.20	1	
PCB029	ND	0.50	0.38	1		PCB138/158	ND	1.0	0.25	1	
PCB031	ND	0.50	0.18	1		PCB141	ND	0.50	0.21	1	
PCB033	ND	0.50	0.22	1		PCB149	ND	0.50	0.21	1	
PCB037	ND	0.50	0.34	1		PCB151	ND	0.50	0.17	1	
PCB044	ND	0.50	0.28	1		PCB153	ND	0.50	0.22	1	
PCB049	ND	0.50	0.21	1		PCB156	ND	0.50	0.22	1	
PCB052	ND	0.50	0.23	1		PCB157	ND	0.50	0.34	1	
PCB056	ND	0.50	0.16	1		PCB167	ND	0.50	0.18	1	
PCB060	ND	0.50	0.32	1		PCB168	ND	0.50	0.19	1	
PCB066	ND	0.50	0.22	1		PCB169/199	ND	1.0	0.19	1	
PCB070	ND	0.50	0.25	1		PCB170	ND	0.50	0.25	1	
PCB074	ND	0.50	0.26	1		PCB174	ND	0.50	0.19	1	
PCB077	ND	0.50	0.25	1		PCB177	ND	0.50	0.24	1	
PCB081	ND	0.50	0.21	1		PCB180	ND	0.50	0.31	1	
PCB087	ND	0.50	0.20	1		PCB183	ND	0.50	0.22	1	
PCB095	ND	0.50	0.17	1		PCB184	ND	0.50	0.18	1	
PCB097	ND	0.50	0.20	1		PCB187	ND	0.50	0.22	1	
PCB099	ND	0.50	0.22	1		PCB189	ND	0.50	0.21	1	
PCB101	ND	0.50	0.25	1		PCB194	ND	0.50	0.24	1	
PCB105	ND	0.50	0.24	1		PCB195	ND	0.50	0.22	1	
PCB110	ND	0.50	0.32	1		PCB200	ND	0.50	0.18	1	
PCB114	ND	0.50	0.19	1		PCB201	ND	0.50	0.22	1	
PCB118	ND	0.50	0.25	1		PCB203	ND	0.50	0.20	1	
PCB119	ND	0.50	0.17	1		PCB206	ND	0.50	0.22	1	
PCB123	ND	0.50	0.20	1		PCB209	ND	0.50	0.23	1	

Surrogates:	REC (%)	Control Limits	Qual
2,4,5,6-Tetrachloro-m-Xylene	107	25-200	

Return to Contents

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Analytical Report

ACCREDITED IN ACCORDANCE WITH nelac

Pacific Ecorisk
2250 Cordelia Road
Fairfield, CA 94534-1912

Date Received: 05/08/12
Work Order No: 12-05-0618
Preparation: EPA 3545
Method: EPA 8270C SIM PAHs
Units: ug/kg

Project: QAQC

Page 1 of 1

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
PER Control Sed.	**12-05-0618-1-B**	**05/05/12 12:00**	**Sediment**	**GC/MS AAA**	**05/14/12**	**05/15/12 17:42**	**120514L14**

Comment(s): -Results were evaluated to the MDL (DL), concentrations >= to the MDL (DL) but < RL (LOQ), if found, are qualified with a "J" flag.
-Results are reported on a dry weight basis.

Parameter	Result	RL	MDL	DF	Qual	Parameter	Result	RL	MDL	DF	Qual
Acenaphthene	ND	13	2.4	1		Fluoranthene	4.9	13	1.3	1	J
Acenaphthylene	ND	13	2.0	1		Fluorene	ND	13	1.9	1	
Anthracene	ND	13	1.1	1		Indeno (1,2,3-c,d) Pyrene	2.1	13	1.4	1	J
Benzo (a) Anthracene	2.8	13	2.1	1	J	2-Methylnaphthalene	ND	13	2.4	1	
Benzo (a) Pyrene	3.2	13	1.3	1	J	1-Methylnaphthalene	ND	13	2.6	1	
Benzo (b) Fluoranthene	2.7	13	1.3	1	J	1-Methylphenanthrene	ND	13	2.1	1	
Benzo (e) Pyrene	2.4	13	2.0	1	J	Naphthalene	ND	13	4.0	1	
Benzo (g,h,i) Perylene	2.6	13	1.2	1	J	Perylene	3.6	13	2.3	1	J
Benzo (k) Fluoranthene	2.4	13	1.8	1	J	Phenanthrene	4.5	13	1.3	1	J
Biphenyl	ND	13	1.8	1		Pyrene	6.1	13	1.3	1	J
Chrysene	2.7	13	1.5	1	J	1,6,7-Trimethylnaphthalene	ND	13	1.9	1	
Dibenz (a,h) Anthracene	ND	13	1.4	1		Dibenzothiophene	ND	13	1.8	1	
2,6-Dimethylnaphthalene	ND	13	2.2	1							

Surrogates:	REC (%)	Control Limits	Qual	Surrogates:	REC (%)	Control Limits	Qual
2-Fluorobiphenyl	98	14-146		Nitrobenzene-d5	146	18-162	
p-Terphenyl-d14	104	34-148					

Method Blank	**099-14-437-23**	**N/A**	**Solid**	**GC/MS AAA**	**05/14/12**	**05/15/12 17:16**	**120514L14**

Comment(s): -Results were evaluated to the MDL (DL), concentrations >= to the MDL (DL) but < RL (LOQ), if found, are qualified with a "J" flag.

Parameter	Result	RL	MDL	DF	Qual	Parameter	Result	RL	MDL	DF	Qual
Acenaphthene	ND	10	1.8	1		Fluoranthene	ND	10	0.98	1	
Acenaphthylene	ND	10	1.5	1		Fluorene	ND	10	1.5	1	
Anthracene	ND	10	0.81	1		Indeno (1,2,3-c,d) Pyrene	ND	10	1.1	1	
Benzo (a) Anthracene	ND	10	1.6	1		2-Methylnaphthalene	ND	10	1.8	1	
Benzo (a) Pyrene	ND	10	1.0	1		1-Methylnaphthalene	ND	10	2.0	1	
Benzo (b) Fluoranthene	ND	10	1.0	1		1-Methylphenanthrene	ND	10	1.6	1	
Benzo (e) Pyrene	ND	10	1.5	1		Naphthalene	ND	10	3.0	1	
Benzo (g,h,i) Perylene	ND	10	0.94	1		Perylene	ND	10	1.7	1	
Benzo (k) Fluoranthene	ND	10	1.4	1		Phenanthrene	ND	10	1.0	1	
Biphenyl	ND	10	1.4	1		Pyrene	ND	10	0.99	1	
Chrysene	ND	10	1.2	1		1,6,7-Trimethylnaphthalene	ND	10	1.4	1	
Dibenz (a,h) Anthracene	ND	10	1.0	1		Dibenzothiophene	ND	10	1.3	1	
2,6-Dimethylnaphthalene	ND	10	1.7	1							

Surrogates:	REC (%)	Control Limits	Qual	Surrogates:	REC (%)	Control Limits	Qual
2-Fluorobiphenyl	107	14-146		Nitrobenzene-d5	151	18-162	
p-Terphenyl-d14	109	34-148					

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Return to Contents

Calscience Environmental Laboratories, Inc.

Analytical Report

ACCREDITED IN ACCORDANCE WITH nelac

Pacific Ecorisk
2250 Cordelia Road
Fairfield, CA 94534-1912

Date Received: 05/08/12
Work Order No: 12-05-0618
Preparation: EPA 3550B
Method: Organotins by Krone et al.
Units: ug/kg

Project: QAQC

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
PER Control Sed.	**12-05-0618-1-A**	**05/05/12 12:00**	**Sediment**	**GC/MS JJJ**	**05/11/12**	**05/17/12 17:16**	**120511L14**

Comment(s): -Results were evaluated to the MDL (DL), concentrations >= to the MDL (DL) but < RL (LOQ), if found, are qualified with a "J" flag.
-Results are reported on a dry weight basis.

Parameter	Result	RL	MDL	DF	Qual	Parameter	Result	RL	MDL	DF	Qual
Dibutyltin	ND	4.0	0.86	1		Tetrabutyltin	ND	4.0	1.0	1	
Monobutyltin	ND	4.0	0.86	1		Tributyltin	ND	4.0	0.76	1	

Surrogates:	REC (%)	Control Limits	Qual
Tripentyltin	96	50-130	

Method Blank	**099-07-016-933**	**N/A**	**Solid**	**GC/MS JJJ**	**05/11/12**	**05/17/12 15:14**	**120511L14**

Comment(s): -Results were evaluated to the MDL (DL), concentrations >= to the MDL (DL) but < RL (LOQ), if found, are qualified with a "J" flag.

Parameter	Result	RL	MDL	DF	Qual	Parameter	Result	RL	MDL	DF	Qual
Dibutyltin	ND	3.0	0.65	1		Tetrabutyltin	ND	3.0	0.77	1	
Monobutyltin	ND	3.0	0.65	1		Tributyltin	ND	3.0	0.58	1	

Surrogates:	REC (%)	Control Limits	Qual
Tripentyltin	99	50-130	

Return to Contents

7440 Lincoln Way, Garden Grove, CA 92841-1427 · TEL:(714) 895-5494 · FAX: (714) 894-7501

Calscience Environmental Laboratories, Inc.

Analytical Report

Pacific Ecorisk	Date Received: 05/08/12
2250 Cordelia Road	Work Order No: 12-05-0618
Fairfield, CA 94534-1912	Preparation: EPA 3050B
	Method: EPA 6020
	Units: mg/kg
Project: QAQC	Page 1 of 1

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
PER Control Sed.	**12-05-0618-1-B**	**05/05/12 12:00**	**Sediment**	**ICP/MS 04**	**05/10/12**	**05/10/12 18:23**	**120510L01E**

Comment(s): -Results were evaluated to the MDL (DL), concentrations >= to the MDL (DL) but < RL (LOQ), if found, are qualified with a "J" flag.
-Results are reported on a dry weight basis.

Parameter	Result	RL	MDL	DF	Qual	Parameter	Result	RL	MDL	DF	Qual
Arsenic	5.33	0.132	0.0121	1		Nickel	29.2	0.132	0.0113	1	B
Cadmium	0.0473	0.132	0.0165	1	J	Selenium	ND	0.132	0.0669	1	
Chromium	25.2	0.132	0.0241	1		Silver	0.0175	0.132	0.0128	1	J
Copper	4.61	0.132	0.0143	1		Zinc	24.0	1.32	0.148	1	
Lead	3.91	0.132	0.00975	1							

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
Method Blank	**096-10-002-2,296**	**N/A**	**Solid**	**ICP/MS 04**	**05/10/12**	**05/11/12 19:28**	**120510L01E**

Comment(s): -Results were evaluated to the MDL (DL), concentrations >= to the MDL (DL) but < RL (LOQ), if found, are qualified with a "J" flag.

Parameter	Result	RL	MDL	DF	Qual	Parameter	Result	RL	MDL	DF	Qual
Arsenic	ND	0.100	0.00914	1		Nickel	0.0206	0.100	0.00853	1	J
Cadmium	ND	0.100	0.0125	1		Selenium	ND	0.100	0.0506	1	
Chromium	ND	0.100	0.0182	1		Silver	ND	0.100	0.00966	1	
Copper	ND	0.100	0.0108	1		Zinc	ND	1.00	0.112	1	
Lead	ND	0.100	0.00737	1							

Return to Contents

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Analytical Report

Pacific Ecorisk	Date Received: 05/08/12
2250 Cordelia Road	Work Order No: 12-05-0618
Fairfield, CA 94534-1912	Preparation: EPA 7471A Total
	Method: EPA 7471A

Project: QAQC

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
PER Control Sed.	**12-05-0618-1-A**	**05/05/12 12:00**	**Sediment**	**Mercury**	**05/09/12**	**05/09/12 16:38**	**120509L05E**

Comment(s): -Results were evaluated to the MDL (DL), concentrations >= to the MDL (DL) but < RL (LOQ), if found, are qualified with a "J" flag.
-Results are reported on a dry weight basis.

Parameter	Result	RL	MDL	DF	Qual	Units
Mercury	0.0118	0.0265	0.00778	1	J	mg/kg

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
Method Blank	**099-12-452-302**	**N/A**	**Solid**	**Mercury**	**05/09/12**	**05/09/12 14:00**	**120509L05E**

Comment(s): -Results were evaluated to the MDL (DL), concentrations >= to the MDL (DL) but < RL (LOQ), if found, are qualified with a "J" flag.

Parameter	Result	RL	MDL	DF	Qual	Units
Mercury	ND	0.0200	0.00588	1		mg/kg

Return to Contents

Calscience Environmental Laboratories, Inc.

PARTICLE SIZE SUMMARY

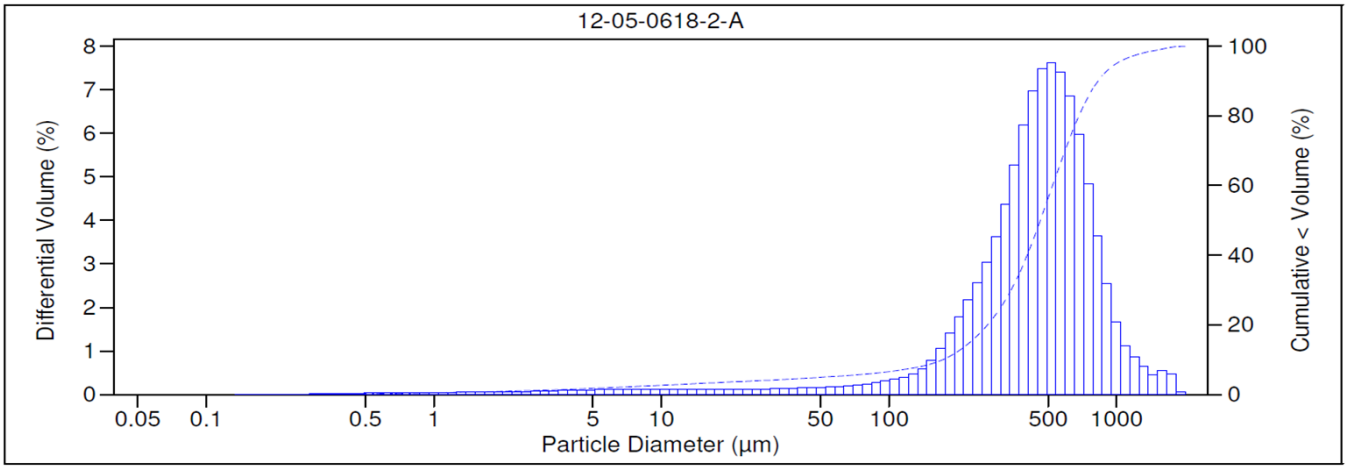
(ASTM D422 / D4464M)

Pacific Ecorisk		Date Sampled:	05/05/12
2250 Cordelia Road		Date Received:	05/08/12
Fairfield, CA		Work Order No:	12-05-0618
94534-1912		Date Analyzed:	05/09/12
		Method:	ASTM D4464M

Project: QAQC

Sample ID	Depth ft	Description	Mean Grain Size mm
PER Control Sed.		Coarse Sand	0.542

Particle Size Distribution, wt by percent								
Total Gravel	Very Coarse Sand	Coarse Sand	Medium Sand	Fine Sand	Very Fine Sand	Silt	Clay	Total Silt & Clay
2.43	4.83	37.87	37.77	9.73	2.12	3.78	1.46	5.24



Return to Contents

Calscience Environmental Laboratories, Inc.

Quality Control - Spike/Spike Duplicate

ACCREDITED IN ACCORDANCE WITH nelac

Pacific Ecorisk
2250 Cordelia Road
Fairfield, CA 94534-1912

Date Received: 05/08/12
Work Order No: 12-05-0618
Preparation: EPA 3050B
Method: EPA 6020

Project QAQC

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
12-05-0729-12	**Solid**	**ICP/MS 04**	**05/10/12**	**05/10/12**	**120510S01A**

Parameter	SPIKE ADDED	MS %REC	MSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Arsenic	25.00	97	97	72-132	0	0-13	
Cadmium	25.00	104	100	85-121	4	0-12	
Chromium	25.00	103	97	20-182	4	0-15	
Copper	25.00	108	95	25-157	6	0-22	
Lead	25.00	105	103	62-134	2	0-23	
Nickel	25.00	102	91	46-154	6	0-15	
Selenium	25.00	92	93	54-132	0	0-14	
Silver	12.50	90	91	78-126	1	0-15	
Zinc	25.00	79	90	23-173	3	0-18	

Return to Contents

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - PDS / PDSD

ACCREDITED IN ACCORDANCE WITH nelac

Pacific Ecorisk	Date Received 05/08/12
2250 Cordelia Road	Work Order No: 12-05-0618
Fairfield, CA 94534-1912	Preparation: EPA 3050B
	Method: EPA 6020

Project: QAQC

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	PDS / PDSD Batch Number
12-05-0729-12	**Solid**	**ICP/MS 04**	**05/10/12**	**05/10/12**	**120510S01A**

Parameter	SPIKE ADDED	PDS %REC	PDSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Arsenic	25.00	101	101	75-125	0	0-13	
Cadmium	25.00	98	98	75-125	0	0-12	
Chromium	25.00	95	96	75-125	1	0-15	
Copper	25.00	99	98	75-125	0	0-22	
Lead	25.00	105	103	75-125	1	0-23	
Nickel	25.00	96	97	75-125	1	0-15	
Selenium	25.00	96	97	75-125	1	0-14	
Silver	12.50	87	86	75-125	2	0-15	
Zinc	25.00	87	88	75-125	0	0-18	

Return to Contents

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - Spike/Spike Duplicate

ACCREDITED IN ACCORDANCE WITH nelac

Pacific Ecorisk		Date Received:	05/08/12
2250 Cordelia Road		Work Order No:	12-05-0618
Fairfield, CA 94534-1912		Preparation:	N/A
		Method:	EPA 9060A

Project QAQC

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
12-05-0443-6	**Sediment**	**TOC 5**	**05/10/12**	**05/10/12**	**C0510TOCS1**

Parameter	SPIKE ADDED	MS %REC	MSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Carbon, Total Organic	3.0	95	96	75-125	1	0-25	

Return to Contents

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - Duplicate

ACCREDITED IN ACCORDANCE WITH nelac

Pacific Ecorisk		Date Received:	05/08/12
2250 Cordelia Road		Work Order No:	12-05-0618
Fairfield, CA 94534-1912		Preparation:	N/A
		Method:	SM 2540 B

Project: QAQC

Quality Control Sample ID	Matrix	Instrument	Date Prepared:	Date Analyzed:	Duplicate Batch Number
12-05-0640-21	**Sediment**	**N/A**	**05/10/12**	**05/10/12**	**C0510TSD1**

Parameter	Sample Conc	DUP Conc	RPD	RPD CL	Qualifiers
Solids, Total	94.4	93.6	1	0-10	

Return to Contents

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - Spike/Spike Duplicate

ACCREDITED IN ACCORDANCE WITH nelac

Pacific Ecorisk
2250 Cordelia Road
Fairfield, CA 94534-1912

Date Received: 05/08/12
Work Order No: 12-05-0618
Preparation: EPA 7471A Total
Method: EPA 7471A

Project QAQC

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
12-05-0627-1	**Solid**	**Mercury**	**05/09/12**	**05/09/12**	**120509S05**

Parameter	SPIKE ADDED	MS %REC	MSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Mercury	0.8350	92	87	71-137	5	0-14	

Return to Contents

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - PDS / PDSD

ACCREDITED IN ACCORDANCE WITH nelac

Pacific Ecorisk	Date Received 05/08/12
2250 Cordelia Road	Work Order No: 12-05-0618
Fairfield, CA 94534-1912	Preparation: EPA 7471A Total
	Method: EPA 7471A

Project: QAQC

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	PDS / PDSD Batch Number
12-05-0627-1	**Solid**	**Mercury**	**05/09/12**	**05/09/12**	**120509S05**

Parameter	SPIKE ADDED	PDS %REC	PDSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Mercury	0.8350	105	106	75-125	2	0-14	

Return to Contents

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - Spike/Spike Duplicate

ACCREDITED IN ACCORDANCE WITH nelac

Pacific Ecorisk	Date Received: 05/08/12
2250 Cordelia Road	Work Order No: 12-05-0618
Fairfield, CA 94534-1912	Preparation: EPA 3550B
	Method: Organotins by Krone et al.

Project QAQC

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
12-05-0477-1	**Sediment**	**GC/MS JJJ**	**05/11/12**	**05/17/12**	**120511S14**

Parameter	SPIKE ADDED	MS %REC	MSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Tetrabutyltin	100.0	114	108	50-130	6	0-20	
Tributyltin	100.0	93	86	50-130	8	0-20	

Return to Contents

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - Spike/Spike Duplicate

ACCREDITED IN ACCORDANCE WITH nelac

Pacific Ecorisk
2250 Cordelia Road
Fairfield, CA 94534-1912

Date Received: 05/08/12
Work Order No: 12-05-0618
Preparation: EPA 3545
Method: EPA 8081A

Project QAQC

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
PER Control Sed.	**Sediment**	**GC 51**	**05/14/12**	**05/18/12**	**120514S15**

Parameter	SPIKE ADDED	MS %REC	MSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Aldrin	5.000	90	84	50-135	7	0-25	
Alpha-BHC	5.000	93	81	50-135	15	0-25	
Beta-BHC	5.000	92	85	50-135	8	0-25	
Delta-BHC	5.000	86	77	50-135	11	0-25	
Gamma-BHC	5.000	92	79	50-135	15	0-25	
Dieldrin	5.000	97	90	50-135	8	0-25	
4,4'-DDD	5.000	99	95	50-135	3	0-25	
4,4'-DDE	5.000	96	101	50-135	5	0-25	
4,4'-DDT	5.000	92	90	50-135	2	0-25	
Endosulfan I	5.000	97	89	50-135	9	0-25	
Endosulfan II	5.000	93	84	50-135	11	0-25	
Endosulfan Sulfate	5.000	103	91	50-135	12	0-25	
Endrin	5.000	111	99	50-135	11	0-25	
Endrin Aldehyde	5.000	81	56	50-135	37	0-25	4
Endrin Ketone	5.000	98	84	50-135	15	0-25	
Heptachlor	5.000	101	94	50-135	8	0-25	
Heptachlor Epoxide	5.000	89	82	50-135	8	0-25	
Methoxychlor	5.000	108	107	50-135	1	0-25	
Alpha Chlordane	5.000	93	89	50-135	4	0-25	
Gamma Chlordane	5.000	101	97	50-135	3	0-25	

Return to Contents

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - Spike/Spike Duplicate

ACCREDITED IN ACCORDANCE WITH nelac

Pacific Ecorisk
2250 Cordelia Road
Fairfield, CA 94534-1912

Date Received: 05/08/12
Work Order No: 12-05-0618
Preparation: EPA 3545
Method: EPA 8270C SIM PAHs

Project QAQC

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
PER Control Sed.	**Sediment**	**GC/MS AAA**	**05/14/12**	**05/15/12**	**120514S14**

Parameter	SPIKE ADDED	MS %REC	MSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Acenaphthene	100.0	83	85	40-160	2	0-20	
Acenaphthylene	100.0	84	85	40-160	1	0-20	
Anthracene	100.0	80	79	40-160	2	0-20	
Benzo (a) Anthracene	100.0	106	98	40-160	8	0-20	
Benzo (a) Pyrene	100.0	94	88	40-160	7	0-20	
Benzo (b) Fluoranthene	100.0	97	96	40-160	1	0-20	
Benzo (g,h,i) Perylene	100.0	87	83	40-160	5	0-20	
Benzo (k) Fluoranthene	100.0	98	93	40-160	5	0-20	
Chrysene	100.0	91	86	40-160	5	0-20	
Dibenz (a,h) Anthracene	100.0	82	80	40-160	3	0-20	
Fluoranthene	100.0	99	92	40-160	7	0-20	
Fluorene	100.0	89	91	40-160	2	0-20	
Indeno (1,2,3-c,d) Pyrene	100.0	93	90	40-160	4	0-20	
2-Methylnaphthalene	100.0	88	88	40-160	1	0-20	
1-Methylnaphthalene	100.0	93	95	40-160	1	0-20	
Naphthalene	100.0	88	88	40-160	1	0-20	
Phenanthrene	100.0	89	87	40-160	2	0-20	
Pyrene	100.0	103	104	40-160	2	0-46	

Return to Contents

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - Spike/Spike Duplicate

ACCREDITED IN ACCORDANCE WITH nelac

Pacific Ecorisk
2250 Cordelia Road
Fairfield, CA 94534-1912

Date Received: 05/08/12
Work Order No: 12-05-0618
Preparation: EPA 3545
Method: EPA 8082A (M)/ECD

Project QAQC

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
PER Control Sed.	**Sediment**	**GC 41**	**05/17/12**	**05/21/12**	**120517S02**

Parameter	SPIKE ADDED	MS %REC	MSD %REC	%REC CL	RPD	RPD CL	Qualifiers
PCB008	2.000	94	101	50-200	7	0-30	
PCB018	2.000	88	97	50-200	10	0-30	
PCB028	2.000	83	101	50-200	20	0-30	
PCB044	2.000	96	110	50-200	13	0-30	
PCB052	2.000	69	93	50-200	29	0-30	
PCB066	2.000	75	82	50-200	9	0-30	
PCB077	2.000	79	84	50-200	6	0-30	
PCB101	2.000	84	91	50-200	8	0-30	
PCB105	2.000	86	93	50-200	7	0-30	
PCB118	2.000	82	90	50-200	10	0-30	
PCB126	2.000	80	83	50-200	4	0-30	
PCB128	2.000	87	93	50-200	7	0-30	
PCB138/158	2.000	76	84	50-200	9	0-30	
PCB153	2.000	86	96	50-200	11	0-30	
PCB170	2.000	74	87	50-200	16	0-30	
PCB180	2.000	79	88	50-200	11	0-30	
PCB187	2.000	77	85	50-200	10	0-30	
PCB195	2.000	94	103	50-200	10	0-30	
PCB206	2.000	83	93	50-200	11	0-30	
PCB209	2.000	85	91	50-200	7	0-30	

Return to Contents

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - LCS/LCS Duplicate

ACCREDITED IN ACCORDANCE WITH nelac

Pacific Ecorisk		Date Received:	N/A
2250 Cordelia Road		Work Order No:	12-05-0618
Fairfield, CA 94534-1912		Preparation:	EPA 3050B
		Method:	EPA 6020

Project: QAQC

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	LCS/LCSD Batch Number
096-10-002-2,296	**Solid**	**ICP/MS 04**	**05/10/12**	**05/11/12**	**120510L01E**

Parameter	SPIKE ADDED	LCS %REC	LCSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Arsenic	25.00	108	106	80-120	2	0-20	
Cadmium	25.00	106	106	80-120	1	0-20	
Chromium	25.00	106	105	80-120	1	0-20	
Copper	25.00	115	111	80-120	4	0-20	
Lead	25.00	104	103	80-120	1	0-20	
Nickel	25.00	108	103	80-120	4	0-20	
Selenium	25.00	110	108	80-120	2	0-20	
Silver	12.50	94	95	80-120	2	0-20	
Zinc	25.00	107	106	80-120	1	0-20	

Return to Contents

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - LCS/LCS Duplicate

ACCREDITED IN ACCORDANCE WITH nelac

Pacific Ecorisk		Date Received:	N/A
2250 Cordelia Road		Work Order No:	12-05-0618
Fairfield, CA 94534-1912		Preparation:	N/A
		Method:	EPA 9060A

Project: QAQC

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	LCS/LCSD Batch Number
099-06-013-719	**Solid**	**TOC 5**	**05/10/12**	**05/10/12**	**C0510TOCL1**

Parameter	SPIKE ADDED	LCS %REC	LCSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Carbon, Total Organic	0.60	96	96	80-120	0	0-20	

Return to Contents

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - LCS/LCS Duplicate

ACCREDITED IN ACCORDANCE WITH nelac

Pacific Ecorisk		Date Received:	N/A
2250 Cordelia Road		Work Order No:	12-05-0618
Fairfield, CA 94534-1912		Preparation:	EPA 7471A Total
		Method:	EPA 7471A

Project: QAQC

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	LCS/LCSD Batch Number
099-12-452-302	**Solid**	**Mercury**	**05/09/12**	**05/09/12**	**120509L05E**

Parameter	SPIKE ADDED	LCS %REC	LCSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Mercury	0.8350	98	98	82-124	0	0-16	

Return to Contents

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - LCS/LCS Duplicate

ACCREDITED IN ACCORDANCE WITH nelac

Pacific Ecorisk		Date Received:	N/A
2250 Cordelia Road		Work Order No:	12-05-0618
Fairfield, CA 94534-1912		Preparation:	EPA 3550B
		Method:	Organotins by Krone et al.

Project: QAQC

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	LCS/LCSD Batch Number
099-07-016-933	**Solid**	**GC/MS JJJ**	**05/11/12**	**05/17/12**	**120511L14**

Parameter	SPIKE ADDED	LCS %REC	LCSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Tetrabutyltin	100.0	127	126	50-130	1	0-20	
Tributyltin	100.0	100	96	50-130	4	0-20	

Return to Contents

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - LCS/LCS Duplicate

ACCREDITED IN ACCORDANCE WITH nelac

Pacific Ecorisk		Date Received:	N/A
2250 Cordelia Road		Work Order No:	12-05-0618
Fairfield, CA 94534-1912		Preparation:	EPA 3545
		Method:	EPA 8081A

Project: QAQC

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	LCS/LCSD Batch Number
099-12-858-142	**Solid**	**GC 51**	**05/14/12**	**05/18/12**	**120514L15**

Parameter	SPIKE ADDED	LCS %REC	LCSD %REC	%REC CL	ME_CL	RPD	RPD CL	Qualifiers
Aldrin	5.000	89	104	50-135	36-149	16	0-25	
Alpha-BHC	5.000	104	106	50-135	36-149	1	0-25	
Beta-BHC	5.000	94	94	50-135	36-149	0	0-25	
Delta-BHC	5.000	87	89	50-135	36-149	2	0-25	
Gamma-BHC	5.000	102	104	50-135	36-149	2	0-25	
Dieldrin	5.000	105	105	50-135	36-149	1	0-25	
4,4'-DDD	5.000	96	97	50-135	36-149	1	0-25	
4,4'-DDE	5.000	96	98	50-135	36-149	2	0-25	
4,4'-DDT	5.000	96	98	50-135	36-149	2	0-25	
Endosulfan I	5.000	111	111	50-135	36-149	0	0-25	
Endosulfan II	5.000	97	97	50-135	36-149	0	0-25	
Endosulfan Sulfate	5.000	101	102	50-135	36-149	1	0-25	
Endrin	5.000	115	116	50-135	36-149	1	0-25	
Endrin Aldehyde	5.000	95	95	50-135	36-149	0	0-25	
Endrin Ketone	5.000	103	104	50-135	36-149	1	0-25	
Heptachlor	5.000	107	108	50-135	36-149	1	0-25	
Heptachlor Epoxide	5.000	100	100	50-135	36-149	0	0-25	
Methoxychlor	5.000	104	106	50-135	36-149	1	0-25	
Alpha Chlordane	5.000	102	102	50-135	36-149	1	0-25	
Gamma Chlordane	5.000	103	104	50-135	36-149	1	0-25	

Total number of LCS compounds : 20
Total number of ME compounds : 0
Total number of ME compounds allowed : 1
LCS ME CL validation result : Pass

Return to Contents

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - LCS/LCS Duplicate

ACCREDITED IN ACCORDANCE WITH nelac

Pacific Ecorisk
2250 Cordelia Road
Fairfield, CA 94534-1912

Date Received: N/A
Work Order No: 12-05-0618
Preparation: EPA 3545
Method: EPA 8270C SIM PAHs

Project: QAQC

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	LCS/LCSD Batch Number
099-14-437-23	**Solid**	**GC/MS AAA**	**05/14/12**	**05/15/12**	**120514L14**

Parameter	SPIKE ADDED	LCS %REC	LCSD %REC	%REC CL	ME_CL	RPD	RPD CL	Qualifiers
Acenaphthene	100.0	99	98	48-108	38-118	0	0-11	
Acenaphthylene	100.0	97	96	40-160	20-180	2	0-20	
Anthracene	100.0	89	89	40-160	20-180	0	0-20	
Benzo (a) Anthracene	100.0	117	108	40-160	20-180	7	0-20	
Benzo (a) Pyrene	100.0	98	97	40-160	20-180	1	0-20	
Benzo (b) Fluoranthene	100.0	108	104	40-160	20-180	3	0-20	
Benzo (g,h,i) Perylene	100.0	92	90	40-160	20-180	2	0-20	
Benzo (k) Fluoranthene	100.0	103	107	40-160	20-180	4	0-20	
Chrysene	100.0	99	100	40-160	20-180	1	0-20	
Dibenz (a,h) Anthracene	100.0	91	89	40-160	20-180	2	0-20	
Fluoranthene	100.0	101	98	40-160	20-180	3	0-20	
Fluorene	100.0	103	102	40-160	20-180	1	0-20	
Indeno (1,2,3-c,d) Pyrene	100.0	101	99	40-160	20-180	2	0-20	
2-Methylnaphthalene	100.0	99	99	40-160	20-180	0	0-20	
1-Methylnaphthalene	100.0	108	107	40-160	20-180	1	0-20	
Naphthalene	100.0	102	103	40-160	20-180	0	0-20	
Phenanthrene	100.0	94	95	40-160	20-180	2	0-20	
Pyrene	100.0	101	99	40-160	20-180	2	0-16	

Total number of LCS compounds : 18
Total number of ME compounds : 0
Total number of ME compounds allowed : 1
LCS ME CL validation result : Pass

Return to Contents

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - LCS/LCS Duplicate

ACCREDITED IN ACCORDANCE WITH nelac

Pacific Ecorisk		Date Received:	N/A
2250 Cordelia Road		Work Order No:	12-05-0618
Fairfield, CA 94534-1912		Preparation:	EPA 3545
		Method:	EPA 8082A (M)/ECD

Project: QAQC

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	LCS/LCSD Batch Number
099-15-202-16	**Solid**	**GC 41**	**05/17/12**	**05/21/12**	**120517F02**

Parameter	SPIKE ADDED	LCS %REC	LCSD %REC	%REC CL	ME_CL	RPD	RPD CL	Qualifiers
PCB008	2.000	94	91	50-200	25-225	2	0-30	
PCB018	2.000	66	55	50-200	25-225	19	0-30	
PCB028	2.000	77	75	50-200	25-225	3	0-30	
PCB044	2.000	91	88	50-200	25-225	3	0-30	
PCB052	2.000	74	72	50-200	25-225	3	0-30	
PCB066	2.000	70	67	50-200	25-225	4	0-30	
PCB077	2.000	72	70	50-200	25-225	3	0-30	
PCB101	2.000	83	81	50-200	25-225	3	0-30	
PCB105	2.000	74	71	50-200	25-225	4	0-30	
PCB118	2.000	74	72	50-200	25-225	2	0-30	
PCB126	2.000	66	63	50-200	25-225	4	0-30	
PCB128	2.000	89	90	50-200	25-225	1	0-30	
PCB138/158	2.000	65	65	50-200	25-225	1	0-30	
PCB153	2.000	74	72	50-200	25-225	4	0-30	
PCB170	2.000	71	68	50-200	25-225	5	0-30	
PCB180	2.000	73	69	50-200	25-225	5	0-30	
PCB187	2.000	75	71	50-200	25-225	5	0-30	
PCB195	2.000	84	82	50-200	25-225	2	0-30	
PCB206	2.000	76	73	50-200	25-225	3	0-30	
PCB209	2.000	81	77	50-200	25-225	5	0-30	

Total number of LCS compounds : 20
Total number of ME compounds : 0
Total number of ME compounds allowed : 1
LCS ME CL validation result : Pass

Return to Contents

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Glossary of Terms and Qualifiers

ACCREDITED IN ACCORDANCE WITH nelac

Work Order Number: 12-05-0618

Qualifier	Definition
*	See applicable analysis comment.
<	Less than the indicated value.
>	Greater than the indicated value.
1	Surrogate compound recovery was out of control due to a required sample dilution. Therefore, the sample data was reported without further clarification.
2	Surrogate compound recovery was out of control due to matrix interference. The associated method blank surrogate spike compound was in control and, therefore, the sample data was reported without further clarification.
3	Recovery of the Matrix Spike (MS) or Matrix Spike Duplicate (MSD) compound was out of control due to matrix interference. The associated LCS and/or LCSD was in control and, therefore, the sample data was reported without further clarification.
4	The MS/MSD RPD was out of control due to matrix interference. The LCS/LCSD RPD was in control and, therefore, the sample data was reported without further clarification.
5	The PDS/PDSD or PES/PESD associated with this batch of samples was out of control due to a matrix interference effect. The associated batch LCS/LCSD was in control and, hence, the associated sample data was reported without further clarification.
6	Surrogate recovery below the acceptance limit.
7	Surrogate recovery above the acceptance limit.
B	Analyte was present in the associated method blank.
BU	Sample analyzed after holding time expired.
E	Concentration exceeds the calibration range.
ET	Sample was extracted past end of recommended max. holding time.
HD	The chromatographic pattern was inconsistent with the profile of the reference fuel standard.
HDH	The sample chromatographic pattern for TPH matches the chromatographic pattern of the specified standard but heavier hydrocarbons were also present (or detected).
HDL	The sample chromatographic pattern for TPH matches the chromatographic pattern of the specified standard but lighter hydrocarbons were also present (or detected).
J	Analyte was detected at a concentration below the reporting limit and above the laboratory method detection limit. Reported value is estimated.
ME	LCS/LCSD Recovery Percentage is within Marginal Exceedance (ME) Control Limit range.
ND	Parameter not detected at the indicated reporting limit.
Q	Spike recovery and RPD control limits do not apply resulting from the parameter concentration in the sample exceeding the spike concentration by a factor of four or greater.
SG	The sample extract was subjected to Silica Gel treatment prior to analysis.
X	% Recovery and/or RPD out-of-range.
Z	Analyte presence was not confirmed by second column or GC/MS analysis.

Solid - Unless otherwise indicated, solid sample data is reported on a wet weight basis, not corrected for % moisture. All QC results are reported on a wet weight basis.
MPN - Most Probable Number

Return to Contents

Pacific EcoRisk
ENVIRONMENTAL CONSULTING & TESTING
2250 Cordelia Rd., Fairfield, CA 94534
(707)207-7760

12-05-0618

CalScience CHAIN-OF-CUSTODY RECORD

Client Name:	Pacific EcoRisk
Client Address:	2250 Cordelia Rd. Fairfield, CA 94534
Sampled By:	PER
Phone:	(707) 207-7760
FAX:	(707) 207-7916
Project Manager:	Jeff Cotsifas
Project Name:	QAQC
PO Number:	PER QAQC

REQUESTED ANALYSIS

	Client Sample ID	Sample Date	Sample Time	Sample Matrix*	Container Number	Container Type	* See Analyte List	Grain Size Analysis									
1	PER Control Sed.	5/5/12	12:00	Sed	1	500ml glass	X										
2	PER Control Sed.	5/5/12	12:00	Sed	1	poly bag		X									

Correct Containers:	**Yes**	**No**	
Sample Temperature:	**Ambient**	**Cold**	**Warm**
Sample Preservative:	**Yes**	**No**	
Turnaround Time:	**STD**	**Specify:**	

Comments:

5 Day TAT.

RELIQUINSHED BY

Signature:	Steve Hummel	**Signature:**	
Print:	Steve Hummel	**Print:**	
Organization: PER		**Organization:**	
DATE: 5/7/12	**TIME:** 0900	**DATE:**	**TIME:**

RECEIVED BY

Signature:		**Signature:**	
Print:		**Print:**	S. PATEL
Organization:		**Organization:**	CEL
DATE:	**TIME:**	**DATE:** 5/8/12	**TIME:** 1300

***MATRIX CODES**: (**SED** = Sediment); (**FW** = Freshwater); (**WW** = Wastewater); (**STRMW** = Stormwater)

Return to Contents

ANALYTE LIST

0618

Pacific EcoRisk
2250 Cordelia Rd.
Fairfield, CA 94534

Project Proponent: **Pacific EcoRisk**

Project #: PER QAQC

Site #: PER Control Sed.

Standard Ocean Disposal List (SF Bay)

Analyte	Method Use	SAP Targeted MRL	
Solids, Total	EPA 160.3	±0.1%	X
Total Organic Carbon	EPA 415.1	±0.1%	X
Grain Size	ASTM 1992	±0.1%	X
Arsenic	EPA 6020	2 mg/kg	X
Cadmium	EPA 6020	0.3 mg/kg	X
Chromium	EPA 6020	5 mg/kg	X
Copper	EPA 6020	5 mg/kg	X
Lead	EPA 6020	5 mg/kg	X
Nickel	EPA 6020	5 mg/kg	X
Silver	EPA 6020	0.2 mg/kg	X
Zinc	EPA 6020	1 mg/kg	X
Mercury	EPA 7471A	0.02 mg/kg	X
Selenium	EPA 7742	0.1 mg/kg	X
2,4'-DDD	EPA 8081B	2 µg/kg	X
2,4'-DDE	EPA 8081B	2 µg/kg	X
2,4'-DDT	EPA 8081B	2 µg/kg	X
4,4'-DDD	EPA 8081B	2 µg/kg	X
4,4'-DDE	EPA 8081B	2 µg/kg	X
4,4'-DDT	EPA 8081B	2 µg/kg	X
Total DDT	EPA 8081B	2 µg/kg	X
Aldrin	EPA 8081B	2 µg/kg	X
alpha-BHC	EPA 8081B	2 µg/kg	X
beta-BHC	EPA 8081B	2 µg/kg	X
Chlordane	EPA 8081B	20 µg/kg	X
delta-BHC	EPA 8081B	2 µg/kg	X
Dieldrin	EPA 8081B	2 µg/kg	X
Endosulfan I	EPA 8081B	2 µg/kg	X
Endosulfan II	EPA 8081B	2 µg/kg	X
Endosulfan Sulfate	EPA 8081B	2 µg/kg	X
Endrin	EPA 8081B	2 µg/kg	X
Endrin Aldehyde	EPA 8081B	2 µg/kg	X
gamma-BHC (Lindane)	EPA 8081B	2 µg/kg	X
Heptachlor	EPA 8081B	2 µg/kg	X
Heptachlor Epoxide	EPA 8081B	2 µg/kg	X
Toxaphene	EPA 8081B	20 µg/kg	X
PCB 008	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 018	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 028	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 031	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 033	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 044	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 049	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 052	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 056	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 060	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 066	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 070	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 074	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 087	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 095	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 097	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 099	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 101	EPA 8082 (congeners)	0.5 µg/kg	X

Return to Contents

0618

PCB 105	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 110	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 118	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 128	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 132	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 138	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 141	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 149	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 151	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 153	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 156	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 158	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 170	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 174	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 177	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 180	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 183	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 187	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 194	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 195	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 201	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 203	EPA 8082 (congeners)	0.5 µg/kg	X
Acenaphthene	EPA 8270C	20 µg/kg	X
Acenaphthylene	EPA 8270C	20 µg/kg	X
Anthracene	EPA 8270C	20 µg/kg	X
Benz(a)anthracene	EPA 8270C	20 µg/kg	X
Benzo(a)pyrene	EPA 8270C	20 µg/kg	X
Benzo(e)pyrene	EPA 8270C	20 µg/kg	X
Benzo(b)fluoranthene	EPA 8270C	20 µg/kg	X
Benzo(g,h,i)perylene	EPA 8270C	20 µg/kg	X
Benzo(k)fluoranthene	EPA 8270C	20 µg/kg	X
Biphenyl	EPA 8270C	20 µg/kg	X
Chrysene	EPA 8270C	20 µg/kg	X
Dibenz(a,h)anthracene	EPA 8270C	20 µg/kg	X
Dibenzothiophene	EPA 8270C	20 µg/kg	X
Dimethylnapthalene 2, 6-	EPA 8270C	20 µg/kg	X
Fluoranthene	EPA 8270C	20 µg/kg	X
Fluorene	EPA 8270C	20 µg/kg	X
Indeno(1,2,3-cd)pyrene	EPA 8270C	20 µg/kg	X
Methylnapthalene, 1-	EPA 8270C	20 µg/kg	X
Methylnapthalene, 2-	EPA 8270C	20 µg/kg	X
Methylphenanthrene, 1-	EPA 8270C	20 µg/kg	X
Naphthalene	EPA 8270C	20 µg/kg	X
Perylene	EPA 8270C	20 µg/kg	X
Phenanthrene	EPA 8270C	20 µg/kg	X
Pyrene	EPA 8270C	20 µg/kg	X
Trimethylnapthalene, 2, 3, 5-	EPA 8270C	20 µg/kg	X
Di-butyltin	Krone 1989	10 µg/kg	X
Mono-Butyltin	Krone 1989	10 µg/kg	X
Tetra-butyltin	Krone 1989	10 µg/kg	X
Tri-butyltin	Krone 1989	10 µg/kg	X

If you have any questions regarding this request as checked,
please call Jeff Cotsifas at (707)207-7760

Return to Contents

0618

From: (707) 207-7760
Yuliya Khadiyeva
PACIFIC ECORISK
2250 Cordelia Road

Fairfield, CA 94534

Origin ID: CCRA

FedEx Express

J12101112190225

Ship Date: 07MAY12
ActWgt: 15.0 LB
CAD: 2549479/INET3250

Delivery Address Bar Code

Ref # PER Sediment Ctl
Invoice #
PO #
Dept #

SHIP TO: (714) 895-5494 BILL SENDER

Danielle Gonsman
Calscience Environmental Labs
7440 Lincoln Way

Garden Grove, CA 92841

TUE - 08 MAY A1
STANDARD OVERNIGHT

TRK# 7935 3779 7856
0201

92 APVA

92841
CA-US
SNA

512G3/61A4/A278

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Return to Contents

Calscience Environmental Laboratories, Inc.

WORK ORDER #: 12-05-0618

SAMPLE RECEIPT FORM

Cooler 1 of 1

CLIENT: Pacific EcoRisk DATE: 05/08/12

TEMPERATURE: Thermometer ID: SC2 (Criteria: 0.0 °C – 6.0 °C, not frozen)

Temperature 5.4 °C - 0.3 °C (CF) = 5.1 °C ☐ Blank ☑ Sample

☐ Sample(s) outside temperature criteria (PM/APM contacted by: _____).

☐ Sample(s) outside temperature criteria but received on ice/chilled on same day of sampling.

☐ **Received at ambient temperature, placed on ice for transport by Courier.**

Ambient Temperature: ☐ Air ☐ Filter **Initial:** JP

CUSTODY SEALS INTACT:

☐ Cooler ☐_____ ☐ No (Not Intact) ☑ Not Present ☐ N/A **Initial:** JP

☐ Sample ☐_____ ☐ No (Not Intact) ☑ Not Present **Initial:** IS

SAMPLE CONDITION:	Yes	No	N/A
Chain-Of-Custody (COC) document(s) received with samples	☑	☐	☐
COC document(s) received complete	☑	☐	☐
☐ Collection date/time, matrix, and/or # of containers logged in based on sample labels.			
☐ No analysis requested. ☐ Not relinquished. ☐ No date/time relinquished.			
Sampler's name indicated on COC	☑	☐	☐
Sample container label(s) consistent with COC	☑	☐	☐
Sample container(s) intact and good condition	☑	☐	☐
Proper containers and sufficient volume for analyses requested	☐	☑	☐
Analyses received within holding time	☑	☐	☐
pH / Res. Chlorine / Diss. Sulfide / Diss. Oxygen received within 24 hours	☐	☐	☑
Proper preservation noted on COC or sample container	☐	☐	☑
☐ Unpreserved vials received for Volatiles analysis			
Volatile analysis container(s) free of headspace	☐	☐	☑
Tedlar bag(s) free of condensation	☐	☐	☑

CONTAINER TYPE:

Solid: ☐4ozCGJ ☐8ozCGJ ☑16ozCGJ ☐Sleeve (_____) ☐EnCores® ☐TerraCores® ☑ 2

Water: ☐VOA ☐VOA**h** ☐VOA**na$_2$** ☐125AGB ☐125AGB**h** ☐125AGB**p** ☐1AGB ☐1AGB**na$_2$** ☐1AGB**s**

☐500AGB ☐500AGJ ☐500AGJ**s** ☐250AGB ☐250CGB ☐250CGB**s** ☐1PB ☐1PB**na** ☐500PB

☐250PB ☐250PB**n** ☐125PB ☐125PB**znna** ☐100PJ ☐100PJ**na$_2$** ☐_____ ☐_____ ☐_____

Air: ☐Tedlar® ☐Summa® **Other:** ☐_____ **Trip Blank Lot#:**_____ **Labeled/Checked by:** IS

Container: **C:** Clear **A:** Amber **P:** Plastic **G:** Glass **J:** Jar **B:** Bottle **Z:** Ziploc/Resealable Bag **E:** Envelope **Reviewed by:** NC

Preservative: **h:** HCL **n:** HNO_3 **na$_2$:** $Na_2S_2O_3$ **na:** NaOH **p:** H_3PO_4 **s:** H_2SO_4 **u:** Ultra-pure **znna:** $ZnAc_2$+NaOH **f:** Filtered **Scanned by:** NC

Return to Contents

Attachment G

Comparative Evaluation of Organism Performance in Control Sediment vs. Silica (Quartz Sand)

Table G-1. Comparison of *Chironomus dilutus* Growth in Control Sediment *vs* Silica

Test Date	Test Media	Initial Weight (mg)	Mean % Survival	Growth (Mean AFDW) (mg)	Emergence
12/16/09	Silica	0.164	93.8	0.71	None
	Control Sediment	0.164	95.0	0.76	None
2/28/11	Silica	0.144	98.8	0.64	None
	Control Sediment	0.144	100	0.89	None
2/10/12	Silica	0.132	98.8	1.04	None
	Control Sediment	0.132	92.5	0.83	None
Silica Mean =		0.147	97.12	0.80	-
Control Sediment Mean =		0.147	95.83	0.83	-

AFDW – Ash-free dry weight.

Attachment H

Metals Analysis of Pacific EcoRisk Type I Water

Monday, May 21, 2012

Stephen Clark
Pacific EcoRisk
2250 Cordelia Road
Fairfield, CA 94534

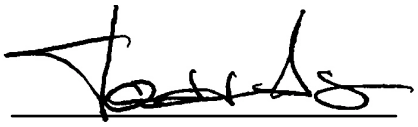
RE: Lab Order: M050289 Collected By: CLIENT
Project ID: PER TYPE 1-050412 PO/Contract #:

Dear Stephen Clark:

Enclosed are the analytical results for sample(s) received by the laboratory on Friday, May 04, 2012. Results reported herein conform to the most current NELAC standards, where applicable, unless otherwise narrated in the body of the report.

If you have any questions concerning this report, please feel free to contact me.

Enclosures



Project Manager: Todd Albertson

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Caltest
ANALYTICAL LABORATORY
ENVIRONMENTAL ANALYSES

SAMPLE SUMMARY

Lab Order: M050289

Project ID: PER TYPE 1-050412

Lab ID	Sample ID	Matrix	Date Collected	Date Received
M050289001	**PER TYPE 1-050412**	Water	5/4/2012 11:30	5/4/2012 13:00

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NARRATIVE

Lab Order: M050289

Project ID: PER TYPE 1-050412

General Qualifiers and Notes

Caltest authorizes this report to be reproduced only in its entirety. Results are specific to the sample(s) as submitted and only to the parameter(s) reported.

Caltest certifies that all test results for wastewater and hazardous waste analyses meet all applicable NELAC requirements; all microbiology and drinking water testing meet applicable ELAP requirements, unless stated otherwise.

All analyses performed by EPA Methods or Standard Methods (SM) 20th Edition except where noted (SMOL=online edition).

Caltest collects samples in compliance with 40 CFR, EPA Methods, Cal. Title 22, and Standard Methods.

Dilution Factors (DF) reported greater than '1' have been used to adjust the result, Reporting Limit (RL), and Method Detection Limit (MDL).

All Solid, sludge, and/or biosolids data is reported in Wet Weight, unless otherwise specified.

Filtrations performed at Caltest for dissolved metals (excluding mercury) and/or pH analysis were not performed within the 15 minute holding time as specified by 40CFR 136.3 table II.

Results Qualifiers: Report fields may contain codes and non-numeric data correlating to one or more of the following definitions:

ND - Non Detect - indicates analytical result has not been detected.

RL - Reporting Limit is the quantitation limit at which the laboratory is able to detect an analyte. An analyte not detected at or above the RL is reported as ND unless otherwise noted or qualified. For analyses pertaining to the State Implementation Plan of the California Toxics Rule, the Caltest Reporting Limit (RL) is equivalent to the Minimum Level (ML). A standard is always run at or below the ML. Where Reporting Limits are elevated due to dilution, the ML calibration criteria has been met.

J - reflects estimated analytical result value detected below the Reporting Limit (RL) and above the Method Detection Limit (MDL). The 'J' flag is equivalent to the DNQ Estimated Concentration flag.

E - indicates an estimated analytical result value.

B - indicates the analyte has been detected in the blank associated with the sample.

NC - means not able to be calculated for RPD or Spike Recoveries.

SS - compound is a Surrogate Spike used per laboratory quality assurance manual.

NOTE: This document represents a complete Analytical Report for the samples referenced herein and should be retained as a permanent record thereof.

Qualifiers and Compound Notes

1	Analyte(s) reported as 'ND' means not detected at or above the listed Method Detection Limits (MDL).
2	Surrogate recovery is high, outside Caltest acceptance criteria. The sample results of 'ND' for analytes of interest should be considered valid.

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ANALYTICAL RESULTS

Lab Order: M050289

Project ID PER TYPE 1-050412

Lab ID: **M050289001** Date Collected: 5/4/2012 11:30 Matrix: Water

Sample ID: **PER TYPE 1-050412** Date Received: 5/4/2012 13:00

Parameters	Result	Units	R. L.	MDL	DF	Prepared	Batch	Analyzed	Batch	Qual
Metals Analysis by ICP		**Prep Method:**	EPA 200.2			**Prep by:** LM				
		Analytical Method:	EPA 200.7					**Analyzed by:** LM		
Calcium	J0.08	mg/L	0.50	0.035	1	05/08/12 00:00	MPR 10880	05/09/12 00:00	MIC 3847	
Magnesium	J0.02	mg/L	0.50	0.0050	1	05/08/12 00:00	MPR 10880	05/09/12 00:00	MIC 3847	
Potassium	J0.17	mg/L	1.0	0.077	1	05/08/12 00:00	MPR 10880	05/09/12 00:00	MIC 3847	
Sodium	ND	mg/L	1.0	0.12	1	05/08/12 00:00	MPR 10880	05/09/12 00:00	MIC 3847	1
Semivolatile Organic Analysis		**Prep Method:**	EPA 625 Low Level			**Prep by:** ECB				
		Analytical Method:	EPA 625 Low Level					**Analyzed by:** MDT		
Acenaphthene	ND	ug/L	0.005	0.0035	1	05/07/12 00:00	SPR 5260	05/11/12 12:47	SMS 2677	1
Acenaphthylene	ND	ug/L	0.005	0.0040	1	05/07/12 00:00	SPR 5260	05/11/12 12:47	SMS 2677	
Anthracene	ND	ug/L	0.005	0.0045	1	05/07/12 00:00	SPR 5260	05/11/12 12:47	SMS 2677	
Benzo(a)anthracene	ND	ug/L	0.005	0.0045	1	05/07/12 00:00	SPR 5260	05/11/12 12:47	SMS 2677	
Benzo(a)pyrene	ND	ug/L	0.005	0.0035	1	05/07/12 00:00	SPR 5260	05/11/12 12:47	SMS 2677	
Benzo(b)fluoranthene	ND	ug/L	0.005	0.0045	1	05/07/12 00:00	SPR 5260	05/11/12 12:47	SMS 2677	
Benzo(e)pyrene	ND	ug/L	0.005	0.0045	1	05/07/12 00:00	SPR 5260	05/11/12 12:47	SMS 2677	
Benzo(g,h,i)perylene	ND	ug/L	0.005	0.0040	1	05/07/12 00:00	SPR 5260	05/11/12 12:47	SMS 2677	
Benzo(k)fluoranthene	ND	ug/L	0.005	0.0035	1	05/07/12 00:00	SPR 5260	05/11/12 12:47	SMS 2677	
Chrysene	ND	ug/L	0.005	0.0035	1	05/07/12 00:00	SPR 5260	05/11/12 12:47	SMS 2677	
Dibenzo(a,h)anthracene	ND	ug/L	0.005	0.0035	1	05/07/12 00:00	SPR 5260	05/11/12 12:47	SMS 2677	
2,6-Dimethylnaphthalene	ND	ug/L	0.005	0.0035	1	05/07/12 00:00	SPR 5260	05/11/12 12:47	SMS 2677	
Fluoranthene	ND	ug/L	0.005	0.0050	1	05/07/12 00:00	SPR 5260	05/11/12 12:47	SMS 2677	
Fluorene	ND	ug/L	0.005	0.0045	1	05/07/12 00:00	SPR 5260	05/11/12 12:47	SMS 2677	
Indeno(1,2,3-cd)pyrene	ND	ug/L	0.005	0.0030	1	05/07/12 00:00	SPR 5260	05/11/12 12:47	SMS 2677	
1-Methylnaphthalene	ND	ug/L	0.005	0.0045	1	05/07/12 00:00	SPR 5260	05/11/12 12:47	SMS 2677	
2-Methylnaphthalene	ND	ug/L	0.005	0.0045	1	05/07/12 00:00	SPR 5260	05/11/12 12:47	SMS 2677	
1-Methylphenanthrene	ND	ug/L	0.005	0.0040	1	05/07/12 00:00	SPR 5260	05/11/12 12:47	SMS 2677	
Naphthalene	ND	ug/L	0.005	0.0045	1	05/07/12 00:00	SPR 5260	05/11/12 12:47	SMS 2677	
Perylene	ND	ug/L	0.005	0.0035	1	05/07/12 00:00	SPR 5260	05/11/12 12:47	SMS 2677	
Phenanthrene	ND	ug/L	0.005	0.0045	1	05/07/12 00:00	SPR 5260	05/11/12 12:47	SMS 2677	
Pyrene	ND	ug/L	0.005	0.0050	1	05/07/12 00:00	SPR 5260	05/11/12 12:47	SMS 2677	
2,3,5-Trimethylnaphthalene	ND	ug/L	0.005	0.0035	1	05/07/12 00:00	SPR 5260	05/11/12 12:47	SMS 2677	
2-Fluorobiphenyl (SS)	50	%	10-100		1	05/07/12 00:00	SPR 5260	05/11/12 12:47	SMS 2677	
Nitrobenzene-d5 (SS)	47	%	27-109		1	05/07/12 00:00	SPR 5260	05/11/12 12:47	SMS 2677	
Terphenyl-d14 (SS)	80	%	35-153		1	05/07/12 00:00	SPR 5260	05/11/12 12:47	SMS 2677	
Chlorinated Pesticides & PCBs Analysis		**Prep Method:**	EPA 608			**Prep by:** EAB				
		Analytical Method:	EPA 608					**Analyzed by:** NTA		
Aldrin	ND	ug/L	0.005	0.0040	1	05/08/12 00:00	SPR 5264	05/10/12 21:09	SMS 2674	
alpha-BHC	ND	ug/L	0.010	0.0050	1	05/08/12 00:00	SPR 5264	05/10/12 21:09	SMS 2674	
beta-BHC	ND	ug/L	0.005	0.0040	1	05/08/12 00:00	SPR 5264	05/10/12 21:09	SMS 2674	

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ANALYTICAL RESULTS

Lab Order: M050289

Project ID PER TYPE 1-050412

Lab ID: **M050289001** Date Collected: 5/4/2012 11:30 Matrix: Water

Sample ID: **PER TYPE 1-050412** Date Received: 5/4/2012 13:00

Parameters	Result	Units	R. L.	MDL	DF	Prepared	Batch	Analyzed	Batch	Qual
delta-BHC	ND	ug/L	0.005	0.0040	1	05/08/12 00:00	SPR 5264	05/10/12 21:09	SMS 2674	
gamma-BHC (Lindane)	ND	ug/L	0.010	0.0040	1	05/08/12 00:00	SPR 5264	05/10/12 21:09	SMS 2674	
Chlordane	ND	ug/L	0.050	0.0050	1	05/08/12 00:00	SPR 5264	05/10/12 21:09	SMS 2674	
4,4'-DDD	ND	ug/L	0.010	0.0040	1	05/08/12 00:00	SPR 5264	05/10/12 21:09	SMS 2674	
4,4'-DDE	ND	ug/L	0.010	0.0030	1	05/08/12 00:00	SPR 5264	05/10/12 21:09	SMS 2674	
4,4'-DDT	ND	ug/L	0.010	0.0040	1	05/08/12 00:00	SPR 5264	05/10/12 21:09	SMS 2674	
Dieldrin	ND	ug/L	0.010	0.0040	1	05/08/12 00:00	SPR 5264	05/10/12 21:09	SMS 2674	
Endosulfan I	ND	ug/L	0.010	0.0040	1	05/08/12 00:00	SPR 5264	05/10/12 21:09	SMS 2674	
Endosulfan II	ND	ug/L	0.010	0.0050	1	05/08/12 00:00	SPR 5264	05/10/12 21:09	SMS 2674	
Endosulfan sulfate	ND	ug/L	0.010	0.0050	1	05/08/12 00:00	SPR 5264	05/10/12 21:09	SMS 2674	
Endrin	ND	ug/L	0.010	0.0050	1	05/08/12 00:00	SPR 5264	05/10/12 21:09	SMS 2674	
Endrin aldehyde	ND	ug/L	0.010	0.0050	1	05/08/12 00:00	SPR 5264	05/10/12 21:09	SMS 2674	
Endrin ketone	ND	ug/L	0.010	0.0050	1	05/08/12 00:00	SPR 5264	05/10/12 21:09	SMS 2674	
Heptachlor	ND	ug/L	0.010	0.0050	1	05/08/12 00:00	SPR 5264	05/10/12 21:09	SMS 2674	
Heptachlor epoxide	ND	ug/L	0.010	0.0040	1	05/08/12 00:00	SPR 5264	05/10/12 21:09	SMS 2674	
Methoxychlor	ND	ug/L	0.010	0.0050	1	05/08/12 00:00	SPR 5264	05/10/12 21:09	SMS 2674	
PCB 1016	ND	ug/L	0.10	0.050	1	05/08/12 00:00	SPR 5264	05/10/12 21:09	SMS 2674	
PCB 1221	ND	ug/L	0.10	0.050	1	05/08/12 00:00	SPR 5264	05/10/12 21:09	SMS 2674	
PCB 1232	ND	ug/L	0.10	0.050	1	05/08/12 00:00	SPR 5264	05/10/12 21:09	SMS 2674	
PCB 1242	ND	ug/L	0.10	0.040	1	05/08/12 00:00	SPR 5264	05/10/12 21:09	SMS 2674	
PCB 1248	ND	ug/L	0.10	0.050	1	05/08/12 00:00	SPR 5264	05/10/12 21:09	SMS 2674	
PCB 1254	ND	ug/L	0.10	0.050	1	05/08/12 00:00	SPR 5264	05/10/12 21:09	SMS 2674	
PCB 1260	ND	ug/L	0.10	0.050	1	05/08/12 00:00	SPR 5264	05/10/12 21:09	SMS 2674	
Toxaphene	ND	ug/L	0.5	0.20	1	05/08/12 00:00	SPR 5264	05/10/12 21:09	SMS 2674	
Decachlorobiphenyl (SS)	88	%	10-195		1	05/08/12 00:00	SPR 5264	05/10/12 21:09	SMS 2674	
Tetrachloro-m-xylene (SS)	82	%	25-105		1	05/08/12 00:00	SPR 5264	05/10/12 21:09	SMS 2674	
Organophosphorous Pesticides		**Prep Method:**	EPA 614			**Prep by:** EAB				
		Analytical Method:	EPA 614					**Analyzed by:** MDT		
Azinphos methyl (Guthion)	ND	ug/L	0.05	0.04	1	05/08/12 00:00	SPR 5265	05/14/12 13:53	SMS 2676	1
Chlorpyrifos	ND	ug/L	0.01	0.005	1	05/08/12 00:00	SPR 5265	05/14/12 13:53	SMS 2676	
Demeton -O and -S	ND	ug/L	0.1	0.02	1	05/08/12 00:00	SPR 5265	05/14/12 13:53	SMS 2676	
Diazinon	ND	ug/L	0.02	0.007	1	05/08/12 00:00	SPR 5265	05/14/12 13:53	SMS 2676	
Disulfoton (Di-Syston)	ND	ug/L	0.1	0.08	1	05/08/12 00:00	SPR 5265	05/14/12 13:53	SMS 2676	
Ethion	ND	ug/L	0.02	0.005	1	05/08/12 00:00	SPR 5265	05/14/12 13:53	SMS 2676	
Malathion	ND	ug/L	0.05	0.008	1	05/08/12 00:00	SPR 5265	05/14/12 13:53	SMS 2676	
Parathion (Parathion ethyl)	ND	ug/L	0.05	0.01	1	05/08/12 00:00	SPR 5265	05/14/12 13:53	SMS 2676	
Parathion methyl	ND	ug/L	0.1	0.06	1	05/08/12 00:00	SPR 5265	05/14/12 13:53	SMS 2676	
Thiobencarb	ND	ug/L	0.05	0.008	1	05/08/12 00:00	SPR 5265	05/14/12 13:53	SMS 2676	
Dichlofenthion (SS)	91	%	45-105		1	05/08/12 00:00	SPR 5265	05/14/12 13:53	SMS 2676	
Triphenylphosphate (SS)	84	%	61-120		1	05/08/12 00:00	SPR 5265	05/14/12 13:53	SMS 2676	

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ANALYTICAL RESULTS

Lab Order: M050289

Project ID PER TYPE 1-050412

Lab ID: **M050289001** Date Collected: 5/4/2012 11:30 Matrix: Water

Sample ID: **PER TYPE 1-050412** Date Received: 5/4/2012 13:00

Parameters	Result	Units	R. L.	MDL	DF	Prepared	Batch	Analyzed	Batch	Qual
Pyrethroids Analysis, NCI, Water		**Prep Method:**	SW846 3510C			**Prep by:** EAB				
		Analytical Method:	SW846 8270 Mod (GCMS-NCI-SIM)					**Analyzed by:** RLH		
Allethrin	ND	ng/L	1.5	0.1	1	05/04/12 14:00	SPR 5257	05/10/12 16:50	SMS 2671	
Bifenthrin	ND	ng/L	1.5	0.1	1	05/04/12 14:00	SPR 5257	05/10/12 16:50	SMS 2671	
Cyfluthrin	ND	ng/L	1.5	0.2	1	05/04/12 14:00	SPR 5257	05/10/12 16:50	SMS 2671	
Lambda-Cyhalothrin	ND	ng/L	1.5	0.2	1	05/04/12 14:00	SPR 5257	05/10/12 16:50	SMS 2671	
Cypermethrin	ND	ng/L	1.5	0.2	1	05/04/12 14:00	SPR 5257	05/10/12 16:50	SMS 2671	
Deltamethrin:Tralomethrin	ND	ng/L	3.0	0.2	1	05/04/12 14:00	SPR 5257	05/10/12 16:50	SMS 2671	
Esfenvalerate:Fenvalerate	ND	ng/L	3.0	0.2	1	05/04/12 14:00	SPR 5257	05/10/12 16:50	SMS 2671	
Fenpropathrin	ND	ng/L	1.5	0.2	1	05/04/12 14:00	SPR 5257	05/10/12 16:50	SMS 2671	
Tau-Fluvalinate	ND	ng/L	1.5	0.2	1	05/04/12 14:00	SPR 5257	05/10/12 16:50	SMS 2671	
Permethrin	ND	ng/L	15	2	1	05/04/12 14:00	SPR 5257	05/10/12 16:50	SMS 2671	
Tetramethrin	ND	ng/L	1.5	0.2	1	05/04/12 14:00	SPR 5257	05/10/12 16:50	SMS 2671	
Decachlorobiphenyl (SS)	145	%	35-105		1	05/04/12 14:00	SPR 5257	05/10/12 16:50	SMS 2671	2
Total Organic Carbon Analysis		**Analytical Method:**	SM20-5310 B					**Analyzed by:** AL		
Total Organic Carbon	ND	mg/L	0.5	0.30	1			05/16/12 18:12	WET 6564	
Anions by Ion Chromatography		**Analytical Method:**	EPA 300.0					**Analyzed by:** MYS		
Nitrogen, Nitrate (as N)	ND	mg/L	0.1	0.010	1			05/04/12 19:58	WIC 3598	
Chloride	ND	mg/L	1	0.010	1			05/04/12 19:58	WIC 3598	
Fluoride	ND	mg/L	0.1	0.010	1			05/04/12 19:58	WIC 3598	
Sulfate (as SO4)	ND	mg/L	0.5	0.010	1			05/04/12 19:58	WIC 3598	

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QUALITY CONTROL DATA

Lab Order: M050289

Project ID: PER TYPE 1-050412

Analysis Description:	Metals Analysis by ICP	**QC Batch:**	MPR/10880
Analysis Method:	EPA 200.7	**QC Batch Method:**	EPA 200.2

METHOD BLANK: 450543

Parameter	Blank Result	Reporting Limit	MDL	Units	Qualifiers
Calcium	J0.05	0.50	0.04	mg/L	
Magnesium	J0.01	0.50	0.005	mg/L	
Potassium	J0.19	1.0	0.08	mg/L	
Sodium	ND	1.0	0.12	mg/L	

LABORATORY CONTROL SAMPLE: 450544

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Calcium	mg/L	20	18	92	85-115	
Magnesium	mg/L	20	17	86	85-115	
Potassium	mg/L	20	18	92	85-115	
Sodium	mg/L	20	19	95	85-115	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 450546 450547

Parameter	Units	M050289001 Result	Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
Calcium	mg/L	0.08	20	19	19	96	96	80-120	0.3	20	
Magnesium	mg/L	0.02	20	18	18	90	90	80-120	0.2	20	
Potassium	mg/L	0.17	20	19	19	96	96	70-130	0.2	20	
Sodium	mg/L	0	20	20	20	98	99	70-130	0.6	20	

Analysis Description:	Pyrethroids Analysis, NCI, Water	**QC Batch:**	SPR/5257
Analysis Method:	SW846 8270 Mod (GCMS-NCI-SIM)	**QC Batch Method:**	SW846 3510C

METHOD BLANK: 449795

Parameter	Blank Result	Reporting Limit	MDL	Units	Qualifiers
Allethrin	ND	1.5	0.1	ng/L	
Bifenthrin	ND	1.5	0.1	ng/L	
Cyfluthrin	ND	1.5	0.2	ng/L	
Lambda-Cyhalothrin	ND	1.5	0.2	ng/L	
Cypermethrin	ND	1.5	0.2	ng/L	
Deltamethrin:Tralomethrin	ND	3.0	0.2	ng/L	
Esfenvalerate:Fenvalerate	ND	3.0	0.2	ng/L	
Fenpropathrin	ND	1.5	0.2	ng/L	

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QUALITY CONTROL DATA

Lab Order: M050289

Project ID: PER TYPE 1-050412

Analysis Description:	Pyrethroids Analysis, NCI, Water	**QC Batch:**	SPR/5257
Analysis Method:	SW846 8270 Mod (GCMS-NCI-SIM)	**QC Batch Method:**	SW846 3510C

Parameter	Blank Result	Reporting Limit	MDL	Units	Qualifiers
Tau-Fluvalinate	ND	1.5	0.2	ng/L	
Permethrin	ND	15	2.0	ng/L	
Tetramethrin	ND	1.5	0.2	ng/L	
Decachlorobiphenyl (SS)	127	35-105		%	3

Analysis Description:	Chlorinated Pesticides & PCBs Analysis	**QC Batch:**	SPR/5264
Analysis Method:	EPA 608	**QC Batch Method:**	EPA 608

METHOD BLANK: 450478

Parameter	Blank Result	Reporting Limit	MDL	Units	Qualifiers
Aldrin	ND	0.005	0.004	ug/L	
alpha-BHC	ND	0.010	0.005	ug/L	
beta-BHC	ND	0.005	0.004	ug/L	
delta-BHC	ND	0.005	0.004	ug/L	
gamma-BHC (Lindane)	ND	0.010	0.004	ug/L	
Chlordane	ND	0.050	0.005	ug/L	
4,4'-DDD	ND	0.010	0.004	ug/L	
4,4'-DDE	ND	0.010	0.003	ug/L	
4,4'-DDT	ND	0.010	0.004	ug/L	
Dieldrin	ND	0.010	0.004	ug/L	
Endosulfan I	ND	0.010	0.004	ug/L	
Endosulfan II	ND	0.010	0.005	ug/L	
Endosulfan sulfate	ND	0.010	0.005	ug/L	
Endrin	ND	0.010	0.005	ug/L	
Endrin aldehyde	ND	0.010	0.005	ug/L	
Endrin ketone	ND	0.010	0.005	ug/L	
Heptachlor	ND	0.010	0.005	ug/L	
Heptachlor epoxide	ND	0.010	0.004	ug/L	
Methoxychlor	ND	0.010	0.005	ug/L	
PCB 1016	ND	0.10	0.050	ug/L	
PCB 1221	ND	0.10	0.050	ug/L	
PCB 1232	ND	0.10	0.050	ug/L	
PCB 1242	ND	0.10	0.040	ug/L	
PCB 1248	ND	0.10	0.050	ug/L	
PCB 1254	ND	0.10	0.050	ug/L	
PCB 1260	ND	0.10	0.050	ug/L	
Toxaphene	ND	0.5	0.2	ug/L	

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QUALITY CONTROL DATA

Lab Order: M050289

Project ID: PER TYPE 1-050412

Analysis Description:	Chlorinated Pesticides & PCBs Analysis	**QC Batch:**	SPR/5264
Analysis Method:	EPA 608	**QC Batch Method:**	EPA 608

Parameter	Blank Result	Reporting Limit	MDL	Units	Qualifiers
Decachlorobiphenyl (SS)	124	30-190		%	
Tetrachloro-m-xylene (SS)	102	25-105		%	

LABORATORY CONTROL SAMPLE: 450479

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Aldrin	ug/L	0.2	0.19	96	42-122	
alpha-BHC	ug/L	0.2	0.18	91	37-134	
beta-BHC	ug/L	0.2	0.2	100	17-147	
delta-BHC	ug/L	0.2	0.17	84	19-140	
gamma-BHC (Lindane)	ug/L	0.2	0.2	98	32-127	
4,4'-DDD	ug/L	0.2	0.17	86	31-141	
4,4'-DDE	ug/L	0.2	0.21	104	30-145	
4,4'-DDT	ug/L	0.2	0.26	133	25-160	
Dieldrin	ug/L	0.2	0.22	109	36-146	
Endosulfan I	ug/L	0.2	0.22	110	45-153	
Endosulfan II	ug/L	0.2	0.25	124	1-202	
Endosulfan sulfate	ug/L	0.2	0.26	130	26-144	
Endrin	ug/L	0.2	0.22	110	30-147	
Endrin aldehyde	ug/L	0.2	0.23	115	34-105	10
Endrin ketone	ug/L	0.2	0.24	118	41-127	
Heptachlor	ug/L	0.2	0.22	108	34-111	
Heptachlor epoxide	ug/L	0.2	0.22	108	37-142	
Methoxychlor	ug/L	0.2	0.26	129	1-186	
Decachlorobiphenyl (SS)	%			125	30-190	
Tetrachloro-m-xylene (SS)	%			95	25-105	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 450481 450482

Parameter	Units	M050195002 Result	Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
Aldrin	ug/L	0	0.21	0.22	0.18	102	88	42-122	16	24	
alpha-BHC	ug/L	0	0.21	0.2	0.18	97	87	37-134	12	30	
beta-BHC	ug/L	0	0.21	0.23	0.21	110	102	17-147	8.1	30	
delta-BHC	ug/L	0	0.21	0.18	0.17	86	80	19-140	8.6	30	
gamma-BHC (Lindane)	ug/L	0	0.21	0.22	0.2	103	94	32-127	10	29	
4,4'-DDD	ug/L	0	0.21	0.2	0.18	95	89	31-141	7.8	30	
4,4'-DDE	ug/L	0	0.21	0.25	0.23	119	110	30-145	8.7	30	
4,4'-DDT	ug/L	0	0.21	0.29	0.28	138	134	25-160	3.9	46	

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QUALITY CONTROL DATA

Lab Order: M050289

Project ID: PER TYPE 1-050412

Analysis Description: Chlorinated Pesticides & PCBs Analysis **QC Batch:** SPR/5264

Analysis Method: EPA 608 **QC Batch Method:** EPA 608

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 450481 450482

Parameter	Units	M050195002 Result	Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
Dieldrin	ug/L	0	0.21	0.24	0.22	116	106	36-146	9.9	24	
Endosulfan I	ug/L	0	0.21	0.24	0.22	115	108	45-153	7.7	30	
Endosulfan II	ug/L	0	0.21	0.28	0.26	134	125	1-202	8.5	30	
Endosulfan sulfate	ug/L	0	0.21	0.28	0.26	131	122	26-144	7.9	30	
Endrin	ug/L	0	0.21	0.25	0.23	117	109	30-147	7.6	23	
Endrin aldehyde	ug/L	0	0.21	0.26	0.24	124	114	34-105	9.6	30	11
Endrin ketone	ug/L	0	0.21	0.25	0.23	119	110	41-127	8.3	30	
Heptachlor	ug/L	0	0.21	0.25	0.22	118	107	34-111	11	52	6
Heptachlor epoxide	ug/L	0	0.21	0.24	0.22	113	103	37-142	10	30	
Methoxychlor	ug/L	0	0.21	0.27	0.25	127	118	1-186	8.2	30	
PCB 1260	ug/L			0	0				0		
Decachlorobiphenyl (SS)	%					134	123	10-195	9.3		
Tetrachloro-m-xylene (SS)	%					101	86	25-105	17		

Analysis Description: Organophosphorous Pesticides **QC Batch:** SPR/5265

Analysis Method: EPA 614 **QC Batch Method:** EPA 614

METHOD BLANK: 450483

Parameter	Blank Result	Reporting Limit	MDL	Units	Qualifiers
Azinphos methyl (Guthion)	ND	0.05	0.04	ug/L	
Chlorpyrifos	ND	0.01	0.005	ug/L	
Demeton -O and -S	ND	0.1	0.02	ug/L	
Diazinon	ND	0.02	0.007	ug/L	
Disulfoton (Di-Syston)	ND	0.1	0.08	ug/L	
Ethion	ND	0.02	0.005	ug/L	
Malathion	ND	0.05	0.008	ug/L	
Parathion (Parathion ethyl)	ND	0.05	0.01	ug/L	
Parathion methyl	ND	0.1	0.06	ug/L	
Thiobencarb	ND	0.05	0.008	ug/L	
Dichlofenthion (SS)	86	45-105		%	
Triphenylphosphate (SS)	76	61-120		%	

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QUALITY CONTROL DATA

Lab Order: M050289

Project ID: PER TYPE 1-050412

Analysis Description:	Organophosphorous Pesticides	**QC Batch:**	SPR/5265
Analysis Method:	EPA 614	**QC Batch Method:**	EPA 614

LABORATORY CONTROL SAMPLE: 450484

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Azinphos methyl (Guthion)	ug/L	3	2.4	79	52-123	
Chlorpyrifos	ug/L	3	2.5	83	45-127	
Demeton -O and -S	ug/L	3	1.5	49	10-100	
Diazinon	ug/L	3	2.5	83	50-121	
Disulfoton (Di-Syston)	ug/L	3	1.7	58	10-114	
Ethion	ug/L	3	2.5	82	47-138	
Malathion	ug/L	3	2.3	75	48-132	
Parathion (Parathion ethyl)	ug/L	3	2.3	78	44-139	
Parathion methyl	ug/L	3	1.9	63	49-124	
Thiobencarb	ug/L	3	2.5	83	40-150	
Dichlofenthion (SS)	%			87	45-105	
Triphenylphosphate (SS)	%			76	61-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 450486 450487

Parameter	Units	M050195002 Result	Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
Azinphos methyl (Guthion)	ug/L	0	3.2	2.3	2.3	73	75	52-123	0.9	50	
Chlorpyrifos	ug/L	0	3.2	2.4	2.4	75	77	45-127	2.5	50	
Demeton -O and -S	ug/L	0	3.2	1.5	1.3	47	42	10-100	15	50	
Diazinon	ug/L	0	3.2	2.4	2.3	74	75	50-121	3.8	50	
Disulfoton (Di-Syston)	ug/L	0	3.2	1.7	1.5	54	49	10-114	14	50	
Ethion	ug/L	0	3.2	2.5	2.4	77	77	47-138	3.7	50	
Malathion	ug/L	0	3.2	2.2	2.1	69	69	48-132	4.1	50	
Parathion (Parathion ethyl)	ug/L	0	3.2	2.3	2.3	72	73	44-139	2.2	50	
Parathion methyl	ug/L	0	3.2	1.9	1.9	59	62	49-124	1.1	50	
Thiobencarb	ug/L	0	3.2	2.4	2.3	74	76	40-150	2.1	50	
Dichlofenthion (SS)	%					79	79	45-105	4.3		
Triphenylphosphate (SS)	%					68	71	61-120	0.5		

Analysis Description:	Semivolatile Organic Analysis	**QC Batch:**	SPR/5260
Analysis Method:	EPA 625 Low Level	**QC Batch Method:**	EPA 625 Low Level

METHOD BLANK: 450233

Parameter	Blank Result	Reporting Limit	MDL	Units	Qualifiers
Acenaphthene	ND	0.005	0.004	ug/L	

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QUALITY CONTROL DATA

Lab Order: M050289

Project ID: PER TYPE 1-050412

Analysis Description:	Semivolatile Organic Analysis	**QC Batch:**	SPR/5260
Analysis Method:	EPA 625 Low Level	**QC Batch Method:**	EPA 625 Low Level

Parameter	Blank Result	Reporting Limit	MDL	Units	Qualifiers
Acenaphthylene	ND	0.005	0.004	ug/L	
Anthracene	ND	0.005	0.004	ug/L	
Benzo(a)anthracene	ND	0.005	0.004	ug/L	
Benzo(a)pyrene	ND	0.005	0.004	ug/L	
Benzo(b)fluoranthene	ND	0.005	0.004	ug/L	
Benzo(e)pyrene	ND	0.005	0.004	ug/L	
Benzo(g,h,i)perylene	ND	0.005	0.004	ug/L	
Benzo(k)fluoranthene	ND	0.005	0.004	ug/L	
Chrysene	ND	0.005	0.004	ug/L	
Dibenzo(a,h)anthracene	ND	0.005	0.004	ug/L	
2,6-Dimethylnaphthalene	ND	0.005	0.004	ug/L	
Fluoranthene	ND	0.005	0.005	ug/L	
Fluorene	ND	0.005	0.004	ug/L	
Indeno(1,2,3-cd)pyrene	ND	0.005	0.003	ug/L	
1-Methylnaphthalene	ND	0.005	0.004	ug/L	
2-Methylnaphthalene	ND	0.005	0.004	ug/L	
1-Methylphenanthrene	ND	0.005	0.004	ug/L	
Naphthalene	ND	0.005	0.004	ug/L	
Perylene	ND	0.005	0.004	ug/L	
Phenanthrene	ND	0.005	0.004	ug/L	
Pyrene	ND	0.005	0.005	ug/L	
2,3,5-Trimethylnaphthalene	ND	0.005	0.004	ug/L	
2-Fluorobiphenyl (SS)	40	10-100		%	
Nitrobenzene-d5 (SS)	37	27-109		%	
Terphenyl-d14 (SS)	66	35-153		%	

LABORATORY CONTROL SAMPLE: 450234

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Acenaphthene	ug/L	0.1	0.0471	47	47-145	
Acenaphthylene	ug/L	0.1	0.0473	47	33-145	
Anthracene	ug/L	0.1	0.0526	53	27-133	
Benzo(a)anthracene	ug/L	0.1	0.065	65	33-143	
Benzo(a)pyrene	ug/L	0.1	0.0536	54	17-163	
Benzo(b)fluoranthene	ug/L	0.1	0.0743	74	24-159	
Benzo(e)pyrene	ug/L	0.1	0.073	73	45-90	
Benzo(g,h,i)perylene	ug/L	0.1	0.0727	73	1-219	
Benzo(k)fluoranthene	ug/L	0.1	0.0654	65	11-162	
Chrysene	ug/L	0.1	0.0622	62	17-168	
Dibenzo(a,h)anthracene	ug/L	0.1	0.0817	82	1-227	

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QUALITY CONTROL DATA

Lab Order: M050289

Project ID: PER TYPE 1-050412

Analysis Description:	Semivolatile Organic Analysis	**QC Batch:**	SPR/5260
Analysis Method:	EPA 625 Low Level	**QC Batch Method:**	EPA 625 Low Level

LABORATORY CONTROL SAMPLE: 450234

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
2,6-Dimethylnaphthalene	ug/L	0.1	0.0457	46	15-75	
Fluoranthene	ug/L	0.1	0.0656	66	26-137	
Fluorene	ug/L	0.1	0.0513	51	59-121	4
Indeno(1,2,3-cd)pyrene	ug/L	0.1	0.0732	73	1-171	
1-Methylnaphthalene	ug/L	0.1	0.0442	44	15-85	
1-Methylphenanthrene	ug/L	0.1	0.0644	64	20-100	
Naphthalene	ug/L	0.1	0.04	42	21-133	
Perylene	ug/L	0.1	0.048	48	30-75	
Phenanthrene	ug/L	0.1	0.0624	62	54-120	
Pyrene	ug/L	0.1	0.0628	63	52-115	
2,3,5-Trimethylnaphthalene	ug/L	0.1	0.0496	50	20-85	
2-Fluorobiphenyl (SS)	%			49	10-100	
Nitrobenzene-d5 (SS)	%			50	27-109	
Terphenyl-d14 (SS)	%			71	35-153	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 450341 450342

Parameter	Units	M050195002 Result	Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
Acenaphthene	ug/L	0	0.106	0.0302	0.0448	28	43	47-145	39	30	5
Acenaphthylene	ug/L	0	0.106	0.0305	0.0454	29	43	33-145	39	30	5
Anthracene	ug/L	0	0.106	0.0482	0.0531	45	50	27-133	9.7	30	
Benzo(a)anthracene	ug/L	0	0.106	0.0664	0.0752	62	71	33-143	12	30	
Benzo(a)pyrene	ug/L	0	0.106	0.0523	0.0556	49	53	17-163	6.1	30	
Benzo(b)fluoranthene	ug/L	0	0.106	0.0629	0.0665	59	63	24-159	5.6	30	
Benzo(e)pyrene	ug/L	0	0.106	0.0607	0.0621	57	59	45-90	2.3	30	
Benzo(g,h,i)perylene	ug/L	0	0.106	0.0175	0.0203	16	19	1-219	15	30	
Benzo(k)fluoranthene	ug/L	0	0.106	0.0577	0.058	54	55	11-162	0.5	30	
Chrysene	ug/L	0	0.106	0.0566	0.0609	53	58	17-168	7.3	30	
Dibenzo(a,h)anthracene	ug/L	0	0.106	0.0189	0.0208	18	20	1-227	9.6	30	
2,6-Dimethylnaphthalene	ug/L	0	0.106	0.027	0.0441	25	42	15-75	48	30	7
Fluoranthene	ug/L	0	0.106	0.0636	0.0709	60	67	26-137	11	30	
Fluorene	ug/L	0	0.106	0.0395	0.0503	37	48	59-121	24	30	6
Indeno(1,2,3-cd)pyrene	ug/L	0	0.106	0.011	0.0219	10	21	1-171	66	30	7
1-Methylnaphthalene	ug/L	0	0.106	0.0209	0.0383	20	36	15-85	59	30	7
1-Methylphenanthrene	ug/L	0	0.106	0.062	0.0658	58	63	20-100	5.9	30	
Naphthalene	ug/L	0	0.1	0.01	0.03	14	32	21-133	77	30	5
Perylene	ug/L	0	0.106	0.0498	0.0517	47	49	30-75	3.7	30	
Phenanthrene	ug/L	0	0.106	0.0548	0.062	52	59	54-120	12	30	

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QUALITY CONTROL DATA

Lab Order: M050289

Project ID: PER TYPE 1-050412

Analysis Description: Semivolatile Organic Analysis **QC Batch:** SPR/5260

Analysis Method: EPA 625 Low Level **QC Batch Method:** EPA 625 Low Level

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 450341 450342

Parameter	Units	M050195002 Result	Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
Pyrene	ug/L	0	0.106	0.0605	0.0683	57	65	52-115	12	30	
2,3,5-Trimethylnaphthalene	ug/L	0	0.106	0.0377	0.0505	35	48	20-85	29	30	
2-Fluorobiphenyl (SS)	%					24	42	10-100	54		
Nitrobenzene-d5 (SS)	%					13	33	27-109	86		8
Terphenyl-d14 (SS)	%					71	71	35-153	0.8		

Analysis Description: Total Organic Carbon Analysis **QC Batch:** WET/6564

Analysis Method: SM20-5310 B **QC Batch Method:** SM20-5310 B

METHOD BLANK: 452135

Parameter	Blank Result	Reporting Limit	MDL	Units	Qualifiers
Total Organic Carbon	ND	0.5	0.3	mg/L	

LABORATORY CONTROL SAMPLE: 452136

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Total Organic Carbon	mg/L	10	11	107	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 452151 452152

Parameter	Units	M050411001 Result	Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
Total Organic Carbon	mg/L	10	10	22	22	116	117	80-120	0.9	20	

Analysis Description: Anions by Ion Chromatography **QC Batch:** WIC/3598

Analysis Method: EPA 300.0 **QC Batch Method:** EPA 300.0

METHOD BLANK: 450381

Parameter	Blank Result	Reporting Limit	MDL	Units	Qualifiers
Nitrogen, Nitrate (as N)	ND	0.1	0.01	mg/L	
Chloride	ND	1	0.01	mg/L	

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QUALITY CONTROL DATA

Lab Order: M050289

Project ID: PER TYPE 1-050412

Analysis Description:	Anions by Ion Chromatography	**QC Batch:**	WIC/3598
Analysis Method:	EPA 300.0	**QC Batch Method:**	EPA 300.0

Parameter	Blank Result	Reporting Limit	MDL	Units	Qualifiers
Sulfate (as SO4)	ND	0.5	0.01	mg/L	
Fluoride	ND	0.1	0.01	mg/L	

LABORATORY CONTROL SAMPLE: 450382

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Nitrogen, Nitrate (as N)	mg/L	4	3.7	93	90-110	
Chloride	mg/L	8	7.7	96	90-110	
Sulfate (as SO4)	mg/L	10	9.2	92	90-110	
Fluoride	mg/L	2	2	102	90-110	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 450383 450384

Parameter	Units	M050259001 Result	Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
Nitrogen, Nitrate (as N)	mg/L	0.049	5	4.6	4.8	92	95	80-120	3.3	20	
Chloride	mg/L	160	8	170	170	RNC	RNC	80-120	0.3	20	9
Sulfate (as SO4)	mg/L	66	16	110	110	RNC	RNC	80-120	0.3	20	9
Fluoride	mg/L			2.2	2.2				1.4	20	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 450387 450388

Parameter	Units	M050272001 Result	Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
Nitrogen, Nitrate (as N)	mg/L	0.046	5	4.8	4.9	96	96	80-120	0.4	20	
Chloride	mg/L	7.3	8	16	16	109	110	80-120	0.6	20	
Sulfate (as SO4)	mg/L	9.2	16	26	26	102	102	80-120	0.2	20	
Fluoride	mg/L	0.11	2	2.2	2.2	104	104	80-120	0.4	20	

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QUALITY CONTROL DATA QUALIFIERS

Lab Order: M050289

Project ID: PER TYPE 1-050412

QUALITY CONTROL PARAMETER QUALIFIERS

Results Qualifiers: Report fields may contain codes and non-numeric data correlating to one or more of the following definitions:

NS - means not spiked and will not have recoveries reported for Analyte Spike Amounts

QC Codes Keys: These descriptors are used to help identify the specific QC samples and clarify the report.

MB - Method Blank

Method Blanks are reported to the same Method Detection Limits (MDLs) or Reporting Limits (RLs) as the analytical samples in the corresponding QC batch.

LCS/LCSD - Laboratory Control Spike / Laboratory Control Spike Duplicate

DUP - Duplicate of Original Sample Matrix

MS/MSD - Matrix Spike / Matrix Spike Duplicate

RPD - Relative Percent Difference

%Recovery - Spike Recovery stated as a percentage

3	Surrogate recoveries were not within QC Acceptance Criteria.
4	This compound does not meet EPA 625 method Table 6/7 criteria as the spike recovery was low. Any sample result reported for this compound should be considered estimated and may not be reportable for regulatory purposes.
5	Matrix spike recovery(ies) and RPD outside control limit. Sample result accepted based on LCS and Method Blank.
6	Matrix Spike recovery(ies) outside control limits: LCS(LCSD) recoveries and RPD are in control. Possible Matrix interference in QC sample.
7	MS/MSD RPD above control limits. LCS and MS/MSD recoveries are in control.
8	Due to matrix interferences present in the sample, surrogate recoveries failed to meet the QA/QC acceptance criteria.
9	RNC = Recovery Not Calculated. Matrix Spike/Matrix Spike Duplicate (MS/MSD) recoveries were not calculated due to the high native concentration in the sample selected for MS/MSD versus the laboratory spike concentration.
10	High LCS Spike recovery failing Caltest acceptance criteria. Any sample results of 'ND' for analytes of interest should be considered valid.
11	Matrix Spike recovery(ies) outside control limits; RPD is in control. The sample results of 'ND' for this compound should be considered valid.

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QUALITY CONTROL DATA CROSS REFERENCE TABLE

Lab Order: M050289

Project ID: PER TYPE 1-050412

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
M050289001	**PER TYPE 1-050412**	EPA 200.2	MPR/10880	EPA 200.7	MIC/3847
M050289001	**PER TYPE 1-050412**	SW846 3510C	SPR/5257	SW846 8270 Mod (GCMS-NCI-SIM)	SMS/2671
M050289001	**PER TYPE 1-050412**	EPA 625 Low Level	SPR/5260	EPA 625 Low Level	SMS/2677
M050289001	**PER TYPE 1-050412**	EPA 608	SPR/5264	EPA 608	SMS/2674
M050289001	**PER TYPE 1-050412**	EPA 614	SPR/5265	EPA 614	SMS/2676
M050289001	**PER TYPE 1-050412**	SM20-5310 B	WET/6564		
M050289001	**PER TYPE 1-050412**	EPA 300.0	WIC/3598		

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M050289

CHAIN OF CUSTODY RECORD

PACIFIC ECORISK
2250 Cordelia Rd
Fairfield, CA 94534
Ph: (707) 207-7760
Fax: (707) 207-7916
www.pacificecorisk.com

RESULTS TO: Stephen Clark (PER)
2250 Cordelia Rd
Fairfield, CA 94534
Attn:
Phone:
Email:

BILL TO: Same
Attn:
Phone:
Email:

PROJECT:

SAMPLE IDENTIFICATION	DATE	TIME	SAMPLE MATRIX	GRAB/ COMP.	# CONTAINERS/TYPE	ANALYSES REQUESTED: 608 and 8141 Pesticides (Mo)	Total Cations	IC Anions S, b-3 by Chromatography	625, PAHs & Extended Compounds	Pyreth roids NCW Water				REMARKS
PERTYPE1_050412	5/4/12	1130			6 1LAG	X			X	X				
PERTYPE1-050412	5/4/12	1130			1 500mL PE +HNO3		X							
PERTYPE1_050412	5/4/12	1130			1 500mL PE			X						
					/									
					/									
					/									
					/									
					/									

METHOD OF SHIPMENT: FedEx:_____ UPS:_____ HAND:_____ OTHER:_____

COMMENTS: 211594 - Type I water system Analyses
5 day TAT Rush by PER Todd

CODES:

RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)	DATE	TIME	PAGE #
	5/4/12	13:00		5/4/12	13:00	OF

WHITE - RETURN W/ SAMPLE YELLOW - KEEP FOR YOUR RECORDS

Revision #8
Effective Date: August 15, 2012
Accepted:_____

Chironomus dilutus

(Formerly Classified as *C. tentans*)

Acute (10-day) Survival & Growth Sediment Toxicity Test

Standard Operating Procedures

This SOP is based upon the U.S. EPA Test Method 100.2 Guidelines described in Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates, Second Edition (EPA/600/R-99/064). It is also in general accordance with ASTM Standard E1706-05 (2012), Test methods for measuring the toxicity of sediment-associated contaminants with freshwater invertebrates.

1.0 Introduction

This test is based on a 10-day static-renewal exposure of 2nd and 3rd ***Chironomus dilutus*** to sediments. The test endpoints are survival and growth (measured as ash-free dry weight [AFDW]).

2.0 Test preparation

2.1 Equipment and Supplies Needed

1. Sample containers may be necessary for the client's collection of sediment. Containers must be pre-cleaned consistent with EPA guidelines. A minimum volume of 2-L of sediment is necessary (4-L is preferred) to provide sediment for the bioassay and particularly if sediment porewater characterization is part of the study plan. Additional volume will be necessary for further characterization of sediment (e.g., grain size characteristics, total organic carbon, contaminant concentrations).
2. Stainless steel bowls and spatulas or spoons, to homogenize sediments prior to placement in replicate containers.
3. Test chambers, consisting of 300-mL tall-form glass beakers, modified as follows:
    a. The flared lip of the beakers should be cut off, and the upper rim flame-polished. Orca Glassworks in Benicia provides this service. The prepared beakers must be appropriately cleaned before further use.
    b. Cut a 2.5 cm-wide band of 120-μm Nitex®, approximately 25 cm in length. Using aquarium-safe silicon sealant, attach the band of Nitex around the upper lip of the beaker, such that ~two-thirds of the width of the Nitex band is above the glass. Make sure to completely seal the Nitex such that there are no openings or seams into which the test organisms might become entrapped. Allow the silicon sealant to cure for a minimum of 24 hrs. The resulting test containers must be

appropriately cleaned and rinsed, and then pre-soaked for 48 hrs in Type I lab water [reverse-osmosis, de-ionized (RO/DI) water], before use in testing.

4. Modified Zumwalt-type water delivery system, consisting of a lower plastic tub to hold replicate containers in position, and an upper plastic tub, plumbed with 60 mL syringes and attached stopcocks for delivery of water to replicate containers.
5. Standard Artificial Medium (SAM-5S), consisting of synthetic freshwater (SAM-5S), prepared as per Borgman 1996 guidelines:
    a. Transfer ~75 L of Type I water into an appropriately-cleaned 120-L HDPE tank.
    b. Add 14.7 g of $CaCl_2 \bullet 2H_2O$ to a 2-L aliquot of Type I water and mix on magnetic stir plate for 30 min or until the salts completely dissolve.
    c. Add 6.2 g of $MgSO_4$, 8.4 g of $NaHCO_3$, 0.37 g of KCl, and 0.10 g of NaBr to a second 2-L aliquot of Type I water, and mix on a magnetic stir plate for 30 min or until the salts completely dissolve.
    d. While vigorously stirring, pour each of the 2-L aliquots of salt solutions into the 75-L of Type I water, and fill to a total volume of 100-L with Type I water.
    e. Vigorously aerate the water for at least 24 hrs prior to use.
    f. The water quality should be:
        i. Hardness, 135-155 mg/L as $CaCO_3$
        ii. Alkalinity, 45-55 mg/L as $CaCO_3$
        iii. Conductivity, 425-525 μS/cm
        iv. pH, 8.0-8.2
6. Water quality (pH, DO, and conductivity/salinity) meters, calibrated and used as per the appropriate SOPs.
7. Type I lab water, for rinsing of probes, etc.
8. Wash bottles, for rinsing of probes, etc.
9. Glass or electronic thermometer, calibrated and used to measure temperature.
10. Disposable plastic Pasteur pipets, for the collection and transfer of test organisms.
11. Fine-tip forceps, for use in collecting individual organisms from culture material at test termination.
12. Glass dishes, for the sorting and collection of test organisms at test initiation and at test termination.
13. Light boxes, for the sorting and collection of test organisms at test initiation and at test termination.
14. Aeration system, in case needed to aerate should D.O. drops below acceptable levels.
15. Test Food, consisting of TetraMin® flake fish food:
    a. Ground TetraMin® is fed to provide 6.0 mg of dry solids daily per test chamber

16. Sieves, #25 (700 μm), #40 (425 μm), and #50 (300 μm), for collection of organisms at test termination.
17. Aluminum foil weighing pans, for drying and weighing of test organisms at end of test. Pans must be dried in muffle furnace prior to taring.
18. Drying oven, at 60˚C to 90˚C for drying test organisms at test termination.
19. Desiccators, for holding dried organisms.
20. Balance, capable of weighing to 0.01 mg. Calibrate and use as per the appropriate SOP.
21. Reference weights, for calibration of balance.
22. Muffle furnace, at 550˚C, for ashing of dried organisms.

2.2 Ordering and Holding of Test Organisms

2.2.1 Ordering and Holding of Test Organisms from Commercial Supplier

1. Test organisms should be ordered far enough in advance so as to ensure arrival of 2nd and 3rd instar animals 24 hrs prior to Day 0; third instar organisms are generally 8-12 days old. Approximately 25% more animals should be ordered than are actually needed for the test, so as to allow for some attrition of organisms that are stressed from the shipping, etc.
2. Order organisms from:
    a. Environmental Consulting and Testing - (800) 377-3657
    b. Aquatic Research Organisms - (800) 927-1650
3. Upon receipt, the test organism culture should be transferred into 4-L HDPE tanks containing test water at 23˚C; the culture should be gently aerated, and should be fed ground flake fish food (TetraMin). For additional instruction on the receipt and handling of the test organisms, see the "Test Organism Receipt and Handling S.O.P."

2.2.2 Organisms from In-Lab Culture

Test organisms can be raised from eggs (obtained from in-lab cultures, or from commercial suppliers), as per the *'C. dilutus* Culture SOP'. Egg cases are incubated in test water at 23˚C until hatching begins, as evidenced by apparent disintegration of the egg case coil. Larvae are also incubated in gently aerated test water and provided ground flake fish food for use as food and tube-building substrate. Typical growth and development at 23˚C should result in organisms at the second to third instar stage about 8-12 days after hatching.

2.2.3 Organism Health

Test organisms must appear healthy, behave normally, feed well, and have low mortality in the cultures during holding. There should be <20% mortality in the cultures 48 hrs prior to test initiation.

2.3 Collection and Holding of Sediment Samples

Grab or composite samples should be collected into appropriately-cleaned glass or plastic container(s), and immediately placed on ice (or "blue ice" type product) to bring the temperature to 0-6°C. The sample should be shipped or transported to the testing laboratory ASAP. Upon receipt of the sample(s) in the laboratory, each sample should be logged in, and then placed in the sample refrigerator at 4°C. For instruction on the log-in of incoming samples, see the "**Test Sample(s) Log-In Procedures**". The test sample(s) used to start the test should be <14 days old, although samples <8 weeks old can be used. For each sample tested, a minimum of 2 L volume (4 L is preferred) of debris-free sediment will be needed for the sediment testing. Chemistry analyses will require additional sample.

3.0 TEST INITIATION

Before test initiation begins, be aware of any client-specific testing requirements and read the attached "**Summary of Test Conditions for *Chironomus dilutus* (formerly *C. tentans*)**."

3.1 On the Day Before Test Initiation (Day –1):

1. Remove the test replicate containers from soaking in the tank of Type I water and shake excess water off. Each test treatment, including each Control, will require 8 test chambers. Label the test containers with their treatment and replicate ID code (replicates "A" through "H") using an indelible black ink (Sharpie®) pen.
2. Remove the sediment from the sample storage refrigerator and allow thermal equilibration to room temperature. Using a stainless steel spoon and bowl, re-homogenize the sediment along with any overlying water that has developed.
3. For each sediment sample, use a stainless steel spoon or spatula to transfer approximately 100 mL of homogenized sediment into each of the 8 replicates, carefully "tamping" down the sediments. Carefully pour approximately 175 mL of control water into each beaker, taking care to minimize disturbance of the sediment.
4. Place the test replicates into the water bath or controlled temperature room, with the temperature set at 23°C, under cool-white fluorescent lighting on a 16L:8D photoperiod.

3.2 Pre-Test Sediment Porewater Characterization, if required (Day –1, or before):

1. Place approximately 500 mL of each homogenized sediment into a 750-mL centrifuge bottle, and centrifuge at 2500 g for 30 min.
2. Decant supernatant (= sediment porewater), and measure routine water quality characteristics of the porewater (pH, DO, conductivity, and total ammonia). Record the water quality data into the appropriate test data sheet.

3.3 Immediately Prior to Test Initiation (Day 0):

1. Renewal of the overlying water using the Zumwalt water delivery system is implemented immediately prior to the introduction of the test organisms into the test replicates. Using

the Zumwalt water delivery system, renew the overlying water in each of the replicate containers with 1 replicate volume of water as described below:

To renew the overlying water, place the test chambers in the lower plastic tub to hold them in place. Place the tub with the test chambers directly under the syringes connected to the upper splitting chamber of the Zumwalt water delivery system and fill each syringe with SAM-5S water. Adjust the stopcocks so as to minimize any disturbance of the flow on the sediment. After the syringe has emptied, repeat twice with additional syringe volumes of water (for a total of 3 syringe volumes).

2. After the water is renewed, use a disposable 25 mL pipet to collect test water from 1-2 cm above the sediment for each replicate, compositing the replicate water samples for each test treatment to provide a total volume of ~200 mL. The pipet must be inspected to ensure no organisms were removed during sampling. Bring the volume of overlying water in each test chamber back to the appropriate level with fresh test water.
3. Measure the initial water quality conditions (temperature, pH, D.O., conductivity, hardness, alkalinity, and total ammonia). From the composite, collect sub-samples for analysis of alkalinity, hardness, and ammonia, which are recorded in their respective logbooks. Then measure routine water quality parameters (pH, D.O., and conductivity) in the remaining composited water. Record the water quality data onto the Sediment Toxicity Test Water Quality Data Sheet.
4. If the D.O. levels fall below 2.5 mg/L, implement gentle aeration at about 1 bubble/second in the overlying water of each test replicate.
5. Isolation and collection of individual test organisms:
    a. Immediately prior to test initiation, transfer a small portion of test organism culture and test water into a shallow glass dish placed on top of light box.
    b. Using plastic pipette, gently agitate the culture material. This disturbance will cause the larval chironomids to emerge from their tubes, facilitating their capture.

3.4 Initiate the Test (Day 0):

1. Gently draw individual 2nd and 3rd instar larvae into the pipette and transfer organisms into a small transfer dish (e.g., plastic weigh boats) containing small aliquot of test water (make sure that organisms are transferred below the water surface), continuing this process until there are 10 organisms in the transfer dish. At least 50% of the organisms must be at the 3rd instar stage. Upon confirming the organisms' life stage and that they are all of good quality (active organisms with 'plump' segments and bright red pigmentation), the organisms within a dish can be poured into a test replicate, again making sure that organisms are below the water surface. Note – this process must take place quickly, as extended period in the transfer dish will stress the organisms.

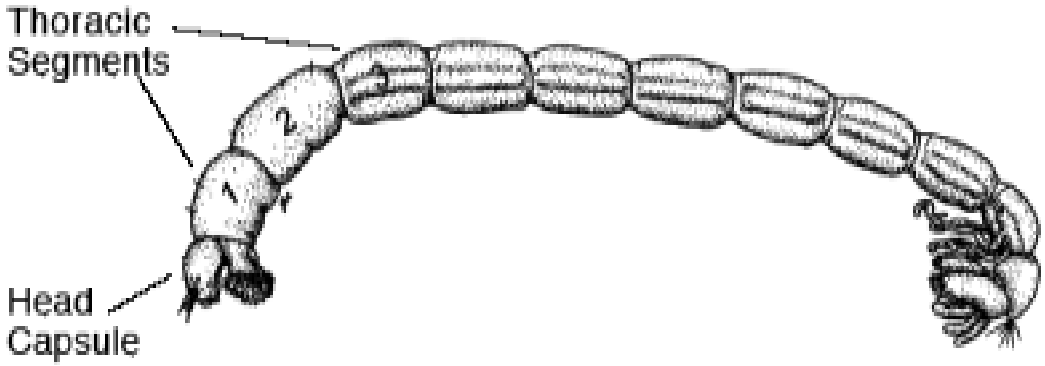

Figure 10.2. *Chironomus tentans* larvae. Note thoracic segments which are used to measure instars. (Reprinted from Clifford, 1991 with kind permission from the University of Alberta Press.)

2. Load test replicates following a randomized block approach. Load all "A" replicate containers first, with the order of test treatments being randomized. Repeat process for the "B" replicates, with the order of test treatments being re-randomized. Continue until all test replicates are loaded.
3. Immediately re-examine the replicates, replacing any dead or injured animals. Due to surface tension, some organisms may be "trapped" on the water surface. Examine each replicate to ensure that all test organisms are below the water surface. Using a plastic pipette, organisms that are at the water surface should be moved into the water by gently squirting the organisms with test water.
4. Following a randomization template, randomly place the replicate containers into the temperature-controlled water bath or test room at 23°C, under cool-white fluorescent lighting on a 16L:8D photoperiod.
5. Feed each replicate ground TetraMin® so as to provide 6.0 mg of dry solids daily per test chamber.
6. For an assessment of growth, at t=0, a minimum of 80 organisms should be dried as described below in Section 5, Steps 9-12. If length measurements are required, 20 chironomids should be archived in sugar formalin (as per EPA guidelines).

4.0 TEST MAINTENANCE (DAYS 1-9)

AM:

a. Examine each replicate container. Any dead organisms should be removed via pipette, and the number of mortalities recorded onto the test data sheet. Similarly, any observed pupae, pupal exuvia, and/or emerged adults should also be removed, and similarly recorded onto test data sheet.

b. Measure the temperature in the test water from one randomly-selected replicate for each treatment and record data onto test datasheet.

c. Using a disposable 25 mL pipet, collect "old" test water from 1-2 cm above the sediment for a test replicate chamber. The pipet must be inspected to ensure no organisms were removed during sampling. Measure the "old" pH and DO and record data onto the test data sheet. If the D.O. levels fall below 2.5 mg/L, implement gentle aeration of each test replicate.

d. Renew the overlying water using the Zumwalt water delivery system to deliver 1 replicate water volume to each replicate container as described above in Section 3.3, Step 1.

e. Using a disposable 25 mL pipet, collect "new" test water from 1-2 cm above the sediment for a test replicate chamber. The pipet must be inspected to ensure no organisms were removed during sampling. Measure the "new" pH and D.O. and record data onto the test data sheet.

f. Return the test replicates to the water bath or test room and record your initials in the "AM" maintenance check box on the data sheet.

PM:

a. Examine each replicate container. Any dead organisms should be removed via pipette, and the number of mortalities recorded onto the test data sheet.

b. Renew the overlying water using the Zumwalt water delivery system to deliver 1 replicate water volumes to each replicate container as described above in Section 3.3, Step 1.

c. Return the test replicates to the test waterbath or constant temperature room, and feed each replicate ground TetraMin® so as to provide 6.0 mg of dry solids daily per test chamber.

d. Record your initials in the "PM" maintenance check box on the data sheet.

5.0 TEST TERMINANTION

Survival, mean dry weight and ash-free dry weight (AFDW) are assessed at Day 10. Remove the replicates for one treatment at a time and process as follows:

1. Measure the temperature in the test water in one randomly-selected replicate for each treatment and record data onto test data sheet.
2. Collect ~25 mL of test water from 1-2 cm above the sediment in each test replicate using a disposable 25-mL glass pipette; composite the replicate water samples for each test treatment to provide a total volume of ~200 mL.

3. From the composite, collect sub-samples for analysis of alkalinity, hardness, and total ammonia, which are recorded in their respective logbooks. Then measure routine water quality parameters (pH, D.O., and conductivity) in the remaining composited water. Record the final water quality data onto the Sediment Toxicity Test Water Quality Data Sheet.
4. Working one replicate at a time, examine each replicate, noting and recording the number of any larvae, pupae, adults and/or pupal exuvia, and record this data onto the test weight data sheet.
5. Label weight boats with the corresponding sediment test treatment and replicate identification for each test replicate and fill the weigh boats with a small volume of clean test water.
6. Using a pipette or a squirt bottle containing clean test water, vigorously squirt water onto the top of the sediment so as to disturb the surficial layer – this will often result in the emergence of many of the *Chironomus*, facilitating their collection. Using a pipette and/or forceps, collect and transfer any emerging larvae into a weigh boat. Using a squirt bottle, rinse the organisms with fresh 'test' water to remove any sediment or other clinging material. Using the forceps, transfer the individual larvae into a pre-labeled, -dried (via muffle furnace), and –weighed aluminum foil drying pan.
7. Carefully wash the sediment from the same replicate container through a #40 stainless steel sieve, washing the retained materials into a large glass tray. Using a pipette and/or forceps, collect and transfer any emerging larvae into the appropriately labeled weigh boat. Using a squirt bottle, rinse the organisms with clean test water to remove any sediment or other clinging material. Using the forceps, transfer the individual larvae into the same pre-labeled, -dried, and –weighed aluminum foil drying pan that was used for the organisms collected from that same replicate in the earlier Step 6, above.
8. Repeat Step 7 until no additional organisms have been found after three sediment washes. If there is any question as to whether or not all of the organisms have been accounted for, sieve the remaining sediment sequentially with #25, #40, and #50 sieves.
9. Record the total number of live larvae collected from that replicate onto the test weight data sheet.
10. Repeat steps 4 through 9 for each test replicate.
11. When all of the replicate organisms have been transferred into their respective drying pans, place the pans into the drying oven, and dry at 105˚C for a minimum of 48 hrs.
12. After drying, place the aluminum pans into the desiccator and seal. Allow to cool at least 4 hrs, after which each pan must be weighed and the weight data recorded onto the test weight data sheet.
13. Place the pans of dried organisms into the muffle furnace at 550˚C for 2 hrs to obtain the dry-ash weights.

14. After drying, place the aluminum pans into the desiccator and seal. Allow to cool at least 4 hrs, after which each pan must be weighed and the weight data recorded onto the test weight data sheet.

6.0 DATA ANALYSIS

1. For each sediment, sum up the total number of live organisms that were counted at test termination (number of live larvae, live pupae, and number of emerged adults [as evidenced by the number of exuvia]) and record total number of live organisms at test termination onto the toxicity test data sheet.
2. On the test weight data sheet, subtract the weight recorded for the 'pans + dried animals' minus the empty 'tare' pan weight = the pooled dry weight of the organisms for that replicate. Divide this number by the number of organisms in the replicate to obtain the mean dry weight for individual organisms in that replicate.
3. On the test weight data sheet, subtract the weight recorded for the 'pans + dry-ashed animals' minus the previous 'pans + dried animals' weight = the pooled ash-free dry weight of the organisms for that replicate. Divide this number by the number of organisms in the replicate to obtain the mean ash-free dry weight (AFDW) for individual organisms in that replicate.
4. Using the CETIS® statistical software, input the survival and relevant weight data for the Control treatment and for a given test sediment into a linked-file specific for that test sediment.
5. Analyze the test data, as per the EPA guidelines statistical flowchart procedures, comparing the test responses of the test sediment against the Control treatment to determine whether the test sediment exposure resulted in statistically significant reductions in survival or growth (as AFDW) of the larval chironomids.

7.0 TEST ACCEPTABILITY CRITERIA

1. Tests must be started with 2nd to 3rd instar larvae (about 10-d-old larvae), and at least 50% of the organisms must be 3rd instar.
2. The mean percentage survival of *C. dilutus* in the control sediment must be greater than or equal to 70% at the end of the test.
3. The mean size (measured as weight) of *C. dilutus* in the control sediment must be at least 0.48 mg AFDW at the end of the test.
4. Hardness, alkalinity, and ammonia in the overlying water typically should not vary by more than 50% during the test, and D.O. should be maintained above 2.5 mg/L in the overlying water.

8.0 QUALITY CONTROL

1. To ensure that the organisms being used in the test are responding to test conditions in a "typical" manner, a lab reference or "Control" sediment of known quality is run side-by-side with the test sediment. In the absence of a reference site sediment, the lab "Control" sediment is used for comparison purposes.
2. Additional Control sediments may be tested (i.e., silica quartz sand), as appropriate to the study.
3. Reference sediment test set-up, maintenance, and termination are identical to those described above.
4. All measured water quality should be within the limits established by the EPA guidelines; any deviations must be noted in lab notebook and explained.
5. All equipment is calibrated and operated as described in each applicable equipment SOP.
6. All staff working independently on any test shall have previously demonstrated familiarity and competency with the test, analytical equipment used, and the corresponding SOPs.
7. A reference toxicant test can be performed, at the client's discretion, to validate the response of the test organisms.

9.0 TEST INTERFERENCES

Characteristics of a sediment, aside from sediment-associated chemical constituents of concern, that can potentially affect test organism survival and growth should be assessed prior to preparing data submittals to the client. Interferences for this test generally fall into the categories of contaminant and non-contaminant factors.

9.1 Contaminant Interferences

1. All efforts should be made to avoid contaminating any component of the test system or sediments used in testing so as to avoid both false positives and false negatives. Standard "clean techniques" should be used in the lab at all times.
2. Measurable concentrations of ammonia are common in the pore water of many sediments and have been found to be a common cause of toxicity in pore water. Total ammonia results should be generated to determine if the concentration exceeds the reported tolerance limit for this test species.

9.2 Non-contaminant Interferences

1. Natural geomorphological and physico-chemical characteristics, such as sediment texture, may influence the response of test organisms. A control sediment that includes characteristics (e.g., grain size, organic carbon) that are within the tolerance range of the

test organism should be included in the study design. This may best be accomplished by using a formulated sediment.

2. Morphologically similar indigenous organisms in a sediment sample may be confused with the test species during test termination, and result in overestimates in survival. In addition, indigenous organisms may also compete for food or prey with the test species. Should indigenous organisms be observed during test termination, the scientist should immediately notify the Project Manager, as it may be necessary to identify the indigenous organism, and determine the number or biomass in order to better interpret the growth data.

10.0 SAFETY

The 10-day *Chironomus dilutus* survival and growth toxicity test poses little risk to those performing it. Sediments can contain pathogenic organisms and appropriate precautions should be observed when handling this material. After the test is complete, the sediments should be disposed of in an appropriate fashion.

11.0 REPORTING

1. Following the completion of the statistical analyses and the QC review of the statistical analyses, the PER Project Lead is to summarize the results for an email submittal to the PER Project Manager for review. Following this review, either the Project Lead or Project Manager will submit the email summary to the client.
2. The Project Lead will generate a draft report and submit it to the Project Manager for review. The Project Manager reviews the draft report, makes any necessary revisions, and then submits a final report to administrative staff for preparation of the proper number of project-specific hard copies and electronic copies for posting to the client.
3. As per project-specific guidelines, any necessary electronic data deliverables will be generated under guidance by the Project Lead, and will be reviewed for accuracy by properly trained scientists.

12.0 REFERENCES

American Society for Testing and Materials (ASTM). 2012. Standard test method for measuring 1633 the toxicity of sediment-associated contaminants with freshwater invertebrates (ASTM 1634 E1706-05 (Reapproved 2010)). Annual Book of ASTM Standards Volume 11.06, West Conshohocken, PA.

Borgmann, U. 1996. Systematic analysis of aqueous ion requirements of *Hyalella azteca*: A standard artificial medium including the essential bromide ion. *Arch. Environ. Contam. Toxicol.* 30:356-363.

USEPA. 2000. Method for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates, Second Edition. EPA-600/R-99-064, Duluth, MN

Summary of Test Conditions and Test Acceptability Criteria for Conducting the 10-Day ***Chironomus dilutus*** Survival and Growth Sediment Toxicity Test (Test Method 100.2)	
1. Test type	Whole-sediment toxicity test with renewal of overlying water
2. Test duration	10 days
3. Temperature	23 ± 1°C
4. Light quality	Wide-spectrum fluorescent lights
5. Light intensity	About 100 to 1000 lux
6. Photoperiod	16L:8D
7. Test chamber size	300-mL high-form lipless beaker
8. Test sediment volume	100 mL
9. Overlying water	SAM-5S reconstituted water
10. Overlying water volume	175 mL
11. Overlying water quality	Temperature and D.O. daily. Hardness, alkalinity, conductivity, pH, and ammonia at beginning and end of test.
12. Overlying water renewal	2 volume additions/day via one volume addition twice per day
13. Age of test organisms	2nd- to 3rd-instar larvae (about 10-d-old larvae; all organisms must be third instar or younger with at least 50% of the organisms at 3rd instar)
14. Noumber of organisms per test chamber	10
15. Number of replicates per concentration	8, but depends on the objective of the test
16. Feeding regime	Ground TetraMin® so as to provide 6.0 mg of dry solids daily per test chamber
17. Test chamber cleaning	If screens become clogged during the test, gently brush the *outside* of the screen to remove material
18. Test solution aeration	None, unless DO in overlying water drops below 2.5 mg/L
19. Endpoints	Survival and growth (ash-free dry weight, AFDW)
20. Sample and sample holding requirements	Grab or composite samples should be stored at 0-6°C
21. Sample volume required	2 Liter (minimum), 4 L preferred
22. Test acceptability criteria	Minimum mean control survival must be 70%, with minimum mean weight/ surviving control organism of 0.48 mg AFDW

Supplemental SOP Language

Definitions:

ACS:	American Chemical Society
ASAP :	As soon as possible
ASTM :	American Society for Testing Materials
°C :	degrees Celsius
dH_2O :	distilled water
D.O.:	dissolved oxygen
ECx:	Effective concentration in X% of the population.
hrs :	hours
ICx:	Inhibitory concentration in X% of the population.
LCx:	Lethal concentration in X% of the population.
LOEC:	Lowest Observed Effect Concentration
mg :	milligram
mg/L :	milligram per liter
mL :	milliliter
NOEC:	No Observed Effect Concentration
NPDES :	National Pollutant Discharge Elimination System
S.O.P.:	Standard Operation Procedure
TIE:	Toxicity Identification Evaluation
U.S. EPA :	United States Environmental Protection Agency

Interferences:

In an effort to eliminate interferences, SOPs have been established for every procedure involved in conducting a successful bioassay test. Additionally, a rigorous daily QA/QC inspection is designed to identify potential sources of interference. Prior to the initiation of toxicity tests every effort is made to identify and eliminate potential sources of interference that could compromise test results. These can include but are not limited to the following: clean and functional facilities, equipment and test chambers; sample storage and handling; test organism and food quality; laboratory water quality.

Pollution Prevention

As a pollution prevention measure, wastes generates during toxicity testing must be properly handled and disposed of in an appropriate manner. Care should be taken not to generate excessive wastes when preparing solutions for testing. All materials identified as hazardous should be labeled and appropriately stored for hazardous waste disposal.

Data Assessment

Bioassay and water quality data are assessed each day during the course of testing for accuracy and compliance with established criteria. At test termination, the data for each replicate, which

are recorded on the appropriate data sheets, are entered into a CETIS™ data file labeled for identification of the specific test. Statistical analyses are performed in accordance with EPA guidelines for statistical analysis. Control data for all endpoints are evaluated for compliance with established test acceptability criteria. Water Quality data are assessed for compliance with specifications outlined in the appropriate USEPA testing manuals.

Corrective Actions and Contingencies for Out-of-Control Data

If control performance is not met, a project manager should be notified immediately and, upon approval, the test is to be repeated. The potential cause(s) of poor control performance will be documented by scientific staff and evaluated and assessed by a project manager. Corrective actions will be determined on a case-by-case basis. The results of all tests will be summarized in reports for the regulatory authorities with an explanation of the results.

Revision #3
Effective Date: August 15, 2012
Accepted:_____

Hyalella azteca
28-Day Survival & Growth Sediment Toxicity Test
Standard Operating Procedures

This SOP is based upon a modification of the EPA Method 100.4 guidelines described in Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates, Second Edition (EPA/600/R-99/064). It is also in general accordance with ASTM Standard E1706-05, Test methods for measuring the toxicity of sediment-associated contaminants with freshwater invertebrates.

1.0 INTRODUCTION

This test is based on a 28-day static-renewal exposure of 7-8 day old ***Hyalella azteca*** to sediments. The final test endpoints include survival and growth. This method follows the guidelines for the 28-day sediment exposure period of the 42-day test (EPA Method 100.4).

H. azteca are often important components of the benthos in freshwater ecosystems and have been used in sediment toxicity testing and have shown to be a sensitive indicator of contaminants associated with sediments. They have a wide tolerance of sediment grain size with acceptable survival in sediments ranging from >90% fines to 100% sand (Ingersoll and Nelson, 1990).

2.0 TEST PREPARATION

2.1 Equipment and Supplies Needed

1. Sample containers may be necessary for the client's collection of sediment. Containers must be pre-cleaned consistent with EPA guidelines. A minimum volume of 2-L of sediment is necessary (4-L is preferred) to provide sediment for the bioassay and for the accompanying sediment porewater characterization. Additional volume will be necessary for further characterization of sediment (e.g., grain size characteristics, total organic carbon, contaminant concentrations).
2. Stainless steel bowls and spatulas or spoons, to homogenize sediments prior to placement in replicate containers.
3. Test chambers, consisting of 300-mL tall-form glass beakers, modified as follows:
    a. The flared lip of the beakers should be cut off, and the upper rim flame-polished. Orca Glassworks in Benicia provides this service. The prepared beakers must be appropriately cleaned before further use.
    b. Cut a 2.5 cm-wide band of 120-μm Nitex®, approximately 25 cm in length. Using aquarium-safe silicon sealant, attach the band of Nitex around the upper lip of the

beaker, such that ~two-thirds of the width of the Nitex band is above the glass. Make sure to completely seal the Nitex such that there are no openings or seams into which the test organisms might become entrapped. Allow the silicon sealant to cure for a minimum of 24 hrs. The resulting test containers must be appropriately cleaned and rinsed, and then pre-soaked for 48 hrs in Type I lab water [reverse-osmosis, de-ionized (RO/DI) water] before use in testing

4. Modified Zumwalt-type water delivery system, consisting of a lower plastic tub to hold replicate containers in position, and an upper plastic tub, plumbed with 60 mL syringes and attached stopcocks for delivery of water to replicate containers.
5. Standard Artificial Medium (SAM-5S), consisting of synthetic freshwater (SAM-5S), prepared as per Borgman 1996:
    a. Transfer ~75 L of Type I water into an appropriately-cleaned 120-L HDPE tank.
    b. Add 14.7 g of $CaCl_2 \bullet 2H_2O$ to a 2-L aliquot of Type I water and mix on magnetic stir plate for 30 min or until the salts completely dissolve.
    c. Add 6.2 g of $MgSO_4$, 8.4 g of $NaHCO_3$, 0.37 g of KCl, and 0.10 g of NaBr to a second 2-L aliquot of Type I water, and mix on a magnetic stir plate for 30 min or until the salts completely dissolve.
    d. While vigorously stirring, pour each of the 2-L aliquots of salt solutions into the 75-L of Type I water, and fill to a total volume of 100-L with Type I water.
    e. Vigorously aerate the water for at least 24 hrs prior to use.
    f. The water quality should be:
        i. Hardness, 135-155 mg/L as $CaCO_3$
        ii. Alkalinity, 45-55 mg/L as $CaCO_3$
        iii. Conductivity, 425-525 μS/cm
        iv. pH, 8.0-8.2
6. Water quality (pH, D.O., and conductivity/salinity) meters, calibrated and used as per the appropriate SOPs.
7. Type I lab water, for rinsing of probes, etc.
8. Wash bottles, for rinsing of probes, etc.
9. Glass or electronic thermometer, calibrated and used to measure temperature.
10. Disposable plastic Pasteur pipettes, for the collection and transfer of test organisms, and collection of water quality subsamples.
11. Fine-tip forceps, for use in collecting individual organisms from culture material at test termination.
12. Glass dishes, for the sorting and collection of test organisms at test initiation and at test initiation.

13. Light boxes, for the sorting and collection of test organisms at test initiation and at test termination.
14. Aeration system, in cases where the chambers need to be aerated when the D.O. drops below acceptable levels.
15. Test Food.
    a. YCT (yeast, Cerophyl®, trout chow) is prepared according to Appendix B, EPA 600/R-99/064.
    b. YCT is amended with powdered *Spirulina*, sieved at 250 µm, at a rate of 90 mg per 100 mL YCT.
16. Sieves, #25 (701 μm), #40 (425 μm), and #50 (300 μm), for collection of organisms at test termination.
17. Aluminum foil weighing pans, for drying and weighing of organisms at end of test.
18. Drying oven, at 60˚C to 90˚C for drying organisms at test termination.
19. Desiccators, for holding dried organisms.
20. Balance, capable of weighing to 0.01 mg. Calibrate and use as per the appropriate SOP.
21. Reference weights, for calibration of balance.
22. Microscope and calibrated software for performing length measurements (if length is measured rather than mean dry weight).

2.2 Ordering and Holding of Test Organisms

2.2.1 Ordering and Holding of Test Organisms from a Commercial Supplier

1. Test organisms should be ordered far enough in advance so as to ensure the arrival of 6-7 day old organisms at least 24 hrs prior to Day 0 (so that organism will be 7-8 days old at test initiation). Approximately 25% more animals should be ordered than are actually needed for the test, so as to allow for some attrition of organisms that are stressed from the shipping, etc.
2. Order organisms from:
    a. Chesapeake Cultures - (803) 694-4046
    b. Aquatic Biosystems Inc. - (800) 331-5916
3. Upon receipt, the test organism culture should be transferred into 4-L HDPE tanks containing test water at 23˚C; the culture should be gently aerated, and should be fed *Spirulina*-amended YCT. If the test is to be run at salinity >2 ‰ (up to 15‰), cultures must be salinity adjusted. Place them in control water at the receiving salinity and immediately begin to adjust the holding salinity towards the test salinity. For additional instruction on the receipt and handling of the test organisms, see the "Test Organism Receipt and Handling S.O.P."

2.2.2 Organisms from In-Lab Culture

If the test organisms will be supplied from in-lab cultures, the organisms must be isolated from the in-lab culture 7-8 days before the test is to begin in order to have 7-8-day old organisms at the time of test initiation. Adults from each of the culture tanks should be collected and transferred to a #25 sieve resting in a collection bowls containing SAM-5S water. Add a few conditioned leaves to each of the sieves as well, and provide gentle aeration. Allow the culture to sit undisturbed overnight.

The following day, carefully remove the leaves, shaking to dislodge any clinging adults. Gently shake the top sieve and lift out of the neonate collection bowl assembly, carefully transferring the retained adults into a temporary holding container (make sure the transferred adults are not trapped at the water surface). The remaining water in the bottom bowl contains all of the neonates that were released overnight. These should be transferred into a new culture tank containing a few conditioned leaves. During this transfer, the neonates should be counted. There should be at least 125% of the number needed for the test. If not, repeat this process with the adults and collect a second day's batch of neonates, which will be combined with the first days. After enough neonates are collected, the adults can be returned to their culture tanks.

The collected neonates should be fed *Spirulina*-amended YCT. Change the water every 3 days, inspecting the animals to ensure adequate abundance, health and quality.

2.2.3 Organism Health

Test organisms must appear healthy, behave normally, feed well, and have low mortality in the cultures during holding. There should be <20% mortality in the cultures 48 hrs prior to test initiation.

2.3 Collection and Holding of Sediment Samples

Grab or composite samples should be collected into appropriately-cleaned glass or plastic container(s), and immediately be placed on ice (or "blue ice" type product) to bring the temperature to 0-6°C. The sample should be shipped or transported to the testing laboratory ASAP. Upon receipt of the sample(s) in the laboratory, each sample should be logged in, and then placed in the sample refrigerator at 4°C. For instruction on the log-in of incoming samples, see the "**Test Sample(s) Log-In Procedures**". The test sample(s) used to start the test should be <14 days old, although samples <8 weeks old can be used. For each sample tested, a minimum of 2 L of debris-free sediment will be needed for the sediment testing (4 L is preferred). If needed, chemistry analyses will require additional samples.

3.0 TEST INITIATION

Before test initiation begins, be aware of any client-specific testing requirements and read the attached "**Summary of Test Conditions for the 28-Day *Hyalella azteca* Survival and Growth Sediment Toxicity Test.**"

3.1 On the Day Before the Test Initiation (Day -1):

1. Remove the test replicate containers from soaking in the tank of Type I water and shake excess water off. Each test treatment, including each Control, will require 8 test replicate containers. Label the test containers with their treatment and replicate ID code (Replicates "A" through "H") using an indelible black ink (Sharpie®) pen.
2. Remove the sediment from the sample storage refrigerator and allow thermal equilibration to room temperature. Using a stainless steel spoon and bowl, re-homogenize the sediment along with any overlying water that has developed.
3. For each sediment sample, use a stainless steel spoon or spatula to transfer approximately 100 mL of homogenized sediment into each of the 8 replicates, carefully "tamping" down the sediments. Carefully pour approximately 175 mL of SAM-5S water into each beaker, taking care to minimize disturbance of the sediment.
4. Place the test replicates into the water bath or test room, with the temperature controlled at 23˚C, under cool-white fluorescent lighting on a 16L:8D photoperiod.

3.2 Pre-Test Sediment Porewater Characterization, if required (Day –1, or before):

1. Place approximately 500 mL of each homogenized sediment into a 750-mL centrifuge bottle, and centrifuge at 2500 g for 30 min.
2. Decant sediment porewater, and measure routine water quality characteristics of the porewater (pH, DO, conductivity, and total ammonia). Record the water quality data into the appropriate test data sheet.

3.3 Immediately Prior to Test Initiation (Day 0):

1. Renewal of the overlying water using the Zumwalt water delivery system is implemented immediately prior to the introduction of the test organisms into the test replicates. Using the Zumwalt water delivery system, renew the overlying water in each of the replicate containers with 1 replicate volume of water as described below:
2. To renew the overlying water, place the test chambers in the lower plastic tub to hold them in place. Place the tub with the test chambers directly under the syringes connected to the upper splitting chamber of the Zumwalt water delivery system and add fill each syringe with SAM-5S water. Adjust the stopcocks so as to minimize any disturbance of the flow on the sediment. After the syringe has emptied, repeat twice with additional syringe volumes of water (for a total of 3 syringe volumes).
3. After the water is renewed, use a disposable 25-mL glass pipette to collect ~25 mL of test water from 1-2 cm above the sediment in each test replicate; the pipet must be inspected to ensure no organisms were removed during sampling. Composite the replicate water samples for each test treatment to provide a total volume of ~200 mL for each sediment.
4. From the composite, collect sub-samples for analysis of alkalinity, hardness, and total ammonia, which are recorded in their respective logbooks. Then measure routine water quality parameters (pH, D.O., and conductivity) in the remaining composited water. Record the water quality data onto the Sediment Toxicity Test Water Quality Data Sheet.

5. If the D.O. levels fall below 2.5 mg/L, implement gentle aeration at about 1 bubble/second in the overlying water of each test replicate.
6. Isolation and Collection of Individual Test Organisms:
    a. Immediately prior to test initiation, transfer small portion of test organism culture and test water into shallow glass dish placed on top of light box.
    b. Using plastic pipette, agitate the culture material. This disturbance will cause the larval *H. azteca* to swim up, facilitating their capture.

3.4 Initiate the Test (Day 0):

1. Transfer organisms into a small transfer dish (e.g., plastic weigh boats) containing small aliquot of SAM-5S water, continuing this process until there are 10 organisms in the transfer dish (an independent observer must confirm counts); these can then be "poured" into the test replicates, again making sure that organisms are below the water surface. Note – this process must take place quickly, as extended period in the transfer dish will stress the organisms.
2. Allocate ten 7-8 day old organisms into each replicate beaker. Load all "A" replicate containers first, with the order of test treatments being randomized. Repeat process for the "B" replicates, with the order of test treatments being re-randomized. Continue until all test replicates are loaded.
3. Immediately re-examine the replicates, replacing any dead or injured animals. Due to surface tension, some organisms may be "trapped" on the water surface. Examine each replicate to ensure that all test organisms are below the water surface. Using a plastic pipette, organisms that are at the water surface should be moved into the water by gently squirting the organisms with test water.
4. Randomly place the test replicates into the temperature-controlled water bath or test room at 23˚C, under cool-white fluorescent lighting on a 16L:8D photoperiod.
5. Feed each replicate 1.0 mL of Spirulina-amended YCT.
7. <u>For an assessment of growth, at t=0, a minimum of 80 organisms should be dried as described below in Section 5, Step 11. For length measurements (if a component of the testing), 20 amphipods should be archived in sugar formalin (as per EPA guidelines).</u>

4.0 TEST MAINTENANCE (DAYS 1-27)

Each day:

AM:

1. Examine each replicate container. Any dead organisms should be removed via pipette, and the number of mortalities recorded onto the test data sheet.

2. Measure the temperature in the test water from one randomly-selected replicate for each treatment and record data onto test datasheet.
3. Using a disposable 25 mL pipet, collect "old" test water from 1-2 cm above the sediment for a test replicate chamber; the pipet must be inspected to ensure no organisms were removed during sampling. Measure the "old" D.O. and record data onto the test data sheet. If the D.O. levels fall below 2.5 mg/L, implement gentle aeration of each test replicate.
4. Renew the overlying water using the Zumwalt water delivery system to deliver 1 replicate water volume to each replicate container as described above in Section 3.3, Step 2.
5. Using a disposable 25 mL pipet, collect "new" test water from 1-2 cm above the sediment for a test replicate chamber. The pipet must be inspected to ensure no organisms were removed during sampling. Measure the "new" D.O. and record data onto the test data sheet. If the D.O. levels fall below 2.5 mg/L, implement gentle aeration of each test replicate.
6. Return the test replicates to the water bath or test room and record your initials in the "AM" maintenance check box on the data sheet.

PM:

1. Examine each replicate container. Any dead organisms should be removed via pipette, and the number of mortalities recorded onto the test data sheet.
2. Renew the overlying water using the Zumwalt water delivery system to deliver 1 replicate water volume to each replicate container as described above in Section 3.3, Step 2.
3. Return the test replicates to the water bath or test room, and feed each replicate 1.0 mL of *Spirulina*-amended YCT.
4. Initial "PM" maintenance on data sheet.

Each week, measure pH three times and measure conductivity once.

5.0 TEST TERMINATION

Survival and growth are assessed at Day 28. Remove one sediment test treatment at a time and process as follows:

1. Examine each replicate container. Any dead organisms should be removed via pipette, and the number of mortalities recorded onto the test data sheet.

2. Measure the temperature in the test water in one randomly-selected replicate for each treatment and record data onto test data sheet.
3. Collect ~25 mL of test water from 1-2 cm above the sediment in each test replicate using a disposable 25 ml glass pipet; composite the replicate water samples for each test treatment to provide a total volume of ~200 mL; the pipet must be inspected to ensure no organisms were removed during sampling.
4. From the composite, collect sub-samples for analysis of alkalinity, hardness, and total ammonia, which are recorded in their respective logbooks. Then measure routine water quality parameters (pH, D.O., and conductivity) in the remaining composited water. Record the final water quality data onto the Sediment Toxicity Test Water Quality Data Sheet.
5. Label plastic weigh boats with the corresponding sediment test treatment and replicate identification for each test replicate and fill weigh boat with a small volume of clean test water.
6. Using a squirt bottle containing clean test water, vigorously squirt water onto the surface of the sediment so as to disturb the surficial layer – this will facilitate the collection of the test organisms. Swirl and pour the slurry of water and sediment into a glass sorting dish atop a light box. Using a plastic Pasteur pipettes, carefully capture the individual organisms from the dish and transfer them into the weigh boat. Progressively sort through the entire sediment slurry until all of the surviving organisms have been removed.
7. Repeat Step 6 until no additional organisms have been found after three sediment washes. If there is any question as to whether or not all of the organisms have been accounted for, sieve the remaining sediment sequentially with #25, #40, and #50 sieves.
8. Using a squirt bottle, rinse the organisms with clean test water to remove any sediment or other clinging material. Using the fine-tip forceps, transfer the individual larvae into a pre-labeled, -dried, and –weighed aluminum foil drying pan.
9. Record the number of live amphipods in each replicate onto the test data sheet.
10. Repeat steps 5 through 9 for each test replicate.
11. **Growth Option 1** Transfer the surviving amphipods onto a pre-dried and pre-weighed aluminum pan (the pans should be weighed as per the "Weighing of Test Organisms SOP."). When all of the replicates have been transferred into their respective drying pans, place the pans into the drying oven, and dry at 100˚C for 24 hrs.

    or

12. **Growth Option 2 -** Place the surviving organisms from each replicate into pre-labeled 20 mL scintillation vials with 8% sugar formalin. Length is subsequently measured for each amphipod along the curve of the dorsal surface from the base of the first antenna to the tip of the third uropod using the microscope and measurement system.

6.0 DATA ANALYSIS

Test endpoints include:

- Day 28 % survival,
- Day 28 growth (as length or dry weight)

Using the CETIS® statistical software, input the survival and weight (or length) data for the Control treatment and for a given test sediment into a linked-file specific for that test sediment. Analyze the test data, as per the EPA guidelines statistical flowchart procedures, comparing the test responses of the test sediment against the Control treatment to determine whether the test sediment exposure resulted in statistically significant reductions in survival and weight (or length).

7.0 TEST ACCEPTABILITY CRITERIA

As per the EPA test guidelines, "It is recommended (for this test) that the following performance criteria be met":

1. Mean % survival should be ≥80% in the Control treatment on Day 28, and
2. Growth of test organisms should be measurable in the control sediment at the end of the 28-d test (i.e., relative to organisms at the start of the test). Typically, mean dry weight ≥0.15 mg/individual and mean length ≥3.2 mm/individual on Day 28.
3. Hardness, alkalinity, and total ammonia in the overlying water typically should not vary by more than 50% during the test, and dissolved oxygen should be maintained above 2.5 mg/L in the overlying water.

8.0 QUALITY CONTROL

1. All measured water quality should be within the limits established by the US EPA guidelines; any deviations must be noted in lab notebook and explained.
2. Control water, consisting of consisting of SAM-5S reconstituted water [Borgmann 1996, with bromide concentration modified as per Ivey et al. (2011)], should be used as the overlying water in this test. Use of the reconstituted water "*Hyalella*" Water (USEPA 2000) is NOT recommended.
3. To ensure that the organisms being used in the test are responding to test conditions in a "typical" manner, a lab reference or "Control" sediment of known quality is run concurrently with the test sediment. In the absence of a site reference sediment, the lab "Control" sediment is used for comparison purposes. Reference sediment test set-up, maintenance, and termination are identical to those described above.
4. All equipment is calibrated and operated as described in each applicable equipment SOP.

5. All staff working independently on any test shall have previously demonstrated familiarity and competency with the test, analytical equipment used, and the corresponding SOPs.
6. A reference toxicant test can be performed, at the client's discretion, to validate the response of the test organisms.

9.0 TEST INTERFERENCES

Characteristics of a sediment, aside from sediment-associated chemical constituents of concern, that can potentially affect test organism survival and growth should be assessed prior to preparing data submittals to the client. Interferences for this test generally fall into the categories of contaminant and non-contaminant factors.

9.1 Contaminant Interferences

1. All efforts should be made to avoid contaminating any component of the test system or sediments used in testing so as to avoid both false positives and false negatives. Standard "clean techniques" should be used in the lab at all times.
2. Measurable concentrations of total ammonia are common in the pore water of many types of sediment and have been found to be a common cause of toxicity in pore water. Total ammonia concentrations in the porewater should be determined to evaluate if the concentration exceeds the reported tolerance limit for this test species.

9.2 Non-contaminant Interferences

1. Natural geomorphological and physico-chemical characteristics, such as sediment texture, may influence the response of test organisms. A control sediment that includes characteristics (e.g., grain size, organic carbon) that are within the tolerance range of the test organism should be included in the study design. This may best be accomplished by using a formulated sediment.
2. Morphologically similar indigenous organisms in a sediment sample may be confused with the test species during test termination, and result in overestimates in survival. In addition, indigenous organisms may also compete for food or prey on the test species. Should indigenous organisms be observed during test termination, the scientist should immediately notify the Project Manager, as it may be necessary to identify the indigenous organism, and determine the number or biomass in order to better interpret the growth data.

10.0 SAFETY

The 28-d *Hyalella azteca* toxicity test poses little risk to those performing it. Sediments can contain pathogenic organisms and appropriate precautions should be observed when handling this material. After the test is complete, the sediments should be disposed of in an appropriate fashion.

11.0 REPORTING

1. Following the completion of the statistical analyses and the QC review of the statistical analyses, the PER Project Lead is to summarize the results for an email submittal to the PER Project Manager for review. Following this review, either the Project Lead or Project Manager will submit the email summary to the client.
2. The Project Lead will generate a draft report and submit it to the Project Manager for review. The Project Manager reviews the draft report, makes any necessary revisions, and then submits a final report to administrative staff for preparation of the proper number of project-specific hard copies and electronic copies for posting to the client.
3. As per project-specific guidelines, any necessary electronic data deliverables will be generated under guidance by the Project Lead, and will be reviewed for accuracy by properly trained scientists.

12.0 REFERENCES

Borgmann, U. 1996. Systematic analysis of aqueous ion requirements of *Hyalella azteca*: A standard artificial medium including the essential bromide ion. *Arch. Environ. Contam. Toxicol.* 30:356-363.

Ingersoll, C.G. and Nelson, M.K. 1990. Testing sediment toxicity with *Hyalella azteca* (Amphipoda) and *Chironomus riparius* (Diptera). In *Aquatic Toxicology and Risk Assessment*, 13th volume, eds. W.G. Landis and W.H. van der Schalie, 93-109. ASTM STP 1096. Philadelphia, PA.

USEPA. 2000. Method for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates, Second Edition. EPA-600/R-99-064, Duluth, MN.

Summary of Test Conditions and Test Acceptability Criteria for Conducting the 28-Day ***Hyalella azteca*** Survival & Growth Sediment Toxicity Test (Modified from EPA Test Method 100.4)		
1.	Test type	Whole-sediment toxicity test with renewal of overlying water
2.	Test duration	28 days
3.	Temperature	23 ± 1°C
4.	Light quality	Wide-spectrum fluorescent lights
5.	Light intensity	About 100 to 1000 lux
6.	Photoperiod	16L:8D
7.	Test chamber size	300-mL high-form lipless beaker
8.	Test sediment volume	100 mL
9.	Overlying water	SAM-5S Reconstituted Water
10.	Overlying water volume	175 mL
11.	Overlying water quality	Hardness, alkalinity, conductivity, and total ammonia are measured at Day 0 and Day 28. Temperature daily. pH and D.O. three times per week. Conductivity weekly.
12.	Overlying water renewal	2 volume additions/day via one volume addition twice per day
13.	Age of test organisms	7- to 8-d old at the start of the test
14.	No. of organisms per test chamber	10
15.	No. of rep. chambers/concentration	8, but depends on the test objective
16.	Feeding regime	*Spirulina*-amended YCT, fed 1.0 mL daily (1800 mg/L stock) to each test chamber
17.	Test chamber cleaning	If screens become clogged during the test, gently brush the *outside* of the screen
18.	Test solution aeration	None, unless D.O. in overlying water drops below 2.5 mg/L
19.	Endpoints	Survival and growth
20.	Sample and sample holding requirements	Grab or composite samples should be stored at 0-6°C
21.	Sample volume required	2 Liter (minimum), 4 L preferred
22.	Test acceptability criteria	Minimum mean control survival of 80%. Measurable growth in the control; typically, mean dry weight ≥0.15 mg/individual and average length is ≥3.2 mm/individual for test organisms in the control sediment.

Supplemental SOP Language

Definitions:

ACS:	American Chemical Society
ASAP :	As soon as possible
ASTM :	American Society for Testing Materials
°C :	degrees Celsius
dH_2O :	distilled water
D.O.:	dissolved oxygen
ECx:	Effective concentration in X% of the population.
hrs :	hours
ICx:	Inhibitory concentration in X% of the population.
LCx:	Lethal concentration in X% of the population.
LOEC:	Lowest Observed Effect Concentration
mg :	milligram
mg/L :	milligram per liter
mL :	milliliter
NOEC:	No Observed Effect Concentration
NPDES :	National Pollutant Discharge Elimination System
S.O.P.:	Standard Operation Procedure
TIE:	Toxicity Identification Evaluation
U.S. EPA :	United States Environmental Protection Agency

Interferences:

In an effort to eliminate interferences, SOPs have been established for every procedure involved in conducting a successful bioassay test. Additionally, a rigorous daily QA/QC inspection is designed to identify potential sources of interference. Prior to the initiation of toxicity tests every effort is made to identify and eliminate potential sources of interference that could compromise test results. These can include but are not limited to the following: clean and functional facilities, equipment and test chambers; sample storage and handling; test organism and food quality; laboratory water quality.

Pollution Prevention

As a pollution prevention measure, wastes generates during toxicity testing must be properly handled and disposed of in an appropriate manner. Care should be taken not to generate excessive wastes when preparing solutions for testing. All materials identified as hazardous should be labeled and appropriately stored for hazardous waste disposal.

Data Assessment

Bioassay and water quality data are assessed each day during the course of testing for accuracy and compliance with established criteria. At test termination, the data for each replicate, which

are recorded on the appropriate data sheets, are entered into a CETIS™ data file labeled for identification of the specific test. Statistical analyses are performed in accordance with EPA guidelines for statistical analysis. Control data for all endpoints are evaluated for compliance with established test acceptability criteria. Water Quality data are assessed for compliance with specifications outlined in the appropriate USEPA testing manuals.

Corrective Actions and Contingencies for Out-of-Control Data

If control performance is not met, a project manager should be notified immediately and, upon approval, the test is to be repeated. The potential cause(s) of poor control performance will be documented by scientific staff and evaluated and assessed by a project manager. Corrective actions will be determined on a case-by-case basis. The results of all tests will be summarized in reports for the regulatory authorities with an explanation of the results.

Revision #4
Effective Date: September 14, 2012
Accepted:_____

Chironomus dilutus

(Formerly Classified as *C. tentans*)

Long-Term (~64-Day) Life-Cycle Sediment Toxicity Test

Standard Operating Procedures

This S.O.P. is based upon the U.S. EPA Test Method 100.5 "Life-cycle test for measuring the effects of sediment-associated contaminants on *Chironomus dilutus*" as described in "Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates, Second Edition" (EPA/600/R-99/064). It is also in general accordance with ASTM Standard E1706-05 (2012), Test Methods for Measuring the Toxicity of Sediment-Associated Contaminants with Freshwater Invertebrates.

1. INTRODUCTION

This test is based on exposure of *Chironomus dilutus* to sediment from the post-hatch larval stage through to emergence of adults, with subsequent evaluation of production of offspring by the adults. The test endpoints include survival, growth, emergence, and reproduction.

2. TEST PREPARATION

2.1 Equipment and Supplies Needed

1. Sample containers may be necessary for the client's collection of sediment. Containers must be pre-cleaned consistent with EPA guidelines. A minimum volume of 2-L of sediment is necessary (4-L is preferred, particularly if sediment porewater characterization is part of the study plan.) to provide sediment for the bioassay. Additional volume will be necessary for further characterization of sediment (e.g., grain size characteristics, contaminant concentrations).
2. Stainless steel bowls and spatulas or spoons, to homogenize sediments prior to placement in replicate containers.
3. Test chambers, consisting of 300-mL tall-form glass beakers, modified as follows:
    a. The flared lip of the beakers should be cut off, and the upper rim flame-polished. Orca Glassworks in Benicia can provide this service. The prepared beakers must be appropriately cleaned before further use.
    b. Cut a 2.5 cm-wide band of 120-μm Nitex®, approximately 25 cm in length. Using aquarium-safe silicon sealant, attach the band of Nitex around the upper lip of the beaker, such that ~two-thirds of the width of the Nitex band is above the glass.

Make sure to completely seal the Nitex such that there are no openings or seams into which the test organisms might become entrapped. Allow the silicon sealant to cure for a minimum of 24 hrs. The resulting test containers must be appropriately cleaned and rinsed, and then pre-soaked for 48 hrs in Type 1 lab water (reverse-osmosis, de-ionized (RO/DI) water), before use in testing.

4. Modified Zumwalt-type water delivery system, consisting of a lower plastic tub to hold replicate containers in position, and an upper plastic tub, plumbed with 60 mL syringes for delivery of water to replicate containers.
5. Standard Artificial Medium (SAM-5S), consisting of synthetic freshwater (SAM-5S), prepared as per Borgman 1996 guidelines:
    a. Transfer ~75 L of Type I water into an appropriately-cleaned 120-L HDPE tank.
    b. Add 14.7 g of $CaCl_2 \bullet 2H_2O$ to a 2-L aliquot of Type I water and mix on magnetic stir plate for 30 min or until the salts completely dissolve.
    c. Add 6.2 g of $MgSO_4$, 8.4 g of $NaHCO_3$, 0.37 g of KCl, and 0.10 g of NaBr to a second 2-L aliquot of Type I water, and mix on a magnetic stir plate for 30 min or until the salts completely dissolve.
    d. While vigorously stirring, pour each of the 2-L aliquots of salt solutions into the 75-L of Type I water, and fill to a total volume of 100-L with Type I water.
    e. Vigorously aerate the water for at least 24 hrs prior to use.
    f. The water quality should be:
        i. Hardness, 135-155 mg/L as $CaCO_3$
        ii. Alkalinity, 45-55 mg/L as $CaCO_3$
        iii. Conductivity, 425-525 μS/cm
        iv. pH, 8.0-8.2
6. Water quality (pH, DO, and conductivity/salinity) meters, calibrated and used as per the appropriate SOPs.
7. Type 1 lab water, for rinsing of probes, etc.
8. Wash bottles, for rinsing of probes, etc.
9. Glass or electronic thermometer, calibrated and used as per the appropriate SOP.
10. Pipets, disposable plastic Pasteur pipets, for the collection and transfer of test organisms.
11. Fine-tip Forceps, for use in collecting individual organisms from culture material at test termination.
12. Glass dishes, for the sorting and collection of test organisms at test initiation and at test termination.
13. Glass Crystallization dish
14. Petri dish
15. Light boxes, for the sorting and collection of test organisms at test initiation and at test termination.
16. Aeration System, in case needed to aerate should D.O. drops below acceptable levels.
17. Test Food, consisting of TetraMin® flake fish food:
    a. Ground TetraMin® is fed to provide 6.0 mg of dry solids daily per test chamber

18. Sieves, #25, #40, and #50, for collection of organisms at test termination.
19. Aluminum foil weighing pans, for drying and weighing of test organisms at end of test. Pans must be dried in muffle furnace prior to taring.
20. Drying Oven, at 60˚C to 90˚C for drying larval chironomids at test termination.
21. Muffle Furnace Oven, at 550˚C for obtaining ash-free dry weight after dry weight.
22. Desiccators, for holding dried organisms. Balance capable of weighing to 0.01 mg.
23. Emergence Trap
24. R/O Chamber

2.2 Collection and Holding of Sediment Samples

Grab or composite samples should be collected into appropriately-cleaned glass or plastic container(s), and immediately be placed on ice (or "blue ice" type product) to bring the temperature to 0-6°C. The sample should be shipped or transported to the testing laboratory ASAP. Upon receipt of the sample(s) in the laboratory, each sample should be logged in, and then placed in the sample refrigerator at 0-6°C. For instruction on the log-in of incoming samples, see the "**Test Sample(s) Log-In Procedures**". The test sample(s) used to start the test should be <14 days old, although samples <8 weeks old can be used. For each sample tested, a minimum of 2 L volume of *debris-free* sediment will be needed for the sediment testing. Chemistry analyses will require additional sample.

2.3 Ordering and Hatching of Test Organisms

1. Use egg cases from an in-house culture or order *Chironomus dilutus* egg cases from:
   a. Environmental Consulting and Testing: (800) 377-3657
   b. Aquatic Research Organisms: (800) 927-1650
2. Order 10-15 egg cases to arrive at the lab 2 days prior to test initiation, with a second batch of 5-8 egg cases to arrive at the lab 6 days later (the second batch of eggs will be used to generate auxiliary males).
3. Upon receipt, the egg cases must be logged in (see the "Test Organism Receipt and Handling S.O.P.").
4. Please each egg case into a glass crystallizing dish (or petri dish) containing clean water, and incubate at 23˚C.
5. Hatching generally begins ~48 hrs, with the larvae leaving the egg cases ~24 hrs later.
6. The test will be initiated with <24-hour-old larvae. As soon as the first larvae are observed free of the egg cases, transfer the egg case to a fresh crystallizing dish so as to be able to collect organisms of a known age. The action of transferring the egg cases will stimulate any remaining larvae to leave the egg case – these newly-released larvae are the organisms that will be used to initiate the test.
7. This process will be repeated 6 days later for the second batch of eggs.

3. TEST INITIATION

Before test initiation begins be aware of any client-specific testing requirements and read the attached "**Summary of Test Conditions for *Chironomus dilutus* (formerly *C. tentans*)**."

3.1 On the Day Before Test Initiation (Day –1):

1. Remove the test replicate containers from soaking in the tank of Type 1 water and shake excess water off. Each test treatment, including each Control, will require 12 initial test chambers (four of these will be "sacrificed" for the assessment of the Day 20 survival and growth responses). Label the test containers with their treatment and replicate ID code (Replicates "A" through "L") using an indelible black ink (Sharpie®) pen.
2. Remove the sediment from the sample storage refrigerator and allow thermal equilibration to room temperature. Using a stainless steel spoon and bowl, re-homogenize the sediment incorporating with any overlying water that has developed during storage.
3. For each sediment sample, use a stainless steel spoon or spatula to transfer approximately 100 mL of homogenized sediment into each of the 12 replicates, carefully "tamping" down the sediments. Carefully pour approximately 175 mL of control water into each beaker, taking care to minimize disturbance of the sediment.
4. Place the test replicates into the water bath or controlled temperature room, with the temperature set at 23°C, under cool-white fluorescent lighting on a 16L:8D photoperiod at an intensity of ~500 lux.

3.2 Pre-Test Sediment Porewater Characterization, if required (Day –1, or before):

1. Place approximately 500 mL of each homogenized sediment into 750-mL centrifuge bottles, and centrifuge at 2500 g for 30 min.
2. Decant supernatant (= sediment porewater), and measure routine water quality characteristics of the porewater (pH, DO, conductivity, and total ammonia). Record the water quality data into the appropriate test data sheet.

3.3 Immediately Prior to Test Initiation (Day 0):

1. Renewal of the overlying water using the Zumwalt water delivery system is implemented immediately prior to the introduction of the test organisms into the test replicates. Using the Zumwalt water delivery system, renew the overlying water in each of the replicate containers with 1 replicate volume of water as described below:

   To renew the overlying water, place the test chambers in the lower plastic tub to hold them in place. Place the tub with the test chambers directly under the syringes connected to the upper splitting chamber of the Zumwalt water delivery system and fill each syringe with EPAMH water. Adjust the stopcocks so as to minimize any

disturbance of the water flow on the sediment. After the syringe has emptied, repeat twice with additional syringe volumes of water (for a total of 3 syringe volumes).

2. After the water is renewed, use a disposable 25 mL pipet to collect "old" test water from 1-2 cm above the sediment for each replicate, compositing the replicate water samples for each test treatment to provide a total volume of ~200 mL. **The pipet must be inspected to ensure no organisms were removed during sampling.** Bring the volume of overlying water in each test chamber back to the appropriate level with fresh overlying water.
3. From the composite, collect sub-samples for analysis of alkalinity, hardness, and ammonia, which are recorded in their respective logbooks. Then measure routine water quality parameters (pH, DO, and conductivity) in the remaining composited water. Record the water quality data onto the Sediment Toxicity Test Water Quality Data Sheet.
4. If the DO levels fall below 2.5 mg/L, implement gentle aeration at about 1 bubble/second in the overlying water of each test replicate.

3.4 Initiate the Test (Day 0):

1. Feed each replicate ground TetraMin so as to provide 6.0 mg of dry solids daily per test chamber.
2. Using a glass Pasteur pipet, transfer 12 randomly-selected newly-hatched (<24 hours old) *Chironomus dilutus* into each replicate beaker - care should be exercised to release them under the surface of the water. Transfer of larvae should occur within 4 hrs of emerging from the egg case(s). Load test replicates following a randomized block approach. Load all "A" replicate containers first, with the order of test treatments being randomized. Repeat process for the "B" replicates, with the order of test treatments being re-randomized. Continue until all test replicates are loaded.
3. Due to surface tension, some organisms may be "trapped" on the water surface - examine each replicate to ensure that all test organisms are below the water surface. Using a plastic pipet, organisms that are at the water surface should be moved into the water by gently squirting the organisms with test water.

3.3 Auxiliary Male Production (Day 6)

1. For each test treatment, prepare the remaining 4 replicates to provide auxiliary males, repeating the steps described in Sections 3.1, above.
2. On Day 6 of the test, incubate new egg cases as in Section 2.3.
3. On Days 7-10 of the test, allocate new larval chironomids into each of the "Auxiliary Male" replicates, repeating the steps described in Sections 3.4, above.

4. TEST MAINTENANCE

4.1 Daily Maintenance

AM:

a. Examine each replicate container. Any dead organisms should be removed via pipette, and the number of mortalities recorded onto the test data sheet. Similarly, any observed pupae, pupal exuvia, and/or emerged adults should also be removed, and similarly recorded onto test data sheet.
b. Measure the temperature in the test water from one randomly-selected replicate for each treatment and record data onto test datasheet.
c. Using a disposable 25 mL pipet, collect "old" test water from 1-2 cm above the sediment for a test replicate chamber. **The pipet must be inspected to ensure no organisms were removed during sampling**. Measure the "old" DO and record data onto the test data sheet. If the DO levels fall below 2.5 mg/L, implement gentle aeration of each test replicate.
d. Renew the overlying water using the Zumwalt water delivery system to deliver 1 replicate water volume to each replicate container as described above in Section 3.3, Step 1.
e. Using a disposable 25 mL pipet, collect "new" test water from 1-2 cm above the sediment for a test replicate chamber. The pipet must be inspected to ensure no organisms were removed during sampling. Measure the "new" DO and record data onto the test data sheet.
f. Return the test replicates to the water bath or test room and record your initials in the "AM" maintenance check box on the data sheet.

PM:

a. Examine each replicate container. Any dead organisms should be removed via pipette, and the number of mortalities recorded onto the test data sheet.
b. Renew the overlying water using the Zumwalt water delivery system to deliver 1 replicate water volumes to each replicate container as described above in Section 3.3, Step 1.
c. Return the test replicates to the test waterbath or constant temperature room, and feed each replicate ground TetraMin such as to provide 6.0 mg of dry solids daily per test chamber.
d. Record your initials in the "AM" maintenance check box on the data sheet

4.2 Additional Water Quality Assessment

1. **Every Tues-Thurs-Sat**
   Using a disposable 25 mL pipet, collect "old" test water from 1-2 cm above the sediment for the specified replicate. **The pipet must be inspected to ensure no organisms were removed during sampling**. Measure and record the pH for each test treatment.

2. **Once per Week** (perform concurrently with one of the weekly pH analyses described in Step 1 above)**.** Measure and record the conductivity for each test treatment

5. DAY 20

Survival, mean dry weight and ash-free dry weight (AFDW) are assessed from 4 replicates (out of the initial 12 replicates at each test treatment. Randomly remove the replicates for one treatment at a time and process as follows:

1. Measure the temperature in the test water in one randomly-selected replicate for each treatment and record data onto test data sheet.
2. Working one replicate at a time, examine each replicate, noting and recording the number of any pupae, pupal exuvia, and/or adults, and recording this data onto the test weight data sheet.
3. Using a pipette or a squirt bottle containing clean test water, vigorously squirt water onto the top of the sediment so as to disturb the surficial layer – this will often result in the emergence of many of the chironomids, facilitating their collection. Using a pipette and/or forceps, collect and transfer any emerged larvae into a glass sorting dish atop a light box. Using a squirt bottle, rinse the organisms with fresh 'test' water to remove any adhered sediment or other clinging material. Using the forceps, transfer the cleaned individual larvae into a pre-labeled, -dried (via muffle furnace), and –weighed aluminum foil drying pan.
4. Carefully wash the sediment from the same replicate container through a #40 stainless steel sieve, washing the retained materials into the glass sorting dish. Using a pipette and/or forceps, collect and transfer any emerging larvae into a separate glass sorting dish, crystallizing dish, or petri dish. Using a squirt bottle, rinse the organisms with clean test water to remove any adhering sediment or other clinging material. Using the forceps, transfer the cleaned individual larvae into the same pre-labeled, -dried, and –weighed aluminum foil drying pan that was used for the organisms collected from that same replicate in the earlier Step 3, above.
5. Record the total number of live larvae collected from that replicate onto the test weight data sheet.
6. Repeat steps 3 through 5 for each of the 4 test replicates.
7. When all of the replicate organisms have been transferred into their respective drying pans, place the pans into the drying oven, and dry at 105˚C for a minimum of 48 hrs.

8. After drying, place the aluminum pans into the desiccator and seal. Allow to cool at least 4 hrs, after which each pan must be weighed and the weight data recorded onto the test weight data sheet.
9. Transfer the pans of dried organisms into the muffle furnace at 550˚C for 2 hrs to obtain the dry-ash weights.
10. After drying, place the aluminum pans into the desiccator and seal. Allow to cool at least 4 hrs, after which each pan must be weighed and the weight data recorded onto the test weight data sheet.
11. At this point, there should be 3 endpoint data for each of the 4 replicates at each test treatment:
    - 20-day % survival,
    - mean dry weight per individual, and
    - mean dry ash weight per individual.
12. Install emergence traps on each of the remaining 8 initial replicate beakers for each sediment treatment.

6. TEST MAINTENANCE: Day 21 to End-of-Test

1. Prepare a reproduction/oviposition (R/O) chamber for each of the 8 remaining initial test replicates.
2. On a daily basis, record emergence of males and females, pupal, and adult mortality, and time-to-death for previously collected adults.
    a. Two categories are recorded for emergence: complete emergence and partial emergence. Complete emergence occurs when an organism has shed the pupal exuviae completely. Most of these adults escape the surface tension of the water to become a free terrestrial adult. However, some may become trapped by the surface tension of the water (these are still counted as emergent adults); these "trapped" adults will typically be dead at the time of observation, and a time-to-death of 24 hrs must be recorded for these individuals. Partial emergence occurs when an adult has only partially shed the pupal exuviae; these partially-emerged adults will also die quickly, and time-to-death must be determined and recorded for these individuals, as well.
    b. Pupae at the sediment surface or the air-water interface may emerge successfully during the 24-h period. However, cannibalism of sediment-bound pupae by larvae may also occur.
3. Each day, transfer the completely emerged adults (including those still on the water) from each replicate to the corresponding R/O chamber for that replicate. These adults will begin to mate and produce new egg cases over the remaining duration of the test.
4. Each day, examine each R/O chamber for the presence of egg cases and any dead adults.
5. As per the EPA manual, determination of the time-to-earth for any observed dead adult is made on the basis that the order of deaths (for that sex) is the same as the order in which

the adult was transferred into the R/O chamber (for that sex).

6. Note that the female chironomids are capable of laying multiple egg cases: a primary egg case (typically large and banana-shaped), and an occasional secondary egg case which is much smaller. Transfer each individual primary egg case from the R/O chamber to a corresponding labeled (so as to identify the egg transfer date) 60- x 15-mm plastic petri dish containing ~15 mL of test water to monitor incubation and hatch. Note that if there is more than one gravid female in the R/O chamber, there may be more than one primary egg case.
7. For each transferred primary egg case that appears normal, estimate the number of eggs in the egg case using the ring method). When the integrity of the egg case precludes use of the ring method (i.e., the egg case is convoluted or distorted), the eggs should be enumerated using the direct count method (note that if the direct count method is used, hatchability data will not be obtained for that particular egg case).
   a. **Ring Method**: (1) for each egg case, the mean number of eggs in five rings is determined; (2) these rings should be selected at about equal distances along the length of the egg case; (3) the number of eggs/ring multiplied by the number of number of rings in the egg case will provide an estimate of the total number of eggs. The ring method is best suited to the "C" shaped egg cases.
   b. **Direct Method**: Each egg case is placed into a 5-cm glass culture tube containing about 2 mL of 2 N sulfuric acid (H_2SO_4) and left overnight. After digestion, the eggs are collected with a Pasteur pipet and spread across a microscope slide or petri plate with a grid for counting under a dissecting microscope. The direct count method does not permit determination of hatching success.
8. Record the number of dead adults, number of egg cases oviposited, and number of eggs produced.Determine successful hatch rate for each egg case. Although the time required to initiate hatching at this temperature is about 2 d, the period of time required to bring about complete hatch may be as long as 6 d. Therefore, <u>hatching success is determined after 6 d of incubation</u>.
   (1) After 6 days of incubation, determine the number of eggs that remain unhatched. Unhatched eggs either remain in the gelatinous egg case or are distributed on the bottom of the petri dish.
   (2) Subtract the number of unhatched eggs from the total number of eggs originally estimated for that egg case. The "% Successful Hatch" is then calculated as that difference divided by the total number of eggs estimated for that particular egg case.

7. DAY 28

Place emergence traps on the auxiliary male replicate beakers.

8. DAY 28 – END OF TEST

Transfer males emerging from the auxiliary male replicates to individual inverted petri dishes.

The auxiliary males are used for mating with females from the same test treatment for which there are an insufficient number of males. For each R/O chamber lacking a live male or in which a female has not oviposited an egg case within three days, add an auxiliary male to the R/P chamber.

9. TEST TERMINATION: DAY 40 - END (~DAY 64)

1. After 7 days during which no emergence is observed in any of the 8 replicates for a given sediment treatment, the replicates at that treatment can be terminated.
2. Prior to each treatment termination:
    a. Determine the temperature within one randomly-selected replicate beaker at the test treatment(s).
    b. Using a disposable 25 mL pipet, collect "old" test water from 1-2 cm above the sediment for each replicate, compositing the replicate water samples for each test treatment to provide a total volume of ~200 mL. The pipet must be inspected to ensure no organisms were removed during sampling.. Measure routine water quality parameters (pH, D.O., and conductivity) in the remaining composited water.
3. Process each of the 8 replicates as was done on Day 20 (Section 5, above) to recover larvae, pupae, and/or pupae exuviae. Record data on appropriate data sheet.

10. DATA ANALYSIS

1. The endpoint data include:
    - % survival after 20 days,
    - mean dry weight and/or ash-free dry weight (AFDW) after 20 days,
    - total/percent emergence,
    - cumulative (rate) emergence,
    - time to first emergence
    - time to death of adults,
    - numbers of females and males that emerged,
    - time to oviposition,
    - mean number of eggs per female,
    - number of egg cases per treatment, and
    - egg hatchability.
2. The data for each replicate, which are recorded on the appropriate data sheets, are entered into a CETIS™ data file labeled for identification of the specific test. Statistical analyses are performed in accordance with EPA test guidelines.

11. TEST ACCEPTABILITY CRITERIA

The following conditions must be met (as per the EPA 2000 manual):

- Average size of larvae in the control sediment at 20 d must be at least 0.6 mg/ surviving organism as dry weight or 0.48 mg/surviving organism as AFDW.
- Emergence should be greater than or equal to 50%.
- Pupae survival is typically >83% and adult survival is >96%.
- Time to death after emergence is <6.5 d for males and <5.1 d for females.
- The mean number of eggs/ egg case should be greater than or equal to 800 and the percent hatch should be greater than or equal to 80%.

12. QUALITY CONTROL

1. To ensure that the organisms being used in the test are responding to test conditions in a "typical" manner, a lab reference or "Control" sediment of known quality is run side-by-side with the test sediment. In the absence of a site reference sediment, the lab "Control" sediment is used for comparison purposes.
2. Additional Control sediments may be tested (i.e., silica quartz sand), as appropriate to the study.
3. Reference sediment test set-up, maintenance, and termination are identical to those described above.
4. All measured water quality should be within the limits established by the EPA guidelines; any deviations must be noted in lab notebook and explained.
5. All equipment is calibrated and operated as described in each applicable equipment SOP.
6. All staff working independently on any test shall have previously demonstrated familiarity and competency with the test, analytical equipment used, and the corresponding SOPs.
7. A reference toxicant test can be performed, at the client's discretion, to validate the response of the test organisms.

13. TEST INTERFERENCES

Characteristics of a sediment, aside from sediment-associated chemical constituents of concern, that can potentially affect test organism survival and growth should be assessed prior to preparing data submittals to the client. Interferences for this test generally fall into the categories of contaminant and non-contaminant factors.

13.1 Contaminant Interferences

1 All efforts should be made to avoid contaminating any component of the test system or sediments used in testing so as to avoid both false positives and false negatives.

Standard "clean techniques" should be used in the lab at all times.

2 Measurable concentrations of ammonia are common in the pore water of many sediments and have been found to be a common cause of toxicity in pore water. Total ammonia results should be generated to determine if the concentration exceeds the reported tolerance limit for this test species.

13.2 Non-contaminant Interferences

1 Natural geomorphological and physico-chemical characteristics, such as sediment texture, may influence the response of test organisms. A control sediment that includes characteristics (e.g., grain size, organic carbon) that are within the tolerance range of the test organism should be included in the study design. This may best be accomplished by using a formulated sediment.

2 Morphologically similar indigenous organisms in a sediment sample may be confused with the test species during test termination, and result in overestimates in survival. In addition, indigenous organisms may also compete for food or prey on the test species. Should indigenous organisms be observed during test termination, the scientist should immediately notify the Project Manager, as it may be necessary to identify the indigenous organism, and determine the number or biomass in order to better interpret the growth data.

14. SAFETY

The chronic *Chironomus dilutus* life-cycle toxicity test poses little risk to those performing it. Care should be taken in the preparation of the reference toxicant spiking solution. After the reference toxicant spiking solution has been used, any remaining solution should be appropriately stored for hazardous waste disposal.

15. REPORTING

1. Following the completion of the statistical analyses and the QC review of the statistical analyses, the PER Project Lead is to summarize the results for an email submittal to the PER Project Manager for review. Following this review, either the Project Lead or Project Manager will submit the email summary to the client.
2. The Project Lead will generate a draft and submit it to the Project Manager for review. The Project Manager reviews the draft report, makes any necessary revisions, and then submits a final report to administrative staff for preparation of the proper number of project-specific hard copies and electronic copies for posting to the client.
3. As per project-specific guidelines, any necessary electronic data deliverables will be generated under guidance by the Project Lead, and will be reviewed for accuracy by properly trained scientists.

Summary of Test Conditions and Test Acceptability Criteria for Conducting the Chronic ***Chironomus dilutus*** Life-Cycle Toxicity Test	
1. Test type	Whole Sediment Toxicity test with renewal of overlying water.
2. Test duration	~64 Days. Each treatment ended individually when no emergence is observed for 7 consecutive days.
3. Temperature	23 ± 1°C
4. Light quality	Wide-spectrum fluorescent lights
5. Light intensity	About 100 to 1000 lux
6. Photoperiod	16L:8D
7. Test chamber size	300-mL high-form lipless beaker
8. Test substrate	100 mL of sediment
9. Overlying water	Commercial spring water, site water, or synthetic water
10. Overlying water volume	175 mL
11. Overlying water renewal	2 volume additions Daily
12. Age of test organisms	<24-h old larvae
13. Number of organisms per replicate	12
14. Number of replicates	16 per treatment (4 of which are for auxiliary males)
15. Feeding regime	Ground TetraMin® flake fish food is fed to each replicate such as to provide 6.0 mg of dry solids daily per test chamber starting on Day 0.
16. Test chamber cleaning	If screens become clogged during the test, gently brush the *outside* of the screen
17. Test solution aeration	None, unless DO in overlying water drops below 2.5 mg/L
18. Endpoints	• % Survival after 20 days, • mean dry weight and/or ash-free dry weight (AFDW) after 20 days, • female and male emergence • adult mortality, • the number of eggs produced/egg case, and • the number of hatched eggs, as % hatch
19. Test acceptability criteria	• At Day 20, there must be >0.6 mg mean dry weight/surviving organism, or 0.48 mg AFDW/ surviving organism, • ≥50% emergence, • ≥800 eggs per case, and • ≥80% hatch

Revision #5
Effective Date: May 5, 2012
Accepted:_____

Hyalella azteca
42-Day Survival, Growth & Reproduction
Sediment Toxicity Test
Standard Operating Procedures

This S.O.P. is based upon EPA Method 100.4 guidelines described in Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates, Second Edition (EPA/600/R-99/064). It is also in general accordance with ASTM Standard E1706-05 (2010), Standard Test Method for Measuring the Toxicity of Sediment-Associated Contaminants with Freshwater Invertebrates.

1. INTRODUCTION

This test is based on a 28-day static-renewal exposure of 7-8 day old ***Hyalella azteca*** to sediments, followed by a 14-day exposure in "lab" water only during which reproduction is evaluated. The final test endpoints include survival, growth and reproduction (survival and growth on Day 28, survival and reproduction on Day 35, and survival, growth, and reproduction on Day 42).

Hyalella azteca are often an important component of the benthos in freshwater ecosystems, have been used in sediment toxicity testing, and have shown to be a sensitive indicator of contaminants associated with sediments. They have a wide tolerance of sediment grain size with acceptable survival in sediments ranging from >90% fines to 100% sand (Ingersoll and Nelson, 1990).

2. TEST PREPARATION

2.1 Equipment and Supplies Needed

1. Sample containers may be necessary for the client's collection of sediment. Containers must be pre-cleaned consistent with EPA guidelines. A minimum volume of 2-L of sediment is necessary (4-L is preferred) to provide sediment for the bioassay and for the accompanying sediment porewater characterization. Additional volume will be necessary for further characterization of sediment (e.g., grain size characteristics, contaminant concentrations).
2. Stainless steel bowls and spatulas (or spoons) to homogenize sediments prior to placement in replicate containers.

3. Test containers, consisting of 300-mL tall-form glass beakers, modified as follows:
    a. The flared lip of the beakers should be cut off, and the upper rim flame-polished. Orca Glassworks in Benicia can provide this service. The prepared beakers must be appropriately cleaned before further use.
    b. Cut a 2.5 cm-wide band of 425-μm Nitex®, approximately 25 cm in length. Using aquarium-safe silicon sealant, attach the band of Nitex around the upper lip of the beaker, such that ~two-thirds of the width of the Nitex band is above the glass. Make sure to completely seal the Nitex such that there are no openings or seams into which the test organisms might become entrapped. Allow the silicon sealant to cure for a minimum of 24 hrs. The resulting test containers must be appropriately cleaned and rinsed, and then pre-soaked for 48 hrs in Type 1 lab water (reverse-osmosis, de-ionized (RO/DI) water) before use in testing.
4. "Water Only" replicate containers, consisting of 400 mL glass beakers.
5. Modified Zumwalt-type water delivery system, consisting of lower plastic tub to hold replicate containers in position, and upper plastic tub, plumbed with 60 mL syringes and attached stopcocks for delivery of water to replicate containers.
6. Standard Artificial Medium (SAM-5S), consisting of synthetic freshwater (SAM-5S), prepared as per Borgman 1996 guidelines:
    a. Transfer ~75 L of Type I water into an appropriately-cleaned 120-L HDPE tank.
    b. Add 14.7 g of $CaCl_2 \bullet 2H_2O$ to a 2-L aliquot of Type I water and mix on magnetic stir plate for 30 min or until the salts completely dissolve.
    c. Add 6.2 g of $MgSO_4$, 8.4 g of $NaHCO_3$, 0.37 g of KCl, and 0.10 g of NaBr to a second 2-L aliquot of Type I water, and mix on a magnetic stir plate for 30 min or until the salts completely dissolve.
    d. While vigorously stirring, pour each of the 2-L aliquots of salt solutions into the 75-L of Type I water, and fill to a total volume of 100-L with Type I water.
    e. Vigorously aerate the water for at least 24 hrs prior to use.
    f. The water quality should be:
        i. Hardness, 135-155 mg/L as $CaCO_3$
        ii. Alkalinity, 45-55 mg/L as $CaCO_3$
        iii. Conductivity, 425-525 μS/cm
        iv. pH, 8.0-8.2
7. Water quality (pH, DO, and conductivity/salinity) meters, calibrated and used as per the appropriate SOPs.
8. Type 1 lab water (reverse-osmosis, de-ionized (RO/DI) water), for rinsing of probes, etc.
9. Wash bottles, for rinsing of probes, etc.
10. Glass or electronic thermometer calibrated and used to measure temperature.
11. Pipettes, disposable plastic Pasteur pipettes, for the collection and transfer of test organisms, and collection of water quality subsamples.
12. Fine-tip forceps, for use in collecting individual organisms from culture material at test termination.

13. Glass dishes, for the sorting and collection of test organisms at test initiation and at test initiation.
14. Light boxes, for the sorting and collection of test organisms at test initiation and at test termination.
15. Aeration system, in cases where the chambers need to be aerated when the D.O. drops below acceptable levels.
16. Test Food.
    a. YCT (yeast, Cerophyl®**,** trout chow) is prepared according to Appendix B, EPA 600/R-99/064.
    b. YCT is amended with powdered *Spirulina*, sieved at 250 µm, at a rate of 90 mg per 100 mL YCT.
17. Sieves, #25 (701 μm), #40 (425 μm), and #50 (300 μm), for collection of organisms at test termination.
18. Aluminum Foil Weighing Pans, for drying and weighing of organisms at end of test.
19. Drying Oven, at 60˚C to 90˚C for drying organisms at test termination.
20. Desiccators, for holding dried organisms.
21. Balance, capable of weighing to 0.01 mg. Calibrate and use as per the appropriate SOP.
22. Reference weights, for calibration of balance.
23. Microscope and calibrated software for performing length measurements (if length is measured rather than mean dry weight).

2.2 Ordering and Holding of Test Organisms

2.2.1 Ordering and Holding of Test Organisms from Commercial Supplier

1. Test organisms should be ordered far enough in advance so as to ensure the arrival of 6-7 day old organisms at least 24 hrs prior to Day 0 (so that organism will be 7-8 days old at test initiation). Approximately 25% more animals should be ordered than are actually needed for the test, so as to allow for some attrition of organisms that are stressed from the shipping, etc.
2. Order organisms from:
    a. Chesapeake Cultures - (803) 694-4046
    b. Aquatic Biosystems Inc. - (800) 331-5916
3. Upon receipt, the test organism culture should be transferred into 4-L HDPE tanks containing test water at 23˚C; the culture should be gently aerated, and should be fed *Spirulina*-amended YCT. If the test is to be run at salinity >2 ‰ (up to 15‰), cultures must be salinity adjusted. Place them in control water at the receiving salinity and immediately begin to adjust the holding salinity towards the test salinity. For additional instruction on the receipt and handling of the test organisms, see the "Test Organism Receipt and Handling S.O.P."

2.2.2 Organisms from In-Lab Culture

If the test organisms will be supplied from in-lab cultures, the organisms must be isolated from the in-lab culture 7-8 days before the test is to begin in order to have 7-8-day old organisms at the time of test initiation. Adults from each of the culture tanks should be collected and transferred to a #25 sieve resting in a collection bowl containing SAM-5S water and a few conditioned leaves, and provide gentle aeration. Allow the culture to sit undisturbed overnight.

The following day, carefully remove the leaves, shaking to dislodge any clinging adults. Gently shake the top sieve and lift out of the neonate collection bowl assembly, carefully transferring the retained adults into a temporary holding container (make sure the transferred adults are not trapped at the water surface). The remaining water in the collection bowl contains all of the neonates that were released overnight. These should be transferred into a new culture tank containing a few conditioned leaves, with the neonates being counted during this transfer. There should be at least 125% of the number needed for the test. If not, repeat this process with the retained adults and collect a second day's batch of neonates, which will be combined with the first days. After enough neonates are collected, the adults can be returned to their culture tanks.

The collected neonates should be fed *Spirulina*-amended YCT. Change the water every 3 days, inspecting the animals to ensure adequate abundance, health and quality.

2.2.3 Organism Health

Test organisms must appear healthy, behave normally, feed well, and have low mortality in the cultures during holding. There should be <20% mortality in the cultures 48 hrs prior to test initiation

2.3 Collection and Holding of Sediment Samples

Grab or composite samples should be collected into appropriately-cleaned glass or plastic container(s), and immediately be placed on ice (or "blue ice" type product) to bring the temperature to 0-6°C. The sample should be shipped or transported to the testing laboratory ASAP. Upon receipt of the sample(s) in the laboratory, each sample should be logged in, and then placed in the sample refrigerator at 0-6°C. For instruction on the log-in of incoming samples, see the "**Test Sample(s) Log-In Procedures.**" The test sample(s) used to start the test should be <14 days old, although samples <8 weeks old can be used. For each sample tested, a minimum of 2 L of **debris-free** sediment will be needed for the sediment testing. If needed, chemistry analyses will require additional samples.

3. TEST INITIATION

Before test initiation begins, be aware of any client-specific testing requirements and read the attached "**Summary of Test Conditions for the 42-Day *Hyalella azteca* Survival and Growth Sediment Toxicity Test.**"

3.1 On the Day Before Test Initiation (Day –1):

1. Remove the test replicate containers from soaking in the tank of Type 1 water and shake excess water off. Each test treatment, including each Control, will require 12 test replicate containers. Label the test containers with their treatment and replicate ID code (Replicates "A" through "L") using an indelible black ink (Sharpie®) pen.
2. Remove the sediment from the sample storage refrigerator and allow thermal equilibration to room temperature. Using a stainless steel spoon and bowl, re-homogenize the sediment along with any overlying water that has developed.
3. For each sediment sample, use a stainless steel spoon or spatula to transfer approximately 100 mL of homogenized sediment into each of the 12 replicates, carefully "tamping" down the sediments. Carefully pour approximately 175 mL of SAM-5S water into each beaker, taking care to minimize disturbance of the sediment.
4. Place the test replicates into the water bath or test room, with the temperature controlled at 23˚C, under cool-white fluorescent lighting on a 16L:8D photoperiod.

3.2 Pre-Test Sediment Porewater Characterization, if required (Day –1, or before):

1. Place approximately 500 mL of each homogenized sediment into 750-mL centrifuge bottles, and centrifuge at 2500 g for 30 min.
2. Decant sediment porewater, and measure routine water quality characteristics of the porewater (pH, DO, conductivity, and total ammonia). Record the water quality data into the appropriate test data sheet.

3.3 Immediately Prior to Test Initiation (Day 0):

1. Renewal of the overlying water using the Zumwalt water delivery system is implemented immediately prior to the introduction of the test organisms into the test replicates Using the Zumwalt water delivery system, renew the overlying water in each of the replicate containers with 1 replicate volume of water as described below:
2. To renew the overlying water, place the test chambers in the lower plastic tub to hold them in place. Place the tub with the test chambers directly under the syringes connected to the upper splitting chamber of the Zumwalt water delivery system and add fill each syringe with EPAMH water. Adjust the stopcocks so as to minimize any disturbance of the flow on the sediment. After the syringe has emptied, repeat twice with additional syringe volumes of water (for a total of 3 syringe volumes).
3. After the water is renewed, use a disposable 25-mL glass pipette to collect ~25 mL of test water from 1-2 cm above the sediment in each test replicate; the pipet must be inspected to ensure no organisms were removed during sampling. Composite the replicate water samples for each test treatment to provide a total volume of ~200 mL for each sediment. From the composite, collect sub-samples for analysis of alkalinity, hardness, and ammonia.

4. Measure the initial water quality conditions (temperature, pH, D.O., conductivity, hardness, alkalinity, and total ammonia). From the composite, collect sub-samples for analysis of alkalinity, hardness, and ammonia, which are recorded in their respective logbooks. Then measure routine water quality parameters (pH, DO, and conductivity) in the remaining composited water. Record the water quality data onto the Sediment Toxicity Test Water Quality Data Sheet.
5. If the D.O. levels fall below 2.5 mg/L, implement gentle aeration of each test replicate.
6. Isolation and Collection of Individual Test Organisms:
    a. Immediately prior to test initiation, transfer small portion of test organism culture and test water into shallow glass dish placed on top of light box.
    b. Using a plastic pipette, gently agitate the culture material. This disturbance will cause the larval *H. azteca* to swim up, facilitating their capture.

3.4 Initiate the Test (Day 0):

1. Transfer organisms into a small transfer dish (e.g., plastic weigh boats) containing a small aliquot of SAM-5S water, continuing this process until there are 10 organisms in the transfer dish (these counts must be confirmed by an independent Scientist); these can then be "poured" into the test replicates, making sure that organisms are below the water surface in the test replicate chambers. Note – this process must take place quickly, as extended period in the transfer dish will stress the organisms.
2. Allocate ten 7-8 day old organisms into each replicate beaker. Load all "A" replicate containers first, with the order of test treatments being randomized. Repeat process for the "B" replicates, with the order of test treatments being re-randomized. Continue until all test replicates are loaded.
3. Immediately re-examine each replicate, replacing any dead or injured animals. Examine each replicate to ensure that all test organisms are below the water surface, as some organisms may be "trapped" on the water surface due to surface tension. Using a plastic pipette, organisms that are at the water surface should be moved down into the water by gently squirting the organisms with test water.
4. Randomly place the test replicates into the water bath or test room, with the temperature controlled at 23˚C, under cool-white fluorescent lighting on a 16L:8D photoperiod.
5. Feed each replicate 1.0 mL of Spirulina-amended YCT.
6. For an assessment of growth, at t=0, a minimum of 80 organisms should be dried as described below in Section 5, Step 10. If growth is to be determined using length measurements, 20 amphipods should be archived in sugar formalin (as per EPA guidelines).

4. TEST MAINTENANCE (DAYS 1-27)

Each day:

AM:

1. Examine each replicate container. Any dead organisms should be removed via pipette, and the number of mortalities recorded onto the test data sheet.
2. Measure the temperature in the test water from one randomly-selected replicate for each treatment and record data onto test datasheet.
3. Perform water quality analyses as required (see Section 4.0-2 and 4.0-3), collect ~25 mL of test water from 1-2 cm above the sediment in each test replicate using a disposable 25 ml glass pipet; composite the replicate water samples for each test treatment to provide a total volume of ~50 mL; the pipet must be inspected to ensure no organisms were removed during sampling. Measure the "old" D.O. and record data onto the test data sheet. If the D.O. levels fall below 2.5 mg/L, implement gentle aeration of each test replicate.
4. Renew the overlying water using the Zumwalt water delivery system to deliver 1 replicate water volume to each replicate container as described above in Section 3.3, Step 2.
5. Collect ~25 mL of test water from 1-2 cm above the sediment in each test replicate using a disposable 25 ml glass pipet; composite the replicate water samples for each test treatment to provide a total volume of ~50 mL; the pipet must be inspected to ensure no organisms were removed during sampling. Measure the "new" D.O. and record data onto the test data sheet. If the DO levels fall below 2.5 mg/L, implement gentle aeration of each test replicate.
6. Return the test replicates to the water bath or test room and initial "AM" maintenance on data sheet.

PM:

1. Examine each replicate container. Any dead organisms should be removed via pipette, and the number of mortalities recorded onto the test data sheet.
2. Renew the overlying water using the Zumwalt water delivery system to deliver 1 replicate water volume to each replicate container as described above in Section 3.3, Step 2.
3. Return the test replicates to the water bath or test room, and feed each replicate 1.0 mL of *Spirulina*-amended YCT.
4. Initial "PM" maintenance on data sheet.

Three Days per Week (e.g., T, Th, Sat)

Measure pH three times per week.

Once per Week

Measure conductivity once per week.

5. DAY 28 TEST TERMINATION & INITIATION OF WATER-ONLY EXPOSURES

5.1 Day 28: Interim Assessment of Survival and Growth

Survival and growth at 28 days will be assessed in four of the original 12 replicates, as follows.

1. Examine each replicate container. Any dead organisms should be removed via pipette, and the number of mortalities recorded onto the test data sheet.
2. Measure the temperature in the test water in one randomly-selected replicate for each treatment and record data onto test data sheet.
3. Collect ~25 mL of test water from 1-2 cm above the sediment in each test replicate using a disposable 25 ml glass pipet; composite the replicate water samples for each test treatment to provide a total volume of ~200 mL; the pipet must be inspected to ensure no organisms were removed during sampling.
4. From the composite, collect sub-samples for analysis of alkalinity, hardness, and ammonia, which are recorded in their respective logbooks. Then measure routine water quality parameters (pH, DO, and conductivity) in the remaining composited water. Record the final water quality data onto the Sediment Toxicity Test Water Quality Data Sheet.
5. Label plastic weigh boats with the corresponding sediment test treatment and replicate identification for each test replicate and fill each weigh boat about half-full with fresh test water.
6. Using a squirt bottle containing clean test water, vigorously squirt water onto the surface of the sediment so as to disturb the surficial layer – this will facilitate the collection of the test organisms. Swirl and pour the slurry of water and disturbed surficial sediment into a glass sorting dish atop a light box. Using a plastic Pasteur pipettes, carefully capture the individual organisms from the dish and transfer them into the weigh boat.
7. Repeat Step 6 with the remaining sediment from that replicate until no additional organisms have been found after three surficial sediment washes. If all of the organisms have not been accounted for, sieve the remaining sediment sequentially with #25, #40, and #50 sieves.
8. Using a squirt bottle, rinse the organisms with clean test water to remove any adhered sediment or other clinging material. Using the fine-tip forceps, transfer the cleaned individual amphipods into a pre-labeled, -dried, and –weighed aluminum foil drying pan.
9. Record the number of live amphipods recovered in each replicate onto the test data sheet.
10. Repeat steps 6 through 10 for each of the four test replicates.
11. **Growth Option 1** - Transfer the surviving amphipods from each of the 4 replicates onto separate labeled pre-dried and pre-weighed aluminum pan (the pans should be weighed as per the "Weighing of Test Organisms SOP."). When all of the replicates

have been transferred into their respective drying pans, place the pans into the drying oven, and dry at 100˚C for 24 hrs.
or

12. **Growth Option 2 -** Place the surviving organisms from 4 replicates into pre-labeled 20 mL scintillation vials with 8% sugar formalin. The length of each organism is subsequently determined by measuring along the dorsal surface from the base of the first antenna to the tip of the third uropod along the curve of the dorsal surface using the microscope and measurement system.

5.2 Day 28: Initiation of Water-Only Exposures for Survival, Reproduction, and Growth

1. For each of the remaining eight replicates, prepare a new 'water only' replicate (400 mL glass beaker that will contain water without any sediment); label each replicate appropriately, and fill with control water.
2. Add a 3-cm x 3-cm piece of nylon "coiled-web material" per replicate as an amphipod substrate.
3. Collect ~25 mL of test water from 1-2 cm above the sediment in each of the remaining original 8 test replicates using a disposable 25 ml glass pipet; composite the replicate water samples for each test treatment to provide a total volume of ~200 mL; the pipet must be inspected to ensure no organisms were removed during sampling.
4. From the composite, collect sub-samples for analysis of alkalinity, hardness, and ammonia, which are recorded in their respective logbooks. Then measure routine water quality parameters (pH, DO, and conductivity) in the remaining composited water. Record the final water quality data onto the Sediment Toxicity Test Water Quality Data Sheet.
5. Process each test replicate as described above (Section 5.1, Steps 1-10). For each replicate, transfer the surviving organisms to the corresponding "water only" replicate chamber.
6. Return the "Water Only" replicates to the temperature-controlled room under the same test conditions used in the initial 28-days of testing.

6. TEST MAINTENANCE FOR WATER-ONLY EXPOSURE (DAY 28-42)

1. Renew the overlying water daily; ensure that no offspring are lost during renewal. Examine each replicate container and remove any dead organisms via pipet and record the number of mortalities on the test data sheet.
2. Collect ~25 mL of test water in each test replicate using a disposable 25 ml glass pipet; composite the replicate water samples for each test treatment to provide a total volume of ~50 mL. **The pipet must be inspected to ensure no organisms were removed during sampling** Measure temperature daily, pH and DO three times per week, and

conductivity weekly. Restore the volume of overlying water in each test chamber back to the initial volume with overlying water

3. Feed each replicate 1.0 mL of *Spirulina*-amended YCT.
4. On Day 35, collect ~25 mL of test water from 1-2 cm above the sediment in each test replicate using a disposable 25 ml glass pipet; composite the replicate water samples for each test treatment to provide a total volume of ~200 mL; **the pipet must be inspected to ensure no organisms were removed during sampling**.
5. From the composite, collect sub-samples for analysis of alkalinity, hardness, and ammonia, which are recorded in their respective logbooks. Then measure routine water quality parameters (pH, DO, and conductivity) in the remaining composited water. Record the final water quality data onto the Sediment Toxicity Test Water Quality Data Sheet.
6. On day 35, remove and count the offspring in each replicate, and record on the test data sheet. Return the test replicates to the test room, and continue to maintain for the remaining six days.

7. TEST TERMINATION FOR WATER ONLY EXPOSURE (DAY 42)

1. On Day 42, Collect ~25 mL of test water from 1-2 cm above the sediment in each test replicate using a disposable 25 ml glass pipet; composite the replicate water samples for each test treatment to provide a total volume of ~200 mL; **the pipet must be inspected to ensure no organisms were removed during sampling**.
2. From the composite, collect sub-samples for analysis of alkalinity, hardness, and ammonia, which are recorded in their respective logbooks. Then measure routine water quality parameters (pH, DO, and conductivity) in the remaining composited water. Record the final water quality data onto the Sediment Toxicity Test Water Quality Data Sheet.
3. Remove and count adults and young in each replicate, and record on test data sheet.
4. Determine and record the number of adult males and females for each replicate. Mature male amphipods are distinguished by the presence of an enlarged second gnathopod.
5. From the number of young produced from day 28-to-42 and the number of adult females [at Day 42], calculate and record the number of young produced per female for each replicate.
6. Measure the length or dry weight as described above in section 5.1.

8. DATA ANALYSIS

Test endpoints include:

- Day 28 % survival,
- Day 28 growth (as length or dry weight)
- Day 35 % survival,

- Day 35 number of offspring,
- Day 42 % survival,
- Day 42 growth (as length or dry weight),
- Day 42 number of males and females, and
- Day 42 reproduction (as number of young/female).

The survival, length or weight, and reproduction data for each replicate, which are recorded on the appropriate data sheets, are entered into the most current CETIS statistical software data file labeled for identification of the specific test. Statistical analyses are performed in accordance with EPA guidelines.

9. TEST ACCEPTABILITY CRITERIA

As per the EPA test guidelines, "It is recommended (for this test) that the following performance criteria be met":

1. Mean % survival should be ≥80% in the Control treatment on Day 28.
2. Mean dry weight ≥0.15 mg/individual on Day 28, or Mean length ≥3.2 mm/individual on Day 28.
3. Reproduction from Day 28 to Day 42 of ≧2 offspring/female.

10. QUALITY CONTROL

1. All measured water quality should be within the limits established by the US EPA guidelines; any deviations must be noted in lab notebook and explained.
2. Control water, consisting of consisting of SAM-5S reconstituted water (Borgmann 1996), culture water, well water, surface water, or site water should be used as the overlying water in this test. Use of the reconstituted water "Hyalella" Water (USEPA 2000) is NOT recommended.
3. To ensure that the organisms being used in the test are responding to test conditions in a "typical" manner, a lab reference or "Control" sediment of known quality is run side-by-side with the test sediment. In the absence of a site reference sediment, the lab "Control" sediment is used for comparison purposes. Reference test set-up, maintenance, and termination are identical to those described above.
4. Additional Control sediments may be tested (i.e., silica quartz sand), as appropriate to the study.
5. Reference sediment test set-up, maintenance, and termination are identical to those described above.
6. All measured water quality should be within the limits established by the EPA guidelines; any deviations must be noted in lab notebook and explained.
7. All equipment is calibrated and operated as described in each applicable equipment SOP.

8. All staff working independently on any test shall have previously demonstrated familiarity and competency with the test, analytical equipment used, and the corresponding SOPs.
9. A reference toxicant test can be performed, at the client's discretion, to validate the response of the test organisms.

11. TEST INTERFERENCES

Characteristics of a sediment, aside from sediment-associated chemical constituents of concern, that can potentially affect test organism survival and growth should be assessed prior to preparing data submittals to the client. Interferences for this test generally fall into the categories of contaminant and non-contaminant factors.

11.1 Contaminant Interferences

1. All efforts should be made to avoid contaminating any component of the test system or sediments used in testing so as to avoid both false positives and false negatives. Standard "clean techniques" should be used in the lab at all times.
2. Measurable concentrations of ammonia are common in the pore water of many sediments and have been found to be a common cause of toxicity in pore water. Total ammonia concentrations in the porewater should be determined to evaluate if the concentration exceeds the reported tolerance limit for this test species.

11.2 Non-contaminant Interferences

1 Natural geomorphological and physico-chemical characteristics, such as sediment texture, may influence the response of test organisms. A control sediment that includes characteristics (e.g., grain size, organic carbon) that are within the tolerance range of the test organism should be included in the study design. This may best be accomplished by using a formulated sediment.

2 Morphologically similar indigenous organisms in a sediment sample may be confused with the test species during test termination, and result in overestimates in survival. In addition, indigenous organisms may also compete for food or prey on the test species. Should indigenous organisms be observed during test termination, the scientist should immediately notify the Project Manager, as it may be necessary to identify the indigenous organism, and determine the number or biomass in order to better interpret the growth data.

13. SAFETY

This toxicity test poses little risk to those performing it. Sediments can contain pathogenic organisms and appropriate precautions should be observed when handling this material. After the test is complete, the sediments should be disposed of in an appropriate fashion.

14. REPORTING

1. Following the completion of the statistical analyses and the QC review of the statistical analyses, the PER Project Lead is to summarize the results for an email submittal to the PER Project Manager for review. Following this review, either the Project Lead or Project Manager will submit the email summary to the client.
2. The Project Lead will generate a draft report and submit it to the Project Manager for review. The Project Manager reviews the draft report, makes any necessary revisions, and then submits a final report to administrative staff for preparation of the proper number of project-specific hard copies and electronic copies for posting to the client.
3. As per project-specific guidelines, any necessary electronic data deliverables will be generated under guidance by the Project Lead, and will be reviewed for accuracy by properly trained scientists.

15. REFERENCES

American Society for Testing and Materials (ASTM). 2012. Standard test method for measuring 1633 the toxicity of sediment-associated contaminants with freshwater invertebrates (ASTM 1634 E1706-05 (Reapproved 2010)). Annual Book of ASTM Standards Volume 11.06, West Conshohocken, PA

Borgmann, U. 1996. Systematic analysis of aqueous ion requirements of *Hyalella azteca*: A standard artificial medium including the essential bromide ion. *Arch. Environ. Contam. Toxicol.* 30:356-363.

USEPA. 2000. Method for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates. EPA-600/R-99-064, Duluth, MN.

SUMMARY OF TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR CONDUCTING THE 42-DAY ***HYALELLA AZTECA*** SURVIVAL AND GROWTH SEDIMENT TOXICITY TEST (MODIFIED FROM TEST METHOD 100.4)		
1.	Test type	Whole-sediment toxicity test with renewal of overlying water
2.	Test duration	42 days
3.	Temperature	23 ± 1°C
4.	Light quality	Wide-spectrum fluorescent lights
5.	Light intensity	About 100 to 1000 lux
6.	Photoperiod	16L:8D
7.	Test chamber size	300-mL high-form lipless beaker
8.	Test sediment volume	100 mL
9.	Overlying water	SAM-5S reconstituted Water
10.	Overlying water volume	175 mL
11.	Overlying water quality	Hardness, alkalinity, conductivity and ammonia at beginning and end of sediment exposure. Temperature daily, pH and DO three times per week. Conductivity weekly.
12.	Overlying water renewal	2 volume additions/d @ one volume addition every 12 h
13.	Age of test organisms	7- to 8-d old at the start of the test
14.	No. of organisms per test chamber	10
15.	No. of rep. chambers/concentration	12, but depends on the objective of the test, 8 for 42 days, 4 for 28 growth
16.	Feeding regime	*Spirulina* amended YCT, fed 1.0 mL daily (1800 mg/L stock) to each test chamber
17.	Test chamber cleaning	If screens become clogged during the test, gently brush the *outside* of the screen
18.	Test solution aeration	None, unless DO in overlying water drops below 2.5 mg/L
19.	Endpoints	Survival and growth
20.	Sample and sample holding requirements	Grab or composite samples should be stored at 0-6°C.
21.	Sample volume required	2 Liter, 4 L preferred
22.	Test acceptability criteria	Mean control survival of ≥80% and growth as mean dry weight ≥ 0.15 mg/individual or ≥ 3.2 mm/individual for test organisms in the control sediment at Day 28; reproduction from Day 28 to Day 42 of ≥2 offspring/female.

Supplemental SOP Language

Definitions:

ACS:	American Chemical Society
ASAP :	As soon as possible
ASTM :	American Society for Testing Materials
°C :	degrees Celsius
dH_2O :	distilled water
D.O.:	dissolved oxygen
ECx:	Effective concentration in X% of the population.
hrs :	hours
ICx:	Inhibitory concentration in X% of the population.
LCx:	Lethal concentration in X% of the population.
LOEC:	Lowest Observed Effect Concentration
mg :	milligram
mg/L :	milligram per liter
mL :	milliliter
NOEC:	No Observed Effect Concentration
NPDES :	National Pollutant Discharge Elimination System
S.O.P.:	Standard Operation Procedure
TIE:	Toxicity Identification Evaluation
U.S. EPA :	United States Environmental Protection Agency

Interferences:

In an effort to eliminate interferences, SOPs have been established for every procedure involved in conducting a successful bioassay test. Additionally, a rigorous daily QA/QC inspection is designed to identify potential sources of interference. Prior to the initiation of toxicity tests every effort is made to identify and eliminate potential sources of interference that could compromise test results. These can include but are not limited to the following: clean and functional facilities, equipment and test chambers; sample storage and handling; test organism and food quality; laboratory water quality.

Pollution Prevention

As a pollution prevention measure, wastes generates during toxicity testing must be properly handled and disposed of in an appropriate manner. Care should be taken not to generate excessive wastes when preparing solutions for testing. All materials identified as hazardous should be labeled and appropriately stored for hazardous waste disposal.

Data Assessment

Bioassay and water quality data are assessed each day during the course of testing for accuracy and compliance with established criteria. At test termination, the data for each replicate, which are recorded on the appropriate data sheets, are entered into a CETIS™ data file labeled for

identification of the specific test. Statistical analyses are performed in accordance with EPA guidelines for statistical analysis. Control data for all endpoints are evaluated for compliance with established test acceptability criteria. Water Quality data are assessed for compliance with specifications outlined in the appropriate USEPA testing manuals.

Corrective Actions and Contingencies for Out-of-Control Data

If control performance is not met, a project manager should be notified immediately and, upon approval, the test is to be repeated. The potential cause(s) of poor control performance will be documented by scientific staff and evaluated and assessed by a project manager. Corrective actions will be determined on a case-by-case basis. The results of all tests will be summarized in reports for the regulatory authorities with an explanation of the results.

SINCE 1949
NEW ENGLAND SILICA, INC.
1370 JOHN FITCH BLVD., RT. 5, P.O. BOX 185
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PRODUCT DATA

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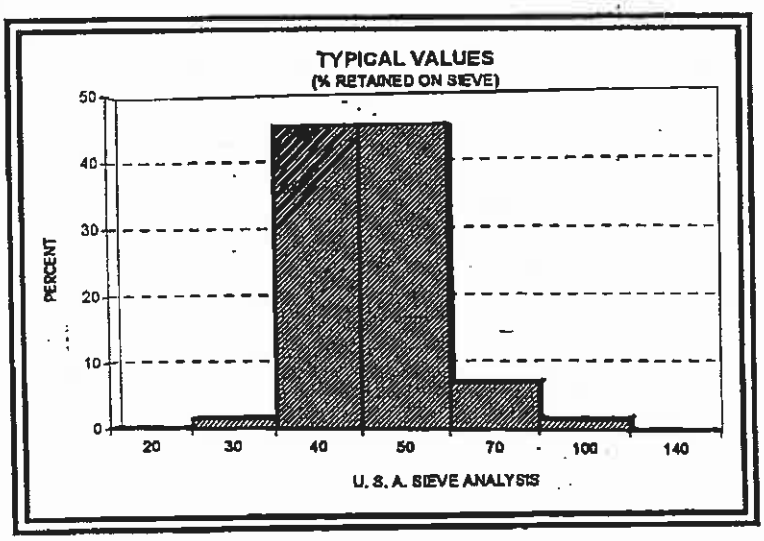
PLANT: OTTAWA, ILLINOIS



USA STD SIEVE SIZE	MILLIMETERS	% RETAINED		CUMULATIVE % PASSING
		INDIVIDUAL	CUMULATIVE	
20	0.850	0.0	0.0	100.0
30	0.600	1.5	1.5	98.5
40	0.425	45.0	46.5	53.5
50	0.300	45.0	91.5	8.5
70	0.212	7.0	98.5	1.5
100	0.150	1.5	100.0	0.0
140	0.106	0.0	100.0	0.0

TYPICAL PHYSICAL PROPERTIES

AFS[1] ACID DEMAND (@pH-7)	<1
AFS GRAIN FINENESS	36
COLOR	WHITE
GRAIN SHAPE	ROUND
HARDNESS (MOHS)	7
MELTING POINT (DEGREES F)	3100
MINERAL	QUARTZ
MOISTURE CONTENT (%)	<0.05
pH	7.0
SPECIFIC GRAVITY (g/cc)	2.65

(1) American Foundrymen's Society

TYPICAL CHEMICAL ANALYSIS, %

SiO_2 (SILICON DIOXIDE)	99.8
Fe_2O_3 (IRON OXIDE)	0.015
Al_2O_3 (ALUMINUM OXIDE)	0.042
TiO_2 (TITANIUM DIOXIDE)	0.013
MgO (MAGNESIUM OXIDE)	<0.01
Na_2O (SODIUM OXIDE)	<0.01
K_2O (POTASSIUM OXIDE)	<0.01
LOI (LOSS ON IGNITION)	0.10

TOTAL P.02

General Activity Schedule for Conducting a Short-term Sediment Toxicity Test with the amphipod *Hyalella azteca* (adapted ASTM 2012 and USEPA 2000).	
Day	**Activity**
About -7	Inform organism supplier of the need to isolate <24-h old amphipods from mass culture, and to observe isolated amphipods daily to evaluate health.
-2 to -1	5-6 or 6-7 day old amphipods are received from the test organism supplier and maintained prior to testing. Amphipods are fed and observed daily to evaluate health.
-1	Sample sediments for physical and chemical characteristics and sample pore water by centrifugation for water quality analyses. Analytical program will follow approved UCR Phase II QAPP. Place sediments into exposure beakers and add overlying water for about a 24-h equilibration period at 23°C. Start delivery of overlying water to the exposure beakers.
0	Measure total water quality of overlying water (pH, temperature, dissolved oxygen, hardness, alkalinity, conductivity, ammonia). Transfer ten test organisms into each test chamber. Release organisms under the surface of the water. Add appropriate food to each test chamber. Isolate 80 amphipods for T0 weight measurement. Place first set of peepers in chemistry beakers on Day 0 and sample peepers from chemistry beakers 7 days later.
1–27	Feed test organisms. Perform AM and PM water changes (2 volume additions per day). Measure temperature and dissolved oxygen (DO) daily, pH three times a week, and conductivity weekly. Observe behavior of test organisms.
7	Sample peepers and sediment porewater from chemistry beakers that were loaded on Day 0. Analytical program will follow approved UCR Phase II QAPP
14	Increase YCT feeding rate from 1.0 ml/day to 2.0 ml/day (Mount 2011).
14–20	Place a second set of peepers in chemistry beakers on one of the days between Day 14-20 and sample peepers from chemistry beakers 7 days later.
21–27	Sample peepers and sediment porewater from chemistry beakers that were loaded on Day 14-20. Analytical program will follow approved UCR Phase II QAPP
28	Measure temperature, dissolved oxygen, pH, hardness, alkalinity, conductivity, and ammonia. End the sediment-exposure portion of the test by collecting the test organisms with a #40 mesh sieve (425-µm mesh; U.S. standard size sieve). Count survivors and weigh test organisms for biomass and mean dry weight test endpoints.

General Activity Schedule for Conducting a Long-term Sediment Toxicity Test with the amphipod *Hyalella azteca* (adapted ASTM 2012 and USEPA 2000).	
Day	**Activity**
About -8	Inform organism supplier of the need to isolate <24-h old amphipods from mass culture, and to observe isolated amphipods daily to evaluate health.
-2 to -1	5-6 or 6-7 day old amphipods are received from the test organism supplier and maintained prior to testing. Amphipods are fed and observed daily to evaluate health.
-1	Sample sediments for physical and chemical characteristics and sample pore water by centrifugation for water quality analyses. Analytical program will follow approved UCR Phase II QAPP. Place sediments into exposure beakers and add overlying water for about a 24-h equilibration period at 23°C. Start delivery of overlying water to the exposure beakers.
0	Measure total water quality of overlying water (pH, temperature, dissolved oxygen, hardness, alkalinity, conductivity, ammonia). Transfer ten test organisms into each test chamber. Release organisms under the surface of the water. Add appropriate food to each test chamber. Isolate 80 amphipods for T0 weight measurement. Place first set of peepers in chemistry beakers on Day 0 and sample peepers from chemistry beakers 7 days later.
1–27	Feed test organisms. Perform AM and PM water changes (2 volume additions per day). Measure temperature and dissolved oxygen (DO) daily, pH three times a week, and conductivity weekly. Observe behavior of test organisms.
7	Sample peepers and sediment porewater by centrifugation from chemistry beakers that were loaded on Day 0. Analytical program will follow approved UCR Phase II QAPP.
14	Increase YCT feeding rate from 1.0 ml/day to 2.0 ml/day (Mount 2011).
14–20	Place a second set of peepers in chemistry beakers on one of the days between Day 14-20 and sample peepers from chemistry beakers 7 days later.
21–27	Sample peepers and sediment porewater by centrifugation from chemistry beakers that were loaded on Day 14-20. Analytical program will follow approved UCR Phase II QAPP.
28	Measure temperature, dissolved oxygen, pH, hardness, alkalinity, conductivity, and ammonia. End the sediment-exposure portion of the test by collecting the test organisms with a #40 mesh sieve (425-µm mesh; U.S. standard size sieve). Count survivors and weigh test organisms for biomass and mean dry weight test endpoints. Prepare eight amphipod replicate beakers for reproduction measurements: Place survivors in individual replicate water-only beakers containing 2 inch squares of nitex mesh. Add food to each test beaker/d and 2 volume additions/d of overlying water.
29–35	Feed daily. Measure temperature and dissolved oxygen (DO) daily, pH three times a week, and conductivity weekly. Perform AM and PM water changes (2 volume additions per day).
35	Record the number of surviving adults and remove offspring. Return adults to their original individual beakers and add food.
36–41	Feed daily. Measure temperature and dissolved oxygen (DO) daily, pH three times a week, and conductivity weekly. Perform AM and PM water changes (2 volume additions per day).
42	Measure total water quality (pH, temperature, dissolved oxygen, hardness, alkalinity, conductivity, ammonia). Record the number of surviving adults and offspring. Surviving adult amphipods on Day 42 are observed for determination of the number of males and females in each replicate. This information is used to calculate the number of young produced per female per replicate from Day 28 to Day 42. Weigh adult test organisms for biomass and mean dry weight test endpoints.

General Activity Schedule for Conducting a Short-term Sediment Toxicity Test with *Chironomus dilutus* (adapted from ASTM 2012a and USEPA 2000).	
Day	**Activity**
About -9	Isolate egg mass from mass cultures for hatching on about Day -7. Feed and observe larvae daily to evaluate health.
-1	Sample sediments for physical and chemical characteristics and sample pore water by centrifugation for water quality analyses. Analytical program will follow approved UCR Phase II QAPP. Place sediments into exposure beakers and add overlying water for about a 24-h equilibration period at 23°C. Start delivery of overlying water to the exposure beakers.
0	1. Transfer larvae into exposure chambers. Add 1.5 ml food to each test beaker with sediment before the larvae are added. Add 10 larvae to each replicate beaker. 2. Measure temperature, pH, hardness, alkalinity, dissolved oxygen, conductivity, and ammonia at start of test. 3. Isolate 80 larvae for T0 weight measurement. 4. Place first set of peepers in chemistry beakers on Day 0 and sample peepers from chemistry beakers 7 days later.
1–10	Perform AM and PM water changes (2 volume additions per day). On a daily basis, add 1.5 ml food to each beaker. Measure temperature and DO daily. Aerate if DO is less than 2.5 mg/L.
7	Sample peepers and sediment porewater by centrifugation from chemistry beakers that were loaded on Day 0. Analytical program will follow approved UCR Phase II QAPP
About 9	In preparation for weight determinations, ash weigh-pans at 550 °C for 2 h. Note that the weigh boats should be ashed before use to eliminate weighing errors due to the pan oxidizing during ashing of samples.
10	Recover larvae for growth, biomass, and survival determinations. Pool all living larvae per replicate and dry the sample to a constant weight (e.g., 60°C for 24 h). Measure overlying water quality (pH, ammonia, DO, conductivity, hardness, and alkalinity).
11	The sample with dried larvae is brought to room temperature in a desiccator and weighed to the nearest 0.01 mg. The dried larvae in the pan are then ashed at 550°C for 2 h. The pan with the ashed larvae is then re-weighed and the tissue mass of the larvae determined as the difference between the weight of the dried larvae plus pan and the weight of the ashed larvae plus pan.

General Activity Schedule for Conducting a Long-term Sediment Toxicity Test with *Chironomus dilutus* (adapted from ASTM 2012 and USEPA 2000 with <24-h-old larvae used to start the exposures).	
Day	**Activity**
About -3	Isolate egg mass from mass cultures for hatching on Day 0. Incubated at 23°C
About -2	Check egg cases for viability and development
-1	Sample sediments for physical and chemical characteristics and sample pore water by centrifugation for water quality analyses. Analytical program will follow approved UCR Phase II QAPP. Place sediments into exposure beakers and add overlying water for about a 24-h equilibration period at 23°C. Add 1.5 ml food to each test beaker after sediment has settled. Start delivery of overlying water to the exposure beakers. Check egg cases for hatch and development.
0	Transfer larvae into exposure chambers. Add 1.5 ml food to each test beaker with sediment before the larvae are added. Add 12 larvae to each replicate beaker. Measure temperature, pH, hardness, alkalinity, dissolved oxygen, conductivity, and ammonia at start of test. Place first set of peepers in chemistry beakers on Day 0 and sample peepers from chemistry beakers 7 days later.
1–End	Perform AM and PM water changes (2 volume additions per day). On a daily basis, add 1.5 ml food to each beaker. Measure temperature and DO daily. Aerate if DO is less than 2.5 mg/L. Measure the pH three times a week, and conductivity weekly.
7	Sample peepers and sediment porewater by centrifugation from chemistry beakers that were loaded on Day 0. Analytical program will follow approved UCR Phase II QAPP
7–10	Set up auxiliary male beakers (4 replicates/treatment) same as those described above for the beginning of the test.
14–20	Place a second set of peepers in chemistry beakers on one of the days between Day 14-20 and sample peepers from chemistry beakers 7 days later.
19	In preparation for weight determinations, ash weigh-pans at 550 °C for 2 h. Note that the weigh boats should be ashed before use to eliminate weighing errors due to the pan oxidizing during ashing of samples.
20	Sample four replicates from each treatment to recover larvae for growth, biomass, and survival determinations. Pool all living larvae per replicate and dry the sample to a constant weight (e.g., 60°C for 24 h). Install emergence traps on each reproductive replicate beaker. Measure overlying water quality (pH, ammonia, DO, conductivity, hardness, and alkalinity).
21	The sample with dried larvae is brought to room temperature in a desiccator and weighed to the nearest 0.01 mg. The dried larvae in the pan are then ashed at 550°C for 2 h. The pan with the ashed larvae is then re-weighed and the tissue mass of the larvae determined as the difference between the weight of the dried larvae plus pan and the weight of the ashed larvae plus pan.
21–27	Sample peepers and sediment porewater by centrifugation from chemistry beakers that were loaded on Day 14-20. Analytical program will follow approved UCR Phase II QAPP
21–End	On a daily basis, record emergence of males and females, pupal, and adult mortality, and time to death for previously collected adults. Each day, transfer adults from each replicate to a corresponding reproduction/oviposition (R/O) chamber. Transfer each primary egg case from the R/O chamber to a corresponding Petri dish to monitor incubation and hatch. Record each egg case oviposited, number of eggs produced (using either the ring or direct count methods), and number or hatched eggs. If it is difficult to estimate the number of eggs in an egg case, use a direct count to determine the number of eggs; however the hatchability data will not be obtained for this egg case.
28	Place emergence traps on auxiliary male replicate beakers.
33–End	Transfer males emerging from the auxiliary male replicates to individual reproduction/oviposition (R/O) chamber. The auxiliary males are used for mating with females from corresponding treatments from which most of the males had already emerged or in which no males emerged.
33–42	Place a second set of peepers in chemistry beakers on one of the days between Day 35-42 and sample peepers from chemistry beakers 7 days later.
42–49	Sample peepers and sediment porewater by centrifugation from chemistry beakers that were loaded on Day 35-42. Analytical program will follow approved UCR Phase II QAPP.
40–End	After 7 d of no recorded emergence in the control treatment, end the study by recovering larvae, pupae, or pupal exuviae. Measure overlying water quality (pH, ammonia, DO, conductivity, hardness, and alkalinity) at the end of the study.

APPENDIX F

EPA PHASE 2 SEDIMENT SAMPLING ALTERNATIVE LOCATIONS, RATIONALE, AND SITE RECONNAISSANCE

APPENDIX F1

ALTERNATIVE SAMPLING LOCATIONS PROPOSAL

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue, Suite 900
Seattle, WA 98101-3140

OFFICE OF
ENVIRONMENTAL CLEANUP

April 27, 2012

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

Reply To: ECL-111

Marko E. Adzic
Teck American Incorporated
501 North Riverpoint Boulevard, Suite 300
Spokane, Washington 99202

RE: Upper Columbia River: EPA proposed alternative sediment sampling locations

Dear Mr. Adzic,

As you are aware, the Unites States Environmental Protection Agency (EPA) is currently reviewing the draft Quality Assurance Project Plan (QAPP) for the Upper Columbia River project Phase 2 Sediment Study. The number and placement of sediment samples proposed by Teck American Incorporated (Teck) in the draft QAPP has been reviewed and discussed at length by the EPA and our project partners. Because the number and placement of samples is a central issue to the QAPP, I wanted to let you know sooner rather than later that the EPA will be proposing additional samples and some alternate sampling locations in our forthcoming comment letter on the QAPP.

Enclosed with this letter are a technical memorandum and a series of maps that describe the EPA's proposed alternative sampling locations. I am also sending today, via Email, an electronic copy of the technical memorandum, an Excel file with lat longs and other information for each of the samples, and the maps and the GIS files of the sample locations.

Please review the EPA's proposed sampling approach. The EPA's team would like to meet with you in the near future to discuss our technical proposal in detail. If you do not have any questions and find the EPA's alternative proposal acceptable, I will simply include the proposed locations in the EPA's forthcoming comments on the draft QAPP.

Sincerely,

Helen H. Bottcher

Helen Bottcher
Project Manager

enclosures (2): Technical Memo, Map portfolio

cc: Dan Audet, U.S. Department of Interior (w/o enclosures)
Patti Bailey, Confederated Tribes of the Colville Reservation (w/o enclosures)
Randy Connolly, Spokane Tribe of Indians (w/o enclosures)
John Roland, Washington Department of Ecology (w/o enclosures)

UCR Phase II Sediment Sampling – Alternative Sampling and Testing

PREPARED FOR: Helen Bottcher/EPA
Bruce Duncan/EPA
Marc Greenberg/EPA
David Charters/EPA

COPY TO: Marilyn Gauthier/PDX

PREPARED BY: Cameron Irvine/SAC

DATE: April 27, 2012

PROJECT NUMBER: 350521

Introduction

EPA is proposing the following approach to determine Upper Columbia River (UCR) Phase II sediment sample locations for benthic toxicity testing. This approach differs from the sample location presented by Teck American Inc. (TAI 2011) in the draft Phase II Sediment Quality Assurance Sampling Plan (QAPP) by 1) increasing the number of samples to be collected for toxicity testing; 2) increasing the number of alternative locations to serve as backup in the event that insufficient sample can be collected from the primary locations; and 3) clustering primary sample locations within a number of focus areas. A comparison of the EPA's approach to TAI's approach by sample type is presented in Table 1. The following sections provide more details of the approach and rational used by EPA to develop the alternative approach.

This plan further differs from the draft QAPP by delaying sample selection for longer-term chronic toxicity testing (i.e., 42-day *Hyalella* and 50-65 day midge) until after initial chronic toxicity tests (i.e., 10-d midge exposures and 28-d *Hyalella*) are completed. These initial test data will inform the sample selection for 18 longer-term chronic tests.

Table 1. Sample Type Summary

	EPA Alternative Sampling Plan		Teck (Draft QAPP)	
Analyses	**Primary**	**Reserve**	**Primary**	**Reserve**
Bioassay	48	114	30	30
Chemistry Only	66		30	
Internal Reference	10	10	-	-
Tributary Reference	6	-	-	-
Upstream Reference	8	4	10	-
Totals	*130*	*124*	*70*	*30*

Approach and Rationale

Sediment sampling for Phase II toxicity testing as part of the Upper Columbia River (UCR) Remedial Investigation/Feasibility Study (RI/FS) is intended to target sediment with grain sizes predominantly <2 mm from depositional areas to assess risks to benthic organisms. Toxicity testing as part of Phase I investigations (CH2M HILL 2012) found the greatest effects in sediment from the upper reaches above Kettle Falls (Reaches 1-3; river

mile 700 to the US-Canada border). Therefore, a goal of Phase II sediment sampling and toxicity testing is to collect and test additional sediments from these reaches to determine if complete dose-response relationships can be identified.

Phase II sediment sampling will cover 8 focus areas, with additional chemistry-only samples between focus areas. With the exception of the Marcus area, each focus area will have 6 bioassay locations, 4 chemistry-only locations, and 10 reserve locations. The Marcus area (focus area 4) will have 2 additional chemistry-only locations (total of 6 chemistry-only locations) and 2 additional reserve locations (total of 12 reserve locations). Areas in between each focus area will have 4 chemistry-only locations and four reserve locations. The proposed sampling emphasis was intended to be on locations predicted in TAI (2011) to have a high mPECQ, with a range of predicted TOC concentrations.

After initially selecting the locations, they were compared to the 2005 sediment sample locations and the 2011 beach sample locations. Any that are within 500 feet or less of a 2005 location or offshore from a sampled beach were noted (refer to comments in Table 2). Further, samples were compared to the Colville Confederated Tribe (CCTs) substrate maps for the margins of the river and reservoir, and any that were noted on top of a bedrock or gravel layer were moved slightly to avoid these locations with non-target substrate (refer to comments in Table 2).

The focus area approach will provide a sense of the small scale sediment variability in representative reaches across the Site. This approach is also expected to improve sampling efficiency by allowing sampling teams to travel relatively short distances between bioassay sample sites. When sampler refusal occurs, there will be multiple alternate locations near-by that can be selected to collect the desired sample within the same target area. Focus areas for Phase 2 sampling are larger than those in Phase 1 and, because there are two more than in Phase 1, they cover a relatively large extent of the study area. Chemistry only locations between focus areas will allow estimates of toxicity based on concentration-response relationships derived from the bioassay data, and will help in targeting future sampling to fill specific bins or sediment categories, if necessary.

Table 2 describes the predicted physico -chemical attributes (TOC, mPECQ, and grain size) for each proposed sample location, coordinates, elevation, river mile, as well as which TAI (2011) “sediment group” it would fall into).

The following goals are targeted:

- At least 10 (of the 48) bioassay samples should have mPECQs > 5
- At least 20 (of the 48) bioassay samples should show SEM-AVS > 60
- At least 4 (of the 48) bioassay samples should fall into the upper 80th percentile of the site-wide concentration distribution for the following parameters: slag, mercury, arsenic, and PAHs.

Sample Collection Hierarchy

The following sample collection hierarchy should be implemented as part of the Standard Operating Procedures (SOP) for sediment sample collection to ensure that the highest priority is given to bioassay samples, to allow flexibility and to guide field sampling efforts that may need to re-assign intended samples to achieve this goal, and to assign collected sediment for analyses based on the available sample volume even if different from the planned analysis.

1) In each focus area, all six bioassay samples should be attempted for collection first.
    a. If a bioassay-designated location does not yield enough sediment for bioassays, but the amount suffices for chemistry-only requirements, the location should be designated as a chemistry-only location and a new bioassay location assigned from the list of chemistry-only locations in the same focus area.

b. If a bioassay-designated location does not yield enough sediment for chemistry-only requirements, a new bioassay location should be assigned from the list of chemistry-only locations in the same focus area and a reserve location from the same focus area should be designated as a chemistry-only location.

2) Primary chemistry or reserve locations outside of the focus area may be designated as bioassay sample stations if insufficient volume can be collected from the primary and reserve sample locations within the focus area.

3) A reserve location outside of the focus area may be designated as a chemistry-only location if insufficient sample volume can be collected from the primary sample locations within the focus area.

4) The field team leader will identify the closest alternative station with similar expected physico -chemical attributes (TOC, mPECQ, and grain size) when alternative stations are needed to fulfill a sample requirement for a bioassay station where insufficient sample volume can be collected. Emphasis will be based on mPECQ, desired grain size, and then TOC when alternate stations are selected.

Reference Samples

Reference samples that closely resemble the properties of UCR sediment (i.e., grain size, TOC, etc,…) are not easily identified or obtained. Therefore, a range of reference samples both internal to the UCR site (with low predicted toxicity), and external to the UCR site (tributaries to the UCR and upstream of Trail) are proposed. These reference samples will cover a range of physical-chemical sediment properties that resemble site samples to varying degrees. A target number of reference samples to collect is 24 with 20-24 of these usable as intended. It is recognized that some of these may not be achievable, or suitable as reference samples, as determined during collection (due to sampler refusal) or after toxicity testing (due to unexpected toxicity or chemistry results).

Ten primary internal reference locations for chemistry-only analysis are proposed (Table 2). Additionally, ten more reserve locations (each located relative near a primary internal reference sample location) have been identified in the event that the primary location is not suitable for sampling or yields insufficient sample volume. Internal reference locations were identified at locations sampled in 2005 (Phase I sediment sampling) where metal concentrations were below 0.1 mPECQ.

Six additional reference samples have been identified at tributary mouths (Table 2). These stations were sampled in 2005 (Phase I sediment sampling) and resulted in acceptable reference sample performance (i.e., they met reference envelope sample criteria).

Multiple upstream reference samples are also desirable, including those identified by TAI (2011). EPA supports the collection of at least six samples from Canada identified in TAI (2011): two from each of Lower Arrow Lake (shallow), Lower Arrow Lake (deep), and Genelle. Two additional samples should also be collected, if possible, from a fourth location between the Hugh-Keenleyside Dam and Castlegar.

Longer-term Chronic Toxicity Test Samples

Longer-term chronic toxicity testing (i.e., 42-day *Hyalella* and 50-65 day midge) will begin as soon as possible after initial chronic toxicity tests (i.e., 10-d midge exposures and 28-d *Hyalella*) are completed. The initial test data will inform the sample selection for 18 longer-term chronic tests. Preliminary data on replicate survival and weight of amphipods or midge should be available within a week of completing the initial exposures. Preliminary chemistry data for AVS/SEM, grain size, initial pore water metals, and bulk sediment metals should also be available for consideration. The following criteria should be used to identify the 16 samples with the objective to make sure the variety of sediment and porewater parameters encountered in mid to low range toxicity is encompassed:

a. Low to moderate toxicity response;

b. high metal concentrations in pore-water or bulk sediment; and,

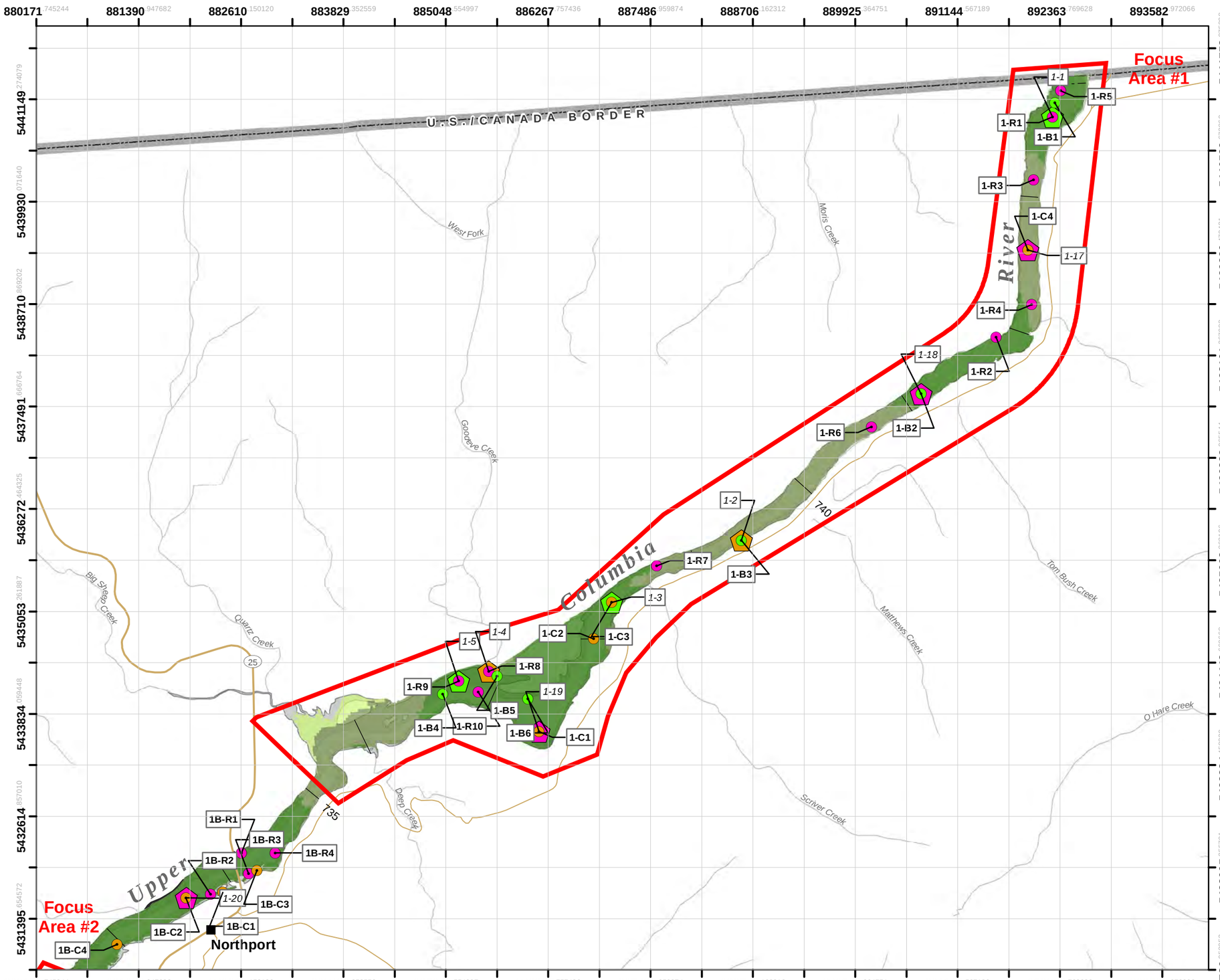
c. representing a range of sediment and porewater characteristics (e.g., grain size, TOC, DOC, etc…) to the best extent possible.

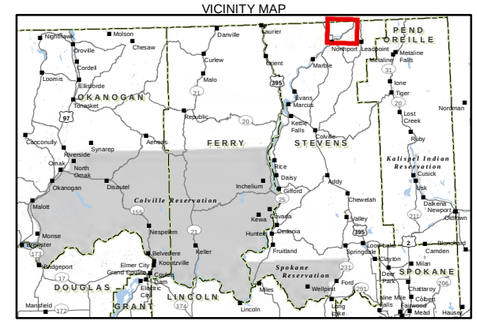
References

CH2M HILL. 2012. Summary and Evaluation of Phase 1 (2005) Sediment Toxicity Tests Upper Columbia River Site. Draft Final. Prepared for U.S. Environmental Protection Agency, Region 10. January 2012.

Teck American Inc. (TAI). 2011. Upper Columbia River Draft Quality Assurance Project Plan for the Phase 2 Sediment Study. Prepared for Teck American Inc by Exponent, Hydroqual and Parametrix, Inc. March 2011.

Figures





LEGEND

- Primary Internal Reference
- Alternate Internal Reference
- Tributary Reference
- EPA Primary Bioassay
- EPA Primary Chemistry-Only
- EPA Alternate Bioassay
- Teck Primary Bioassay
- Teck Primary Chemistry-Only
- Teck Alternate Bioassay

UCR Interpolated mPECQ

- < 0.2
- 0.2 - 2.0
- 2.0 - 5.0
- > 5.0

Bottom Elevation

- 880 - 930
- 931 - 980
- 981 - 1030
- 1031 - 1080
- 1081 - 1130
- 1131 - 1180
- 1181 - 1230
- 1231 - 1280

Other Features

- Tribal Lands
- Water
- Original River Channel
- Landslides
- Cities
- Transect Lines
- Highway
- Major Road

Note:
1. Bottom elevations based on 1949 NOAA bathymetric survey.

DRAFT

N

0 0.75
Miles

FIGURE X
Proposed and Alternative Phase 2 Sediment Sampling Locations with mPECQ, River Miles 733 to 744
CERCLA RI/FS
Upper Columbia River Project

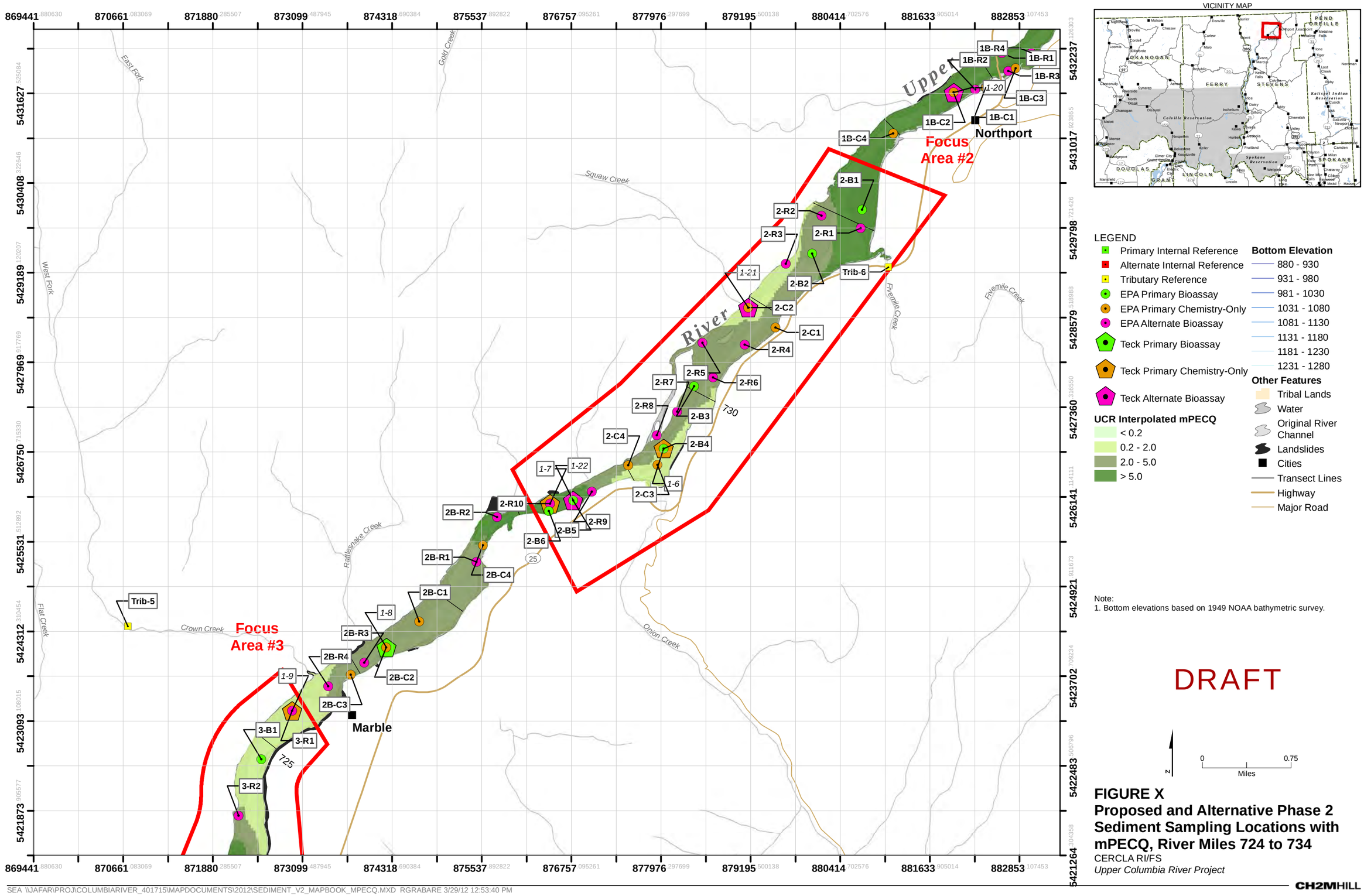
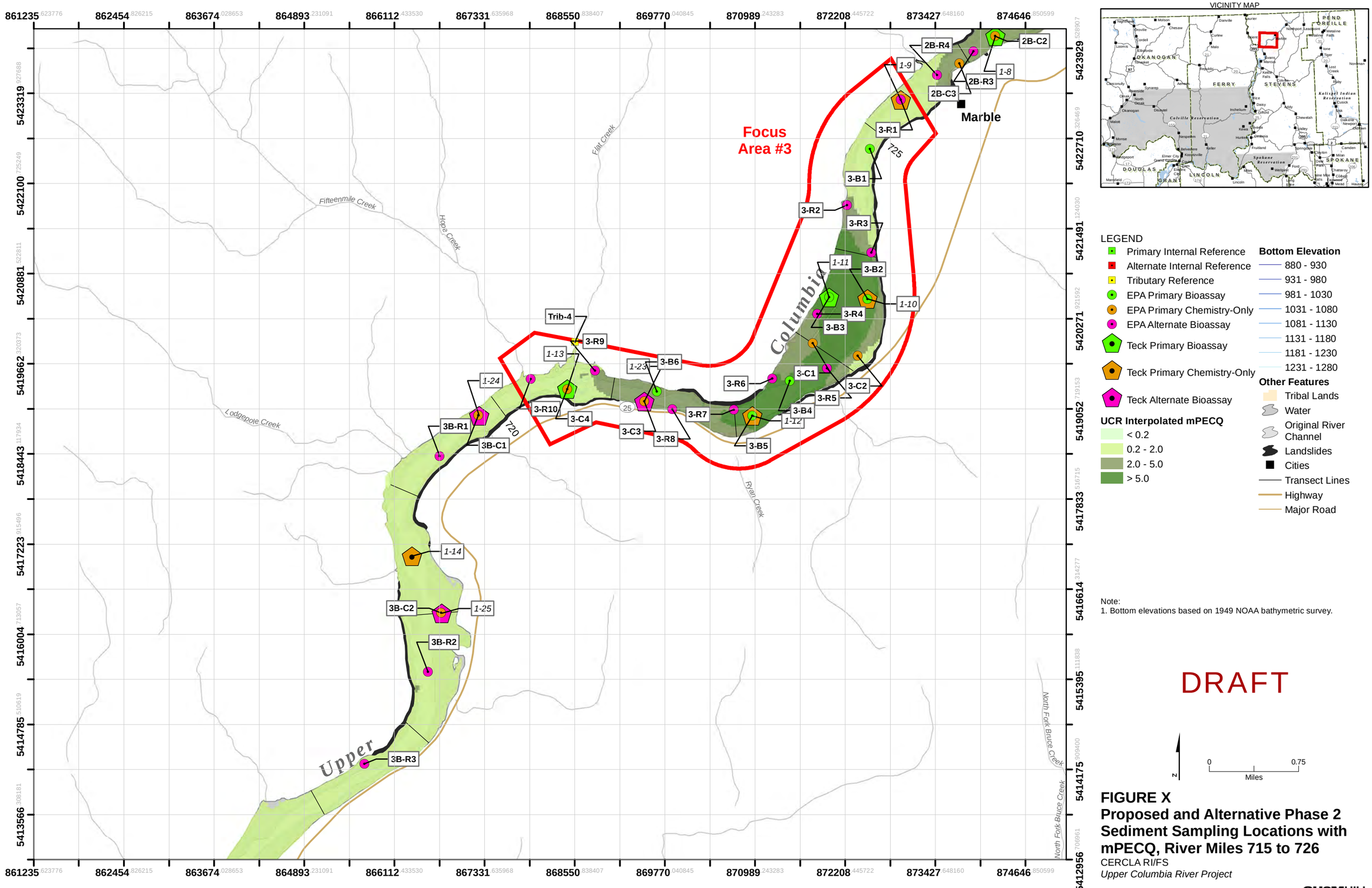


FIGURE X
Proposed and Alternative Phase 2 Sediment Sampling Locations with mPECQ, River Miles 724 to 734
CERCLA RI/FS
Upper Columbia River Project



VICINITY MAP

LEGEND

- Primary Internal Reference
- Alternate Internal Reference
- Tributary Reference
- EPA Primary Bioassay
- EPA Primary Chemistry-Only
- EPA Alternate Bioassay
- Teck Primary Bioassay
- Teck Primary Chemistry-Only
- Teck Alternate Bioassay

UCR Interpolated mPECQ

- < 0.2
- 0.2 - 2.0
- 2.0 - 5.0
- > 5.0

Bottom Elevation

- 880 - 930
- 931 - 980
- 981 - 1030
- 1031 - 1080
- 1081 - 1130
- 1131 - 1180
- 1181 - 1230
- 1231 - 1280

Other Features

- Tribal Lands
- Water
- Original River Channel
- Landslides
- Cities
- Transect Lines
- Highway
- Major Road

Note:
1. Bottom elevations based on 1949 NOAA bathymetric survey.

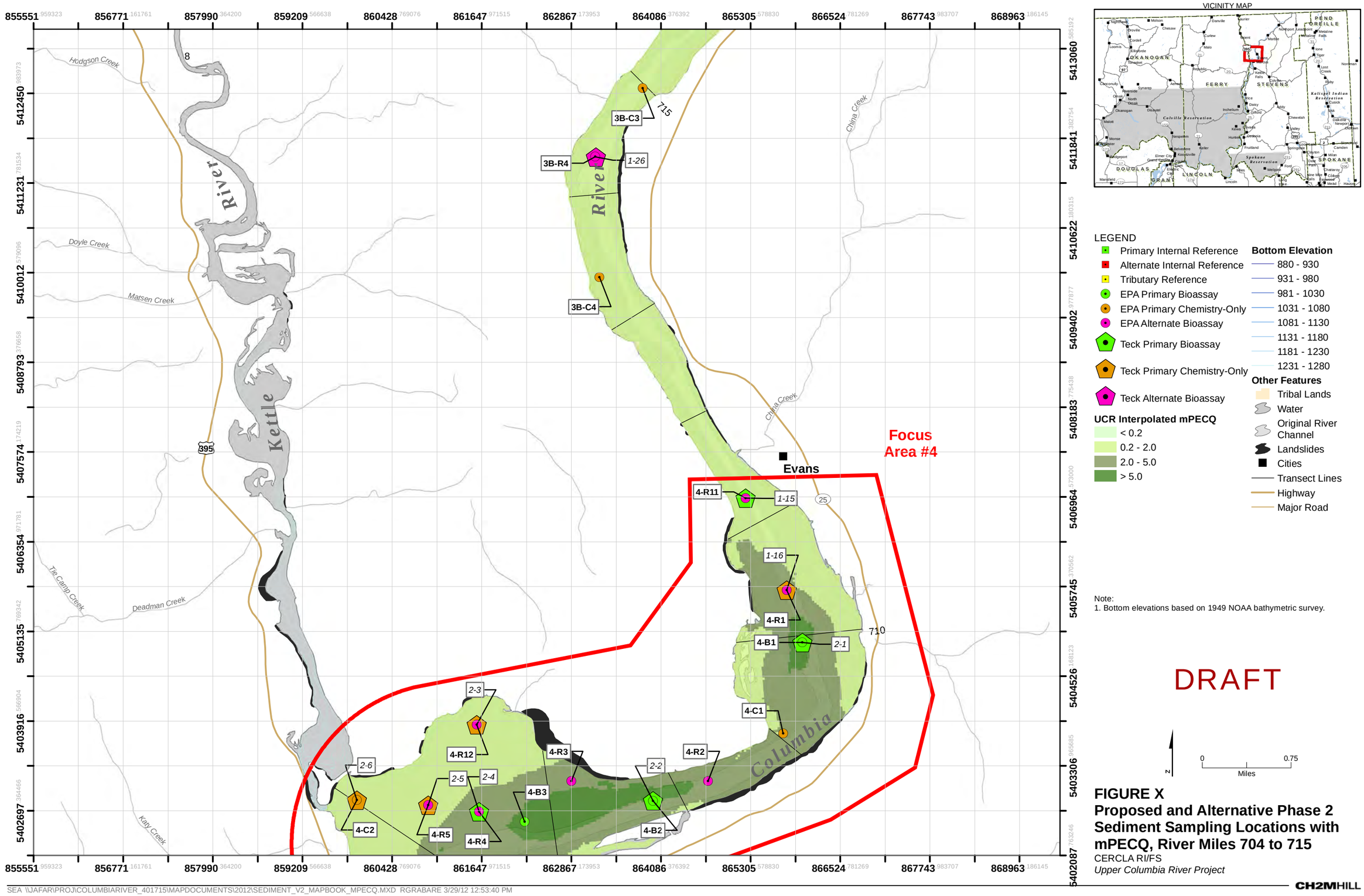
DRAFT

N

0 0.75 Miles

FIGURE X
Proposed and Alternative Phase 2 Sediment Sampling Locations with mPECQ, River Miles 715 to 726
CERCLA RI/FS
Upper Columbia River Project

CH2MHILL



VICINITY MAP

LEGEND

- Primary Internal Reference
- Alternate Internal Reference
- Tributary Reference
- EPA Primary Bioassay
- EPA Primary Chemistry-Only
- EPA Alternate Bioassay
- Teck Primary Bioassay
- Teck Primary Chemistry-Only
- Teck Alternate Bioassay

UCR Interpolated mPECQ

- < 0.2
- 0.2 - 2.0
- 2.0 - 5.0
- > 5.0

Bottom Elevation

- 880 - 930
- 931 - 980
- 981 - 1030
- 1031 - 1080
- 1081 - 1130
- 1131 - 1180
- 1181 - 1230
- 1231 - 1280

Other Features

- Tribal Lands
- Water
- Original River Channel
- Landslides
- Cities
- Transect Lines
- Highway
- Major Road

Note:
1. Bottom elevations based on 1949 NOAA bathymetric survey.

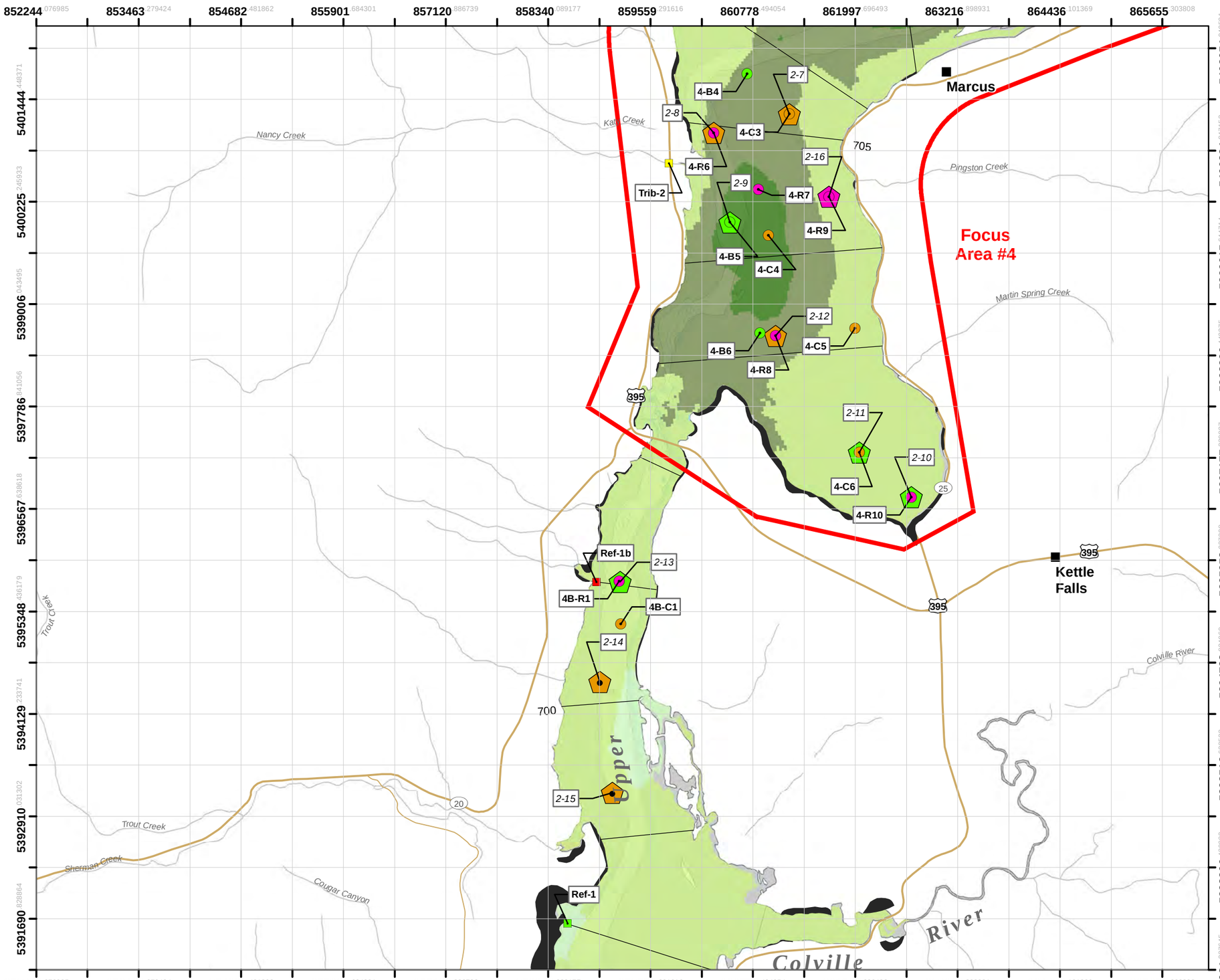
DRAFT

N

0 0.75
Miles

FIGURE X
Proposed and Alternative Phase 2 Sediment Sampling Locations with mPECQ, River Miles 704 to 715
CERCLA RI/FS
Upper Columbia River Project

CH2MHILL



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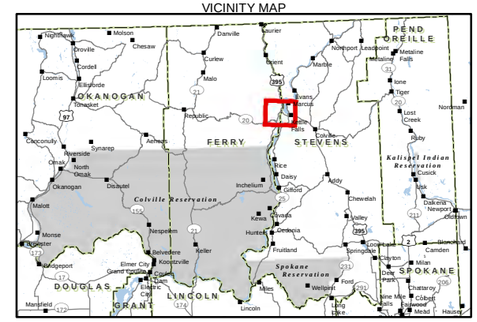


LEGEND

- Primary Internal Reference
- Alternate Internal Reference
- Tributary Reference
- EPA Primary Bioassay
- EPA Primary Chemistry-Only
- EPA Alternate Bioassay
- Teck Primary Bioassay
- Teck Primary Chemistry-Only
- Teck Alternate Bioassay

UCR Interpolated mPECQ

- < 0.2
- 0.2 - 2.0
- 2.0 - 5.0
- > 5.0

Bottom Elevation

- 880 - 930
- 931 - 980
- 981 - 1030
- 1031 - 1080
- 1081 - 1130
- 1131 - 1180
- 1181 - 1230
- 1231 - 1280

Other Features

- Tribal Lands
- Water
- Original River Channel
- Landslides
- Cities
- Transect Lines
- Highway
- Major Road

Note:
1. Bottom elevations based on 1949 NOAA bathymetric survey.

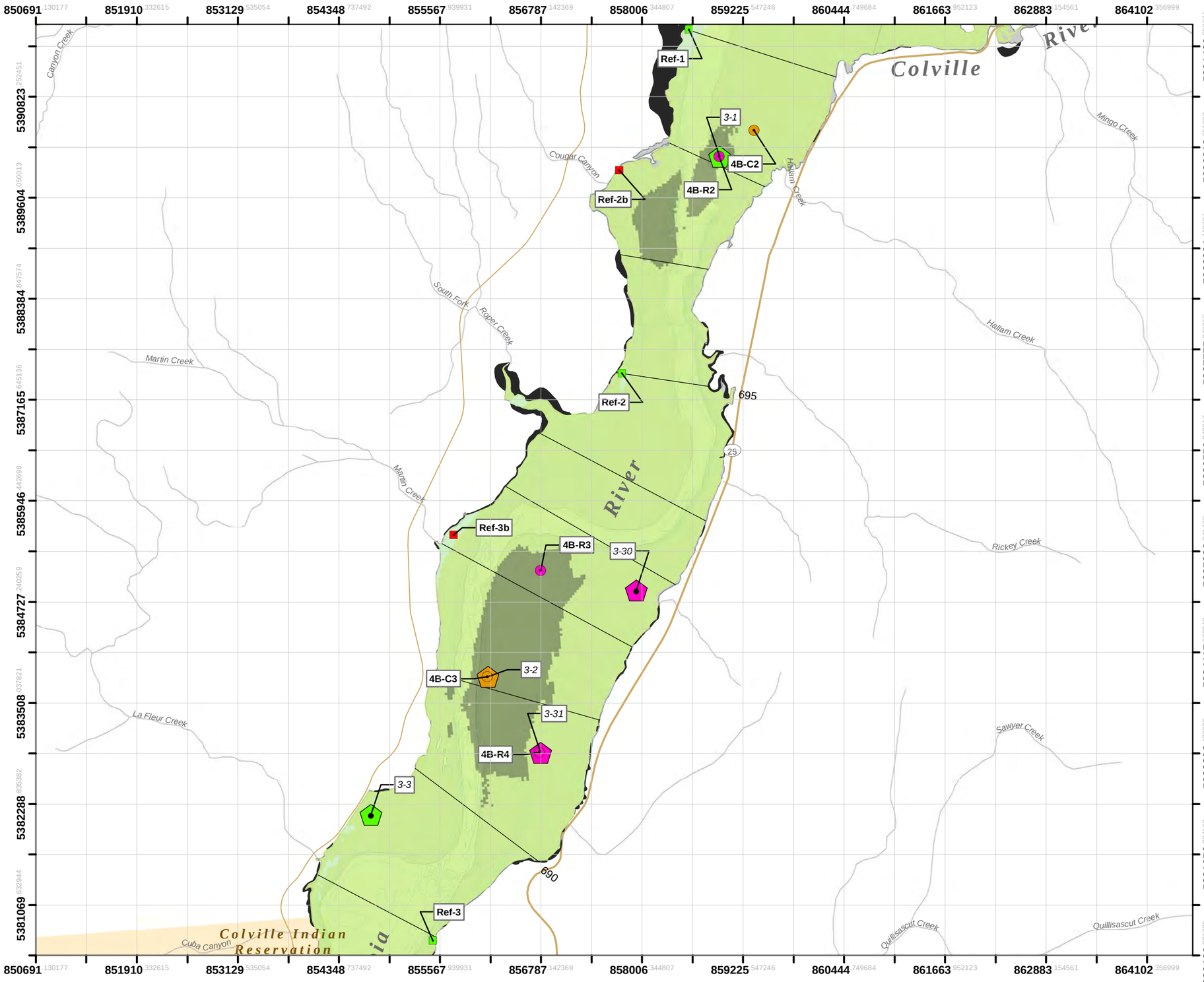
DRAFT

N

0 0.75
Miles

FIGURE X
Proposed and Alternative Phase 2 Sediment Sampling Locations with mPECQ, River Miles 698 to 706
CERCLA RI/FS
Upper Columbia River Project

CH2MHILL



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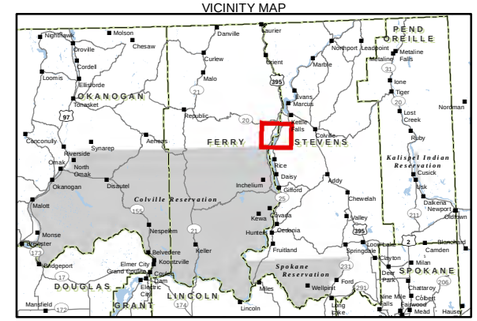

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- EPA Alternate Bioassay
- Teck Primary Bioassay
- Teck Primary Chemistry-Only
- Teck Alternate Bioassay

UCR Interpolated mPECQ

- < 0.2
- 0.2 - 2.0
- 2.0 - 5.0
- > 5.0

Bottom Elevation

- 880 - 930
- 931 - 980
- 981 - 1030
- 1031 - 1080
- 1081 - 1130
- 1131 - 1180
- 1181 - 1230
- 1231 - 1280

Other Features

- Tribal Lands
- Water
- Original River Channel
- Landslides
- Cities
- Transect Lines
- Highway
- Major Road

Note:
1. Bottom elevations based on 1949 NOAA bathymetric survey.

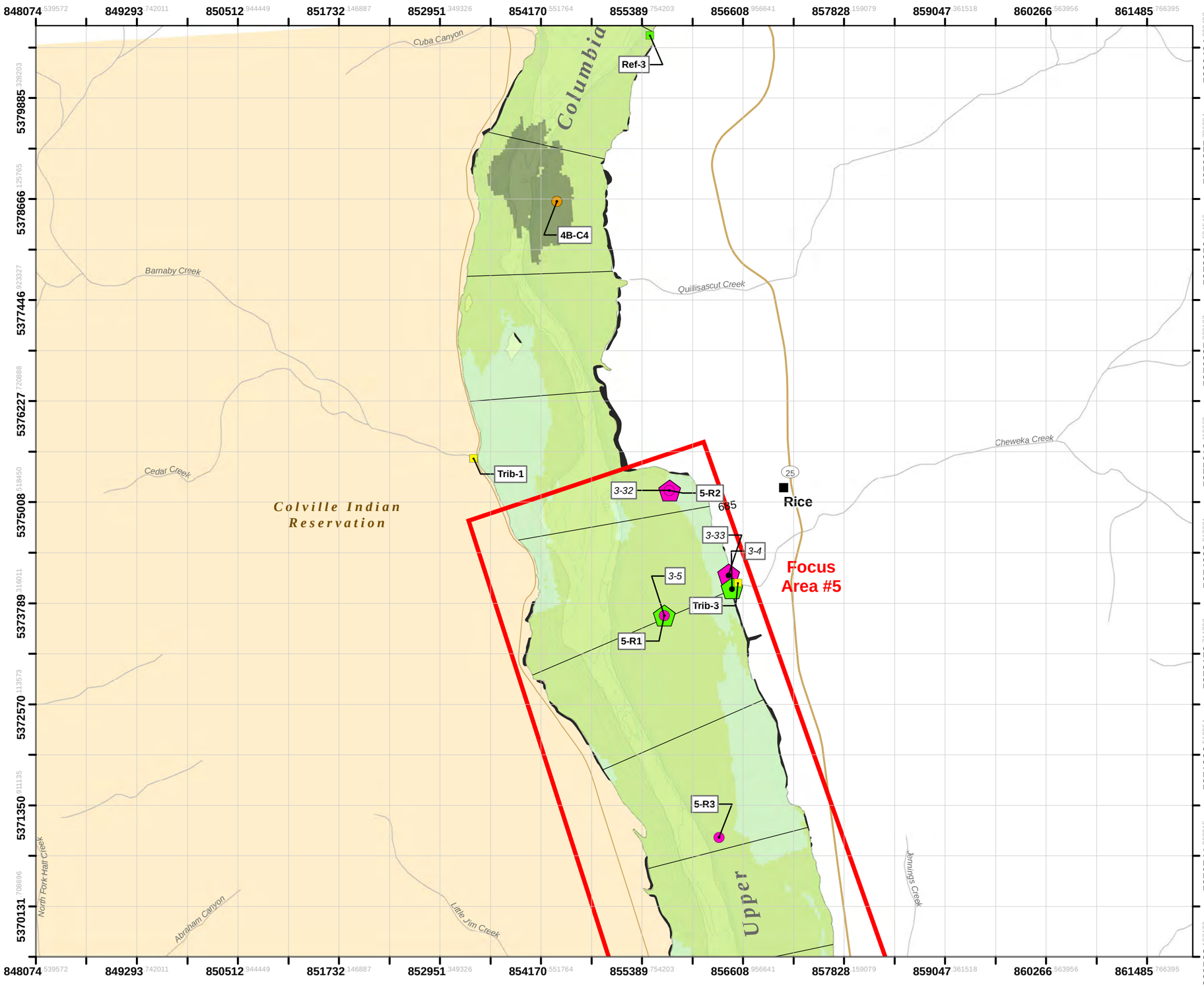
DRAFT

N

0 0.75
Miles

FIGURE X
Proposed and Alternative Phase 2 Sediment Sampling Locations with mPECQ, River Miles 689 to 698
CERCLA RI/FS
Upper Columbia River Project

CH2MHILL



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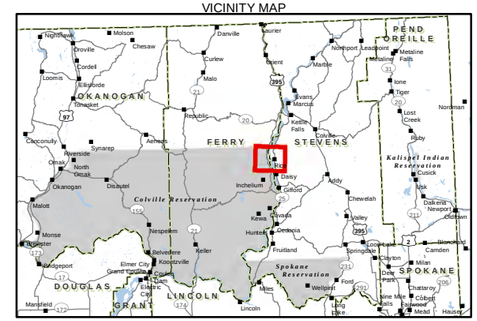

LEGEND

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- Teck Primary Bioassay
- Teck Primary Chemistry-Only
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UCR Interpolated mPECQ

- < 0.2
- 0.2 - 2.0
- 2.0 - 5.0
- > 5.0

Bottom Elevation

- 880 - 930
- 931 - 980
- 981 - 1030
- 1031 - 1080
- 1081 - 1130
- 1131 - 1180
- 1181 - 1230
- 1231 - 1280

Other Features

- Tribal Lands
- Water
- Original River Channel
- Landslides
- Cities
- Transect Lines
- Highway
- Major Road

Note:
1. Bottom elevations based on 1949 NOAA bathymetric survey.

DRAFT

N

0 0.75 Miles

FIGURE X
Proposed and Alternative Phase 2 Sediment Sampling Locations with mPECQ, River Miles 681 to 689
CERCLA RI/FS
Upper Columbia River Project

SEA \\JAFAR\PROJ\COLUMBIARIVER_401715\MAPDOCUMENTS\2012\SEDIMENT_V2_MAPBOOK_MPECQ.MXD RGRABARE 3/29/12 1:13:18 PM

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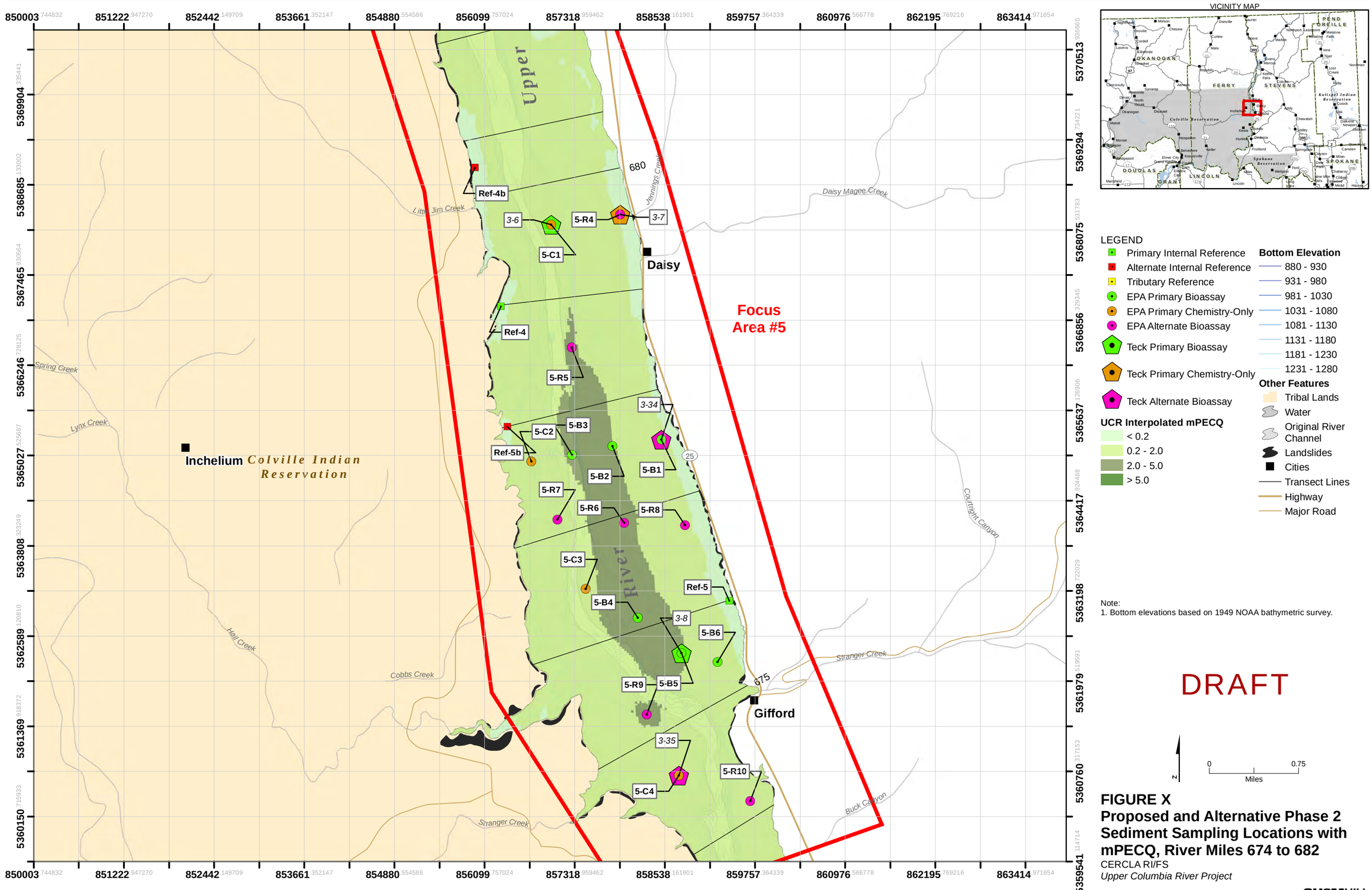
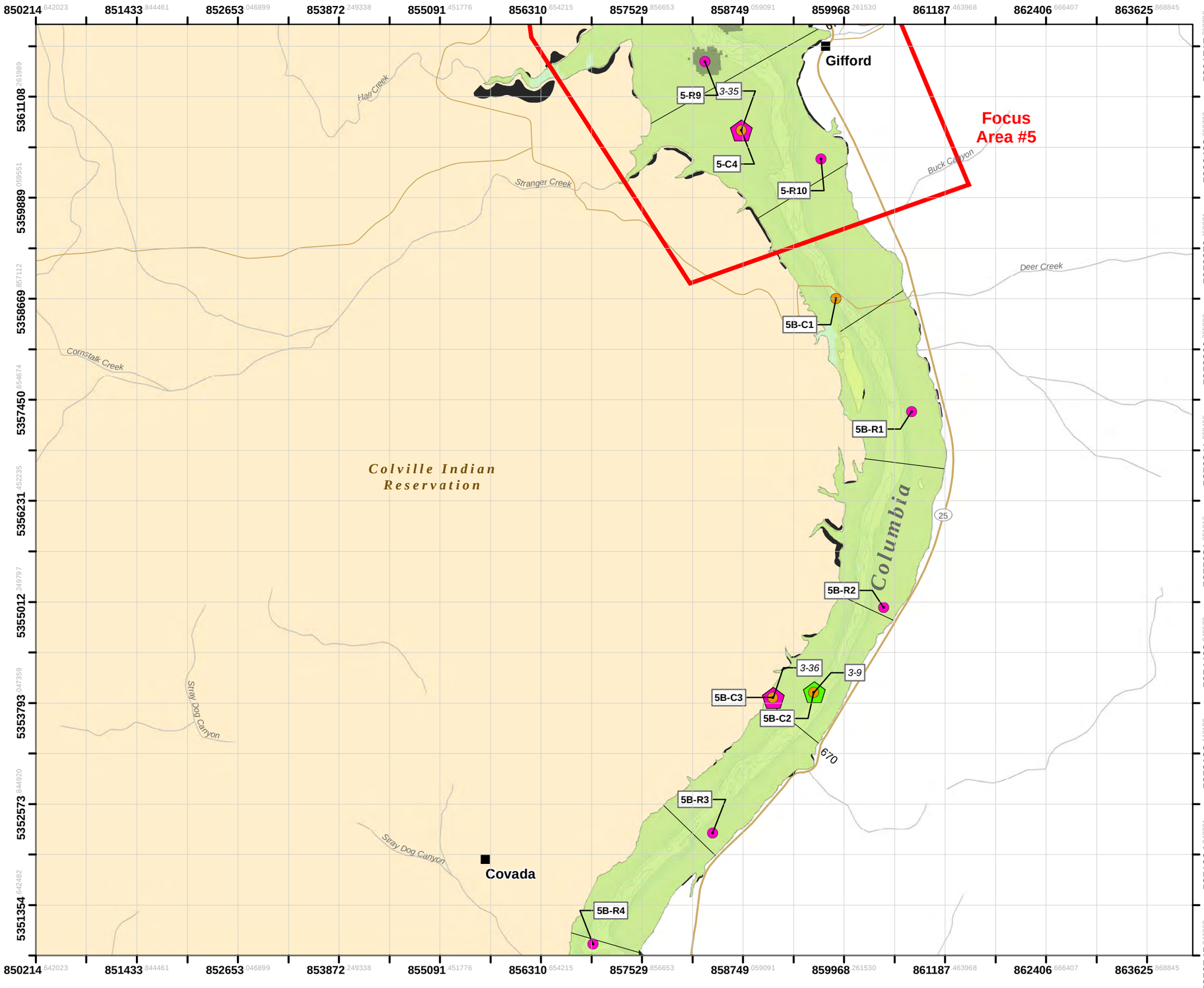


FIGURE X
Proposed and Alternative Phase 2 Sediment Sampling Locations with mPECQ, River Miles 674 to 682
CERCLA RI/FS
Upper Columbia River Project

CH2MHILL



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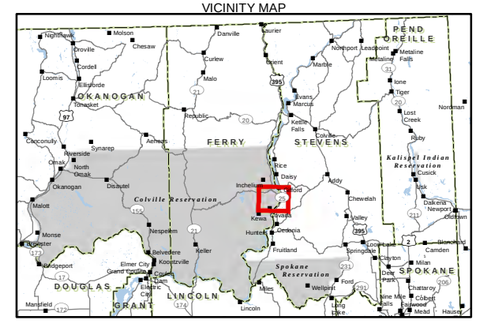

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- Primary Internal Reference
- Alternate Internal Reference
- Tributary Reference
- EPA Primary Bioassay
- EPA Primary Chemistry-Only
- EPA Alternate Bioassay
- Teck Primary Bioassay
- Teck Primary Chemistry-Only
- Teck Alternate Bioassay

UCR Interpolated mPECQ

- < 0.2
- 0.2 - 2.0
- 2.0 - 5.0
- > 5.0

Bottom Elevation

- 880 - 930
- 931 - 980
- 981 - 1030
- 1031 - 1080
- 1081 - 1130
- 1131 - 1180
- 1181 - 1230
- 1231 - 1280

Other Features

- Tribal Lands
- Water
- Original River Channel
- Landslides
- Cities
- Transect Lines
- Highway
- Major Road

Note:
1. Bottom elevations based on 1949 NOAA bathymetric survey.

DRAFT

N

0 0.75
Miles

FIGURE X
Proposed and Alternative Phase 2 Sediment Sampling Locations with mPECQ, River Miles 668 to 675
CERCLA RI/FS
Upper Columbia River Project

CH2MHILL

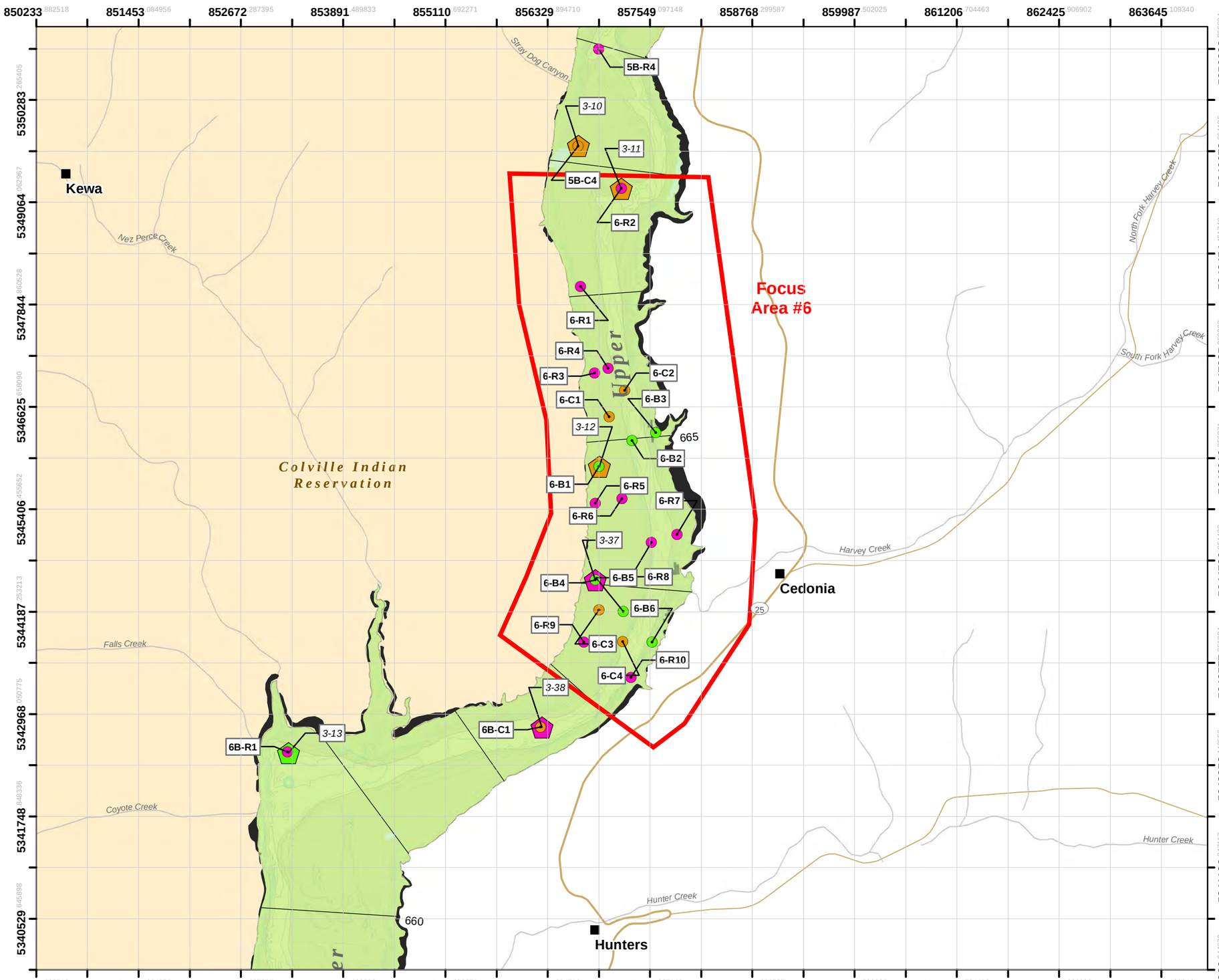
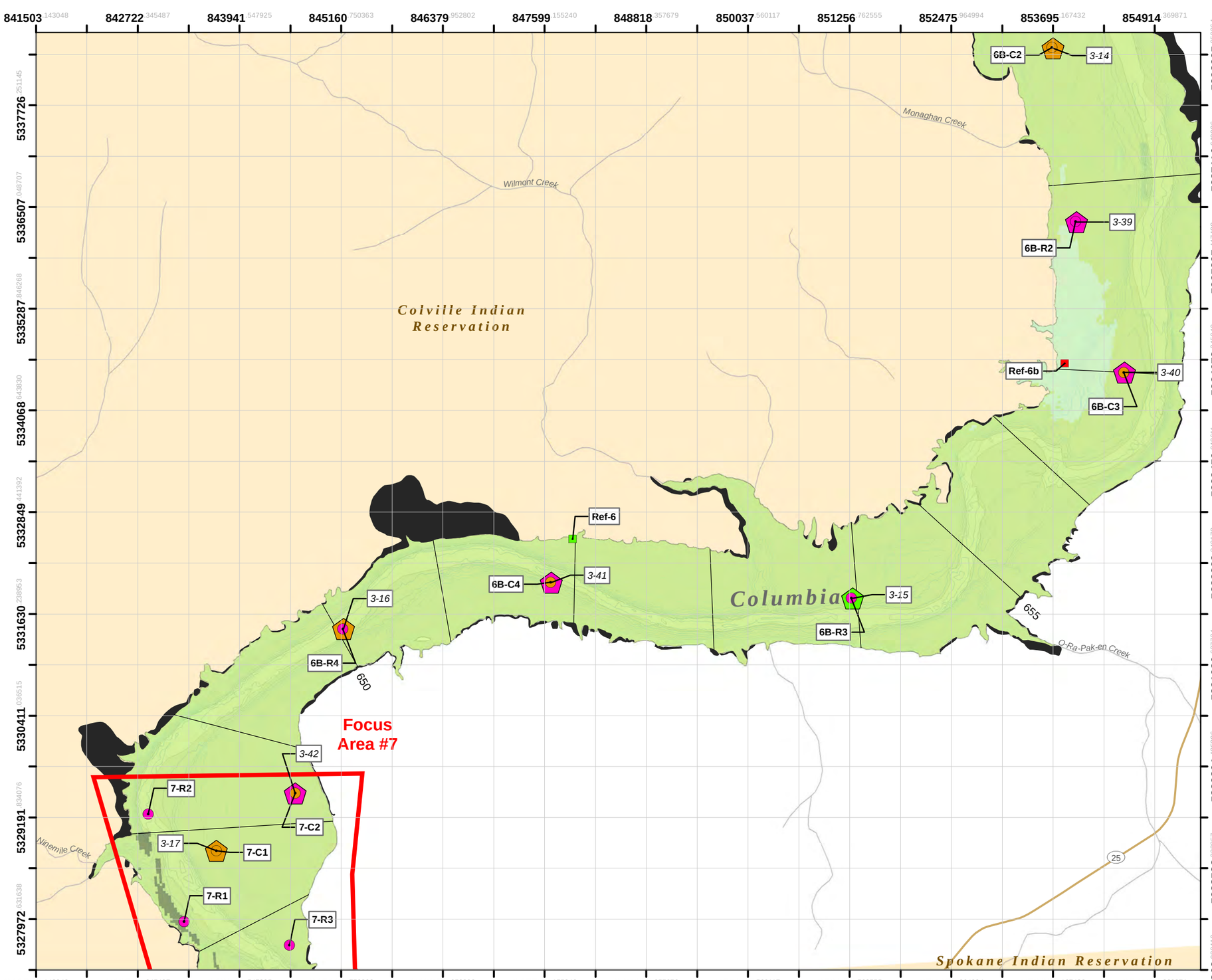


FIGURE X
Proposed and Alternative Phase 2 Sediment Sampling Locations with mPECQ, River Miles 660 to 668
CERCLA RI/FS
Upper Columbia River Project

CH2MHILL



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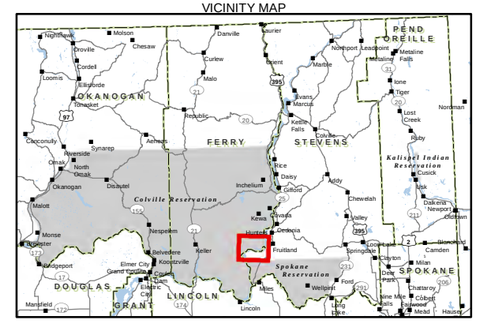


LEGEND

- Primary Internal Reference
- Alternate Internal Reference
- Tributary Reference
- EPA Primary Bioassay
- EPA Primary Chemistry-Only
- EPA Alternate Bioassay
- Teck Primary Bioassay
- Teck Primary Chemistry-Only
- Teck Alternate Bioassay

UCR Interpolated mPECQ

- < 0.2
- 0.2 - 2.0
- 2.0 - 5.0
- > 5.0

Bottom Elevation

- 880 - 930
- 931 - 980
- 981 - 1030
- 1031 - 1080
- 1081 - 1130
- 1131 - 1180
- 1181 - 1230
- 1231 - 1280

Other Features

- Tribal Lands
- Water
- Original River Channel
- Landslides
- Cities
- Transect Lines
- Highway
- Major Road

Note:
1. Bottom elevations based on 1949 NOAA bathymetric survey.

DRAFT

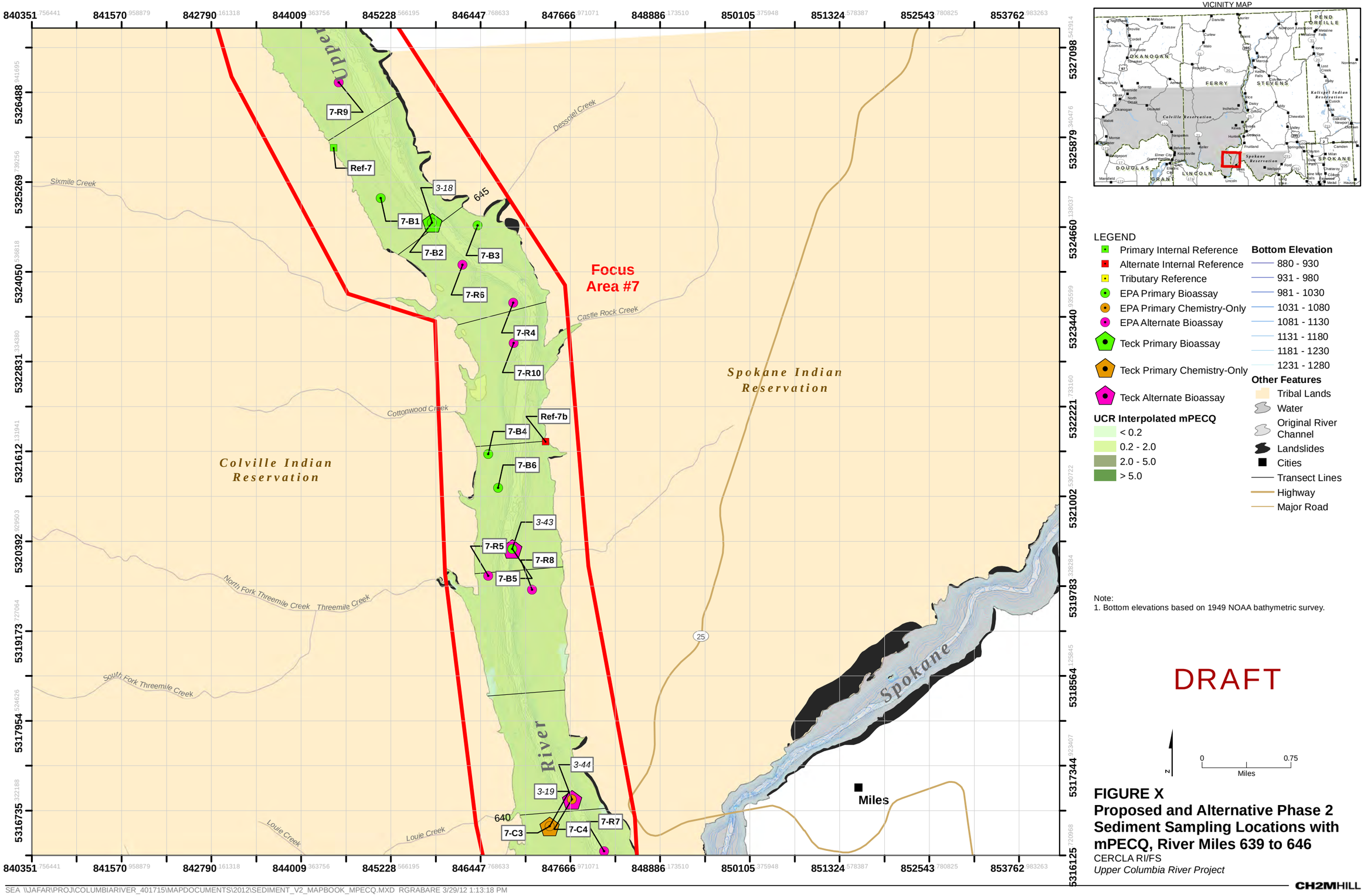
N

0 0.75
Miles

FIGURE X
Proposed and Alternative Phase 2 Sediment Sampling Locations with mPECQ, River Miles 647 to 659
CERCLA RI/FS
Upper Columbia River Project

SEA \\JAFAR\PROJ\COLUMBIARIVER_401715\MAPDOCUMENTS\2012\SEDIMENT_V2_MAPBOOK_MPECQ.MXD RGRABARE 3/29/12 1:13:18 PM

CH2MHILL



VICINITY MAP

LEGEND

- Primary Internal Reference
- Alternate Internal Reference
- Tributary Reference
- EPA Primary Bioassay
- EPA Primary Chemistry-Only
- EPA Alternate Bioassay
- Teck Primary Bioassay
- Teck Primary Chemistry-Only
- Teck Alternate Bioassay

UCR Interpolated mPECQ

- < 0.2
- 0.2 - 2.0
- 2.0 - 5.0
- > 5.0

Bottom Elevation

- 880 - 930
- 931 - 980
- 981 - 1030
- 1031 - 1080
- 1081 - 1130
- 1131 - 1180
- 1181 - 1230
- 1231 - 1280

Other Features

- Tribal Lands
- Water
- Original River Channel
- Landslides
- Cities
- Transect Lines
- Highway
- Major Road

Note:
1. Bottom elevations based on 1949 NOAA bathymetric survey.

DRAFT

N

0 0.75
Miles

FIGURE X
Proposed and Alternative Phase 2 Sediment Sampling Locations with mPECQ, River Miles 639 to 646
CERCLA RI/FS
Upper Columbia River Project

CH2MHILL

SEA \\JAFAR\PROJ\COLUMBIARIVER_401715\MAPDOCUMENTS\2012\SEDIMENT_V2_MAPBOOK_MPECQ.MXD RGRABARE 3/29/12 1:13:18 PM

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5316661.592821 5316051.991602 5315442.390383 5314832.789164 5314223.187944 5313613.586725 5313003.985506 5312394.384287 5311784.783068 5311175.181848 5310565.580629 5309955.979410 5309346.378191 5308736.776972 5308127.175752 5307517.574533 5306907.973314 5306298.372095 5305688.770876

Focus Area #7

Spokane Indian Reservation

Colville Indian Reservation

Louie Creek

George Creek

Lamb Straw

Halverson Canyon

Welsh Creek

Columbia

Upper

River

640

630

635

7-C4

7-C3

3-44

7-R7

3-23

7B-C3

3-22

7B-R1

7B-C2

Ref-8

3-21

3-20

7B-C1

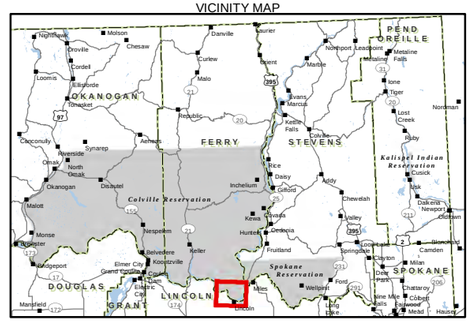
3-45

Ref-8b

7B-C4

Lincoln

VICINITY MAP



LEGEND

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- Tributary Reference
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- EPA Alternate Bioassay
- Teck Primary Bioassay
- Teck Primary Chemistry-Only
- Teck Alternate Bioassay

UCR Interpolated mPECQ

- < 0.2
- 0.2 - 2.0
- 2.0 - 5.0
- > 5.0

Bottom Elevation

- 880 - 930
- 931 - 980
- 981 - 1030
- 1031 - 1080
- 1081 - 1130
- 1131 - 1180
- 1181 - 1230
- 1231 - 1280

Other Features

- Tribal Lands
- Water
- Original River Channel
- Landslides
- Cities
- Transect Lines
- Highway
- Major Road

Note:
1. Bottom elevations based on 1949 NOAA bathymetric survey.

DRAFT

N

0 0.75 Miles

FIGURE X
Proposed and Alternative Phase 2 Sediment Sampling Locations with mPECQ, River Miles 626 to 639
CERCLA RI/FS
Upper Columbia River Project

CH2MHILL

820028.232815 821247.435254 822466.637692 823685.840131 824905.042569 826124.245007 827343.447446 828562.649884 829781.852323 831001.054761 832220.257199 833439.459638

5324311.236104 5323702.334885 5323092.433666 5322483.532447 5321873.631227 5321263.730008 5320654.828789 5320044.927570 5319435.026351 5318825.125131 5318215.223912 5317606.322693 5316996.421474 5316387.520255 5315777.619035 5315167.717816 5314558.816597 5313948.915378 5313339.014159

Brody Creek

Hell Gate Canyon

Sanpoil

Colville Indian Reservation

Columbia River

Upper

21

615

620

3-25

7B-R4

7B-R3

3-46

7B-R2

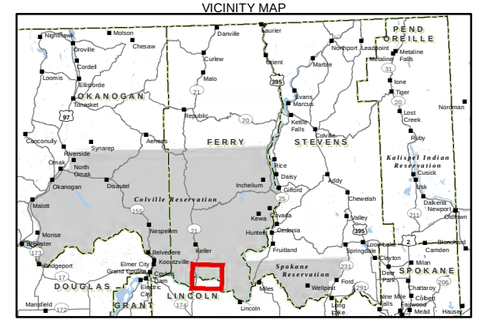
3-24

Penix Canyon

Moyer Canyon

Wynhoff Canyon

VICINITY MAP



LEGEND

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UCR Interpolated mPECQ

- < 0.2
- 0.2 - 2.0
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Bottom Elevation

- 880 - 930
- 931 - 980
- 981 - 1030
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- 1081 - 1130
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- 1181 - 1230
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Other Features

- Tribal Lands
- Water
- Original River Channel
- Landslides
- Cities
- Transect Lines
- Highway
- Major Road

Note:
1. Bottom elevations based on 1949 NOAA bathymetric survey.

DRAFT

N

0 0.75
Miles

FIGURE X
Proposed and Alternative Phase 2 Sediment Sampling Locations with mPECQ, River Miles 612 to 624
CERCLA RI/FS
Upper Columbia River Project

CH2MHILL

SEA \\JAFAR\PROJ\COLUMBIARIVER_401715\MAPDOCUMENTS\2012\SEDIMENT_V2_MAPBOOK_MPECQ.MXD RGRABARE 3/29/12 1:13:18 PM

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5323297.188630 5322077.986192 5320858.783753 5319639.581315 5318420.378877 5317201.176438 5315981.974000 5314762.771561 5313543.569123

Peter Dan Creek

Kwei Kwei Canyon

Niles Canyon

Colville Indian Reservation

Focus Area #8

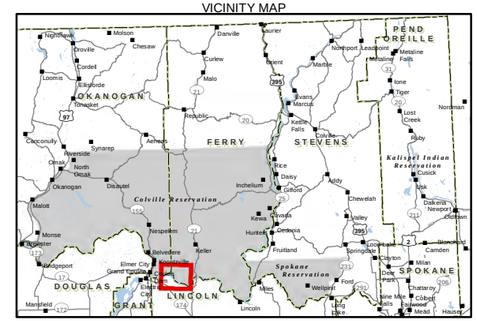
Columbia

Ref-9 3-29 8-C3 8-C4 8-B4 8-C2 3-47 3-28 8-R3 8-R4 8-R8 8B-R2 8B-R1 8B-C1 8-R10 8-B3 8-R2 8-B2 8-R1 8-R6 8-R5 Ref-9b 8-R9 8-B1 8-B6 8-B5 3-27 8-R7 8-C1 3-26

605 610 174

Seal Canyon Sealon Canyon Kaufman Canyon

VICINITY MAP



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UCR Interpolated mPECQ

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Bottom Elevation

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- 1131 - 1180
- 1181 - 1230
- 1231 - 1280

Other Features

- Tribal Lands
- Water
- Original River Channel
- Landslides
- Cities
- Transect Lines
- Highway
- Major Road

Note:
1. Bottom elevations based on 1949 NOAA bathymetric survey.

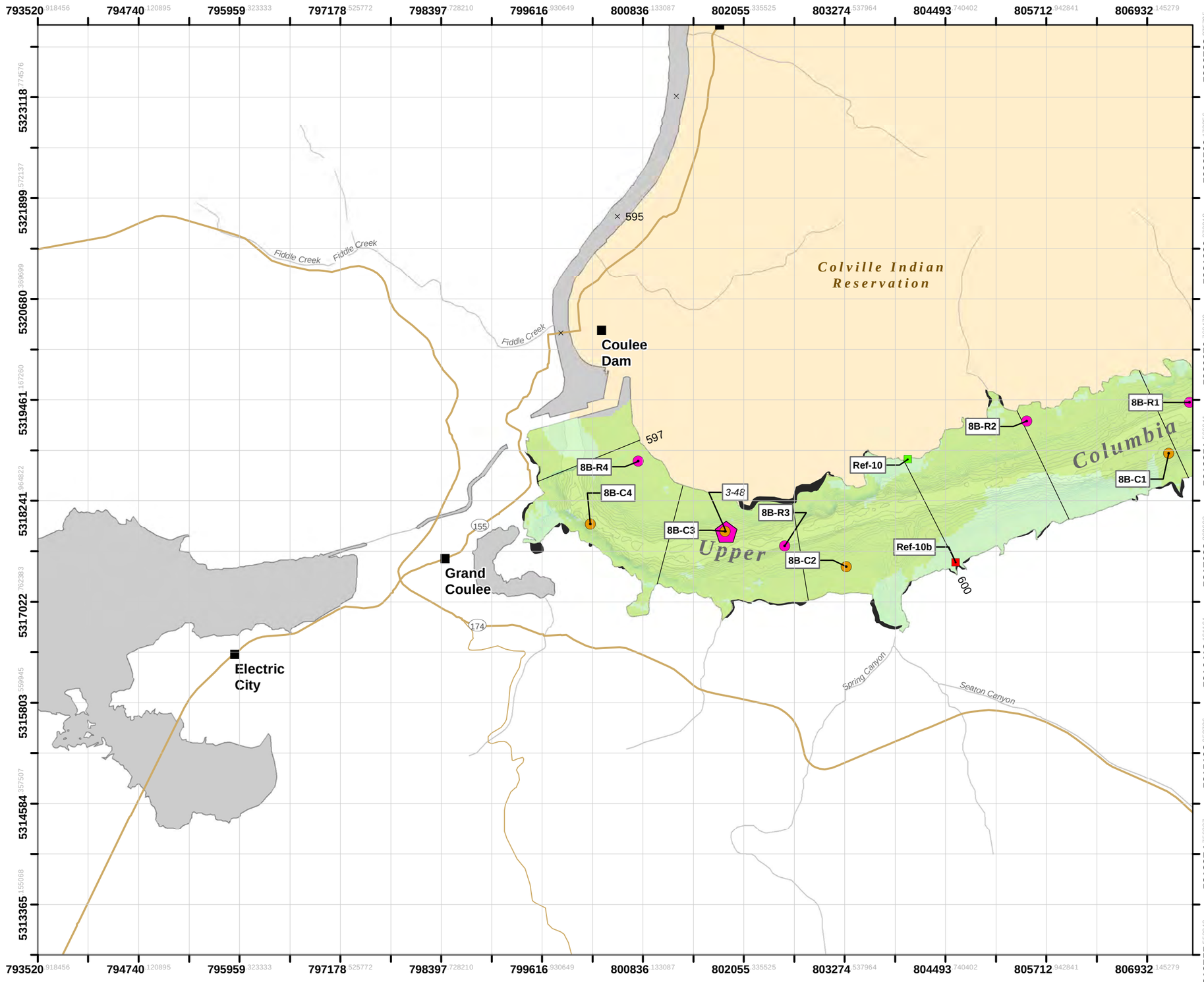
DRAFT

N

0 0.75 Miles

FIGURE X
Proposed and Alternative Phase 2 Sediment Sampling Locations with mPECQ, River Miles 603 to 608
CERCLA RI/FS
Upper Columbia River Project

CH2MHILL



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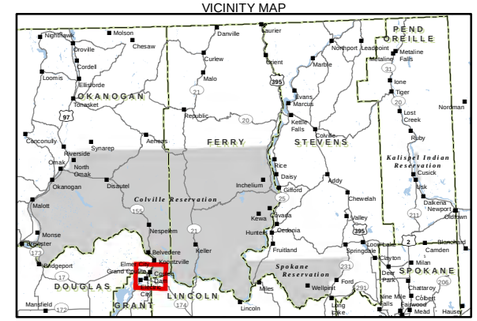

LEGEND

- Primary Internal Reference
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- Tributary Reference
- EPA Primary Bioassay
- EPA Primary Chemistry-Only
- EPA Alternate Bioassay
- Teck Primary Bioassay
- Teck Primary Chemistry-Only
- Teck Alternate Bioassay

UCR Interpolated mPECQ

- < 0.2
- 0.2 - 2.0
- 2.0 - 5.0
- > 5.0

Bottom Elevation

- 880 - 930
- 931 - 980
- 981 - 1030
- 1031 - 1080
- 1081 - 1130
- 1131 - 1180
- 1181 - 1230
- 1231 - 1280

Other Features

- Tribal Lands
- Water
- Original River Channel
- Landslides
- Cities
- Transect Lines
- Highway
- Major Road

Note:
1. Bottom elevations based on 1949 NOAA bathymetric survey.

DRAFT

N

0 0.75
Miles

FIGURE X
Proposed and Alternative Phase 2 Sediment Sampling Locations with mPECQ, River Miles 594 to 602
CERCLA RI/FS
Upper Columbia River Project

CH2MHILL

SEA \\JAFAR\PROJ\COLUMBIARIVER_401715\MAPDOCUMENTS\2012\SEDIMENT_V2_MAPBOOK_MPECQ.MXD RGRABARE 3/29/12 1:13:18 PM

APPENDIX F2

SEDIMENT SAMPLING LOCATION TECH MEMO

UCR Phase II Sediment Sampling Location Reconnaissance

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PREPARED BY: Cameron Irvine/CH2M HILL and Marilyn Gauthier/ CH2M HILL

DATE: June 27, 2012

PROJECT NUMBER: 350521

Introduction

Sediment sampling for Phase II toxicity testing is being planned as part of the Upper Columbia River (UCR) Remedial Investigation/Feasibility Study (RI/FS). Risks to benthic organisms in the UCR will be determined from these samples that will target sediment with grain sizes that are predominantly less than 2 mm. The Phase II sediment sampling and analysis program is detailed in the draft Phase II Sediment Quality Assurance Sampling Plan (Phase II Sediment QAPP) prepared by Teck American Incorporated (TAI) in 2011 and alternative sample locations have been proposed by EPA (Table 1). However, sediment collection in Reaches 1-3, where toxicity has been highest in past testing, has been challenging, due to the presence of cobble, bedrock, large organic debris, and high flows. CH2M HILL and EPA conducted sediment sample location reconnaissance from May 7-9, 2012, to observe conditions at proposed sediment sample locations in Reaches 1 to 3. The purpose of this reconnaissance was to determine whether samples of appropriate quality (i.e., grain size predominantly less than 2 mm) can be collected with the planned equipment (i.e., van Veen power grab sampler) during the Phase II sediment sampling field event, scheduled for the late fall of 2012.

This technical memorandum summarizes the results of this reconnaissance effort and identifies primary and/or alternate Phase II sediment sample locations where conditions were found to be suitable for successful sediment sample collection. The memorandum also identifies locations where conditions are not suitable for sampling and suggests alternate locations nearby where sampling is likely to be more successful. It is expected that the results of the reconnaissance will be used to improve the efficiency and completeness of the Phase II event.

Sediment Sample Locations

The Phase II reconnaissance effort targeted 54 primary sample locations and 54 reserve locations in Reaches 1, 2 and 3 of the UCR (Table 1). These sample locations were identified by USEPA as possible alternatives to sample locations proposed in the draft Phase II Sediment QAPP (TAI 2011). Supporting rationale for selecting some of these sample locations is provided in Table 2. This information is intended to supplement the sample location selection rationale provided by EPA to TAI (letter from Helen Bottcher to Marco Adzic dated April 27, 2012).

Sediment Sample Reconnaissance Timing and River Conditions

Sample location reconnaissance was conducted during early spring runoff on May 7-9, 2012. Lake Roosevelt surface elevation reached a low flow/low pool elevation of 1227 feet on April 24th and had risen over 10 feet to 1239 feet by May 7th (http://www.grandcouleedam.com/lrlevel.html; http://www.usbr.gov/pn/grandcoulee/lakelevel/index.html). Reservoir Elevation stabilized at 1238-1239 feet during the reconnaissance. Normal reservoir full pool is 1290 feet – and all proposed sample locations in the locations influenced by the reservoir are below this elevation. The

USGS stream gauge on the UCR at the international border reported provisional data for discharge averaging 164,000 ft^3/s (http://waterdata.usgs.gov/wa/nwis/uv/?site_no=12399500&PARAmeter_cd=00060,00065).

Field Reconnaissance Team

The following personnel conducted the reconnaissance:

- Helen Bottcher – EPA (May 7 and 8)
- Cameron Irvine – CH2M Hill (May 7 – 9)
- Marilyn Gauthier – CH2M Hill (May 7 – 9)
- Chuck Gruenenfelder – Ecology (May 7)
- John Roland – Ecology (May 8)
- JR (Jedidiah) Sugalski– URS representing Teck (May 7 – 9)

Approach

The field reconnaissance team traveled to the proposed sediment sampling locations in Reaches 1 – 3 by car over public roads and approached accessible locations by foot. Highway 25 north of Kettle Falls was the primary route along the eastern shore of the UCR to the US-Canada border and Highway 395, Northport-Flat Creek Road, and China Bend Road were used to access the west side of the UCR. Boat travel was unavailable during reconnaissance due to risks associated with high flows. The following campsites, boat launches, beaches, recreation areas, and road side pullouts adjacent to the UCR were among the access points visited:

May 7th (river right, accessed by car from Highway 395, Northport-Flat Creek Road, and China Bend Road)

- Marcus Flats
- Kettle River confluence
- Snag Cove campground
- Flat Creek confluence
- China Bend
- Opposite Dalles Orchard
- Beach area opposite Five Mile Creek

May 8th (river left, accessed by car from Highway 25)

- Black Sand Beach
- US-Canada border
- Upper Columbia RV Park
- Deadman's Eddy overlook
- Northport boat launch
- Onion Creek confluence
- Bossburg Flat

May 9th (river left, accessed by car from Highway 25)

- Welty Bay
- Marcus campground
- Evans Campground (campground)
- China Bend (boat launch)
- South of Five Mile Creek

Proposed Phase II sediment sample locations were identified in the field using a Trimble Geo-XT hand-held Global Positioning System (GPS) instrument with navigation software. The area within a radius of 20 meters (66 feet) around each listed coordinate was considered to represent the proposed sample location, although the final sampling locations and associated buffer areas will depend on cultural review and approvals.

Sediment sample location reconnaissance consisted of visiting and making direct visual observations of surface features (i.e., substrate and geomorphology of exposed surroundings) at each proposed Phase II sediment sample location in the upper reaches of the UCR. Attempts were made to reach and visually observe all locations, but in many instances the actual location and its 20 meter buffer area were under water. In such cases, observations were made from shore, or as close as conditions safely allowed.

Conditions indicating a proposed location was likely suitable for successful sediment sample collection:

- Substrate consisted predominately (minimum of 25 percent) of sand sized (2 mm) or smaller material; and,
- Sample location was not dominated by large organic debris, bedrock, boulders, and/or cobble that could interfere with the proposed sample collection device.

The following approach was used to determine if each proposed location was unsuitable or potentially suitable for successful sediment sample collection:

- Bedrock observed and comprises a majority of the substrate at the proposed sample location – reject sample location and evaluate nearest reserve location with sediment characteristics similar to those that were expected at the primary location.
- Large woody debris, large cobbles, or boulders observed to a degree that would likely preclude sample retrieval - reject sample location and evaluate nearest reserve location with similar sediment characteristics.
- Fine gravel, sand, and silt present to the extent that a sample can be collected by the proposed dredge method (i.e., van Veen power grab sampler) and an acceptable sample retrieved (i.e., at least 25 percent grain sizes less than 2 mm) – accept sample location.
- Bedrock, large woody debris, large cobbles, or boulders present, but patchy in distribution such that sampling may be feasible – accept sample location.
- Unable to observe benthic conditions - determine sample collection as uncertain and evaluate nearest reserve location with sediment characteristics similar to those expected at the primary location.

Results

A total of 81 proposed sample locations in Reaches 1, 2, and 3 were observed during this reconnaissance effort. The assessment procedure documented each station with photographs (Appendix A) and the reconnaissance team recorded the observed physical characteristics of the proposed sample location, including an assessment based on best professional judgment regarding whether a sample could potentially be obtained from the location (Appendix B). Most of the observed stations (77) were below the waterline during reconnaissance and substrates were not directly observed (Table 3). Therefore, the reconnaissance survey results for stations that were under water were designated as uncertain and noted with a "?" in Table 3. However, the observable substrate and slopes surrounding these sample locations were helpful in informing a best professional judgment of the potential for successful sampling.

Observed stations included 21 of the 24 primary bioassay locations in Reaches 1, 2, and 3.However, all primary bioassay stations were below the waterline and substrates were not observed directly. Ten of the primary bioassay locations were determined to have substrate that would likely provide acceptable samples, and 11 were uncertain. At this time, we are not recommending any changes to the primary bioassay locations; although, the likelihood of successful sample collection at several chemistry and reserve locations, particularly near Northport, may be improved by minor changes.

Nine proposed sampling stations are recommended to be changed, including four primary chemistry locations and five reserve locations (Table 4). These recommendations are based on direct observations of the substrate at two locations and on best professional judgment at eight stations where the substrates were not viewed directly.

- Station 1-C2 – This primary chemistry-only station in Focus Area 1 is mid-channel adjacent to a cobble-armored sandbar or shoal. Relocate west toward the right bank where smaller-grained materials appear to be present because proposed sampling equipment is unable to collect samples from substrates dominated by cobble.

- Station 1B-C3 - This primary chemistry-only station in between Focus Areas 1 and 2 is upstream of a cobble-armored sand bar, with interstitial black sand. Relocate to one of the sand-dominated depositional areas upstream of the Northport Bridge (e.g., sand substrates logged as waypoints 1-4; Table 4) because proposed sampling equipment is unable to collect samples from substrates dominated by cobble.

- Station 1B-R1 – This reserve station in between Focus Areas 1 and 2 is located upstream of the Northport Bridge adjacent to the right bank. This area appeared to be heavily armored with cobble and is below an exposed bank slide. Relocate to the eddy downstream of the bridge on the right bank because proposed sampling equipment is unable to collect samples from substrates dominated by cobble.

- Station 1B-R2 – This reserve station in between Focus Areas 1 and 2 consists of a dry cobble-armored bar with interstitial sand and should be moved due to the inability of proposed sampling equipment to collect samples from substrates dominated by cobble. Relocate to a sand-dominated depositional area downstream of the Northport Bridge (e.g., sand substrates logged as waypoints 1-4; Table 4).

- Station 1B-R3 – This reserve station in between Focus Areas 1 and 2 consists of a dry cobble-armored bar with interstitial black sand and should be moved due to the inability of proposed sampling equipment to collect samples from substrates dominated by cobble. Relocate to a sand-dominated depositional area downstream of the Northport Bridge (e.g., sand substrates logged as waypoints 1-4; Table 4).

- Station 3-C3 – This primary chemistry-only station in Focus Area 3 is located below a steep cobble-armored bank and should be moved because of the steep slope and inability of proposed sampling equipment to collect samples from substrates dominated by cobble. Relocate upstream of the China Bend Boat Launch where there are finer-grained deposits adjacent to the left bank.

- Station 3-R6 – This reserve station in Focus Area 3 is located adjacent to the right bank at China Bend. USGS substrate maps (Weakland et al. 2011) indicate that this area is dominated by bedrock where sampling would be unsuccessful. Relocate 200 meters to the south where USGS substrate maps indicate the presence of sand.

- Station 3-R9 – This reserve station in Focus Area 3 would likely have greater sampling success if moved 100 meters to the east adjacent to the right bank where an eddy likely containing finer-grained materials occurs (sand was observed on the banks adjacent to the eddy).

- Station 4-C2 - This primary chemistry-only station in Focus Area 4 is in Marcus Flats at the confluence of the Kettle River. Based on the proximity of the Kettle River and observed conditions at the confluence, the substrate is expected to be dominated by cobble, boulders, and/or bedrock and any sediment would likely be more representative of Kettle River conditions than UCR-related deposits. Relocate 200 meters north into observed finer-grained depositional areas beyond the Kettle River confluence.

Figure 1 presents the proposed alternative sample locations in UCR reaches assessed in this reconnaissance survey. Recommended revisions to the proposed sample locations are also shown (Figure 1; Table 4). The substrate types presented in this figure were digitized by the Colville Confederated Tribes (CCT) based on aerial surveys of the UCR shoreline (pers. comm. from Sheri Sears/CCT to Cameron Irvine/CH2M HILL on May 17, 2012).

A suggestion that may improve sampling success would be to request cultural permit approval for sampling over an area covering multiple proposed sample locations, rather than requesting approval for many individual sample locations in a relatively small area. For example, large areas of Deadman's Eddy and China Bend contain a high density of proposed sample locations where sampling areas could be submitted for permit approval. The flexibility for field teams to move to nearby locations that are observed to have improved likelihood of sampling success, after initially failing to collect samples from the planned sampling point, may improve the overall success of Phase II sediment sampling.

References

Teck American Inc. (TAI). 2011. Upper Columbia River Draft Quality Assurance Project Plan for the Phase 2 Sediment Study. Prepared for Teck American Inc by Exponent, Hydroqual and Parametrix, Inc. March 2011.

Weakland, R.J., R.L. Fosness, M.L. Williams, and G.J. Barton. 2010. Bathymetric and Sediment Facies Maps for China Bend and Marcus Flats, Franklin D. Roosevelt Lake, Washington, 2008 and 2009. Scientific Investigations Map 3150. http://pubs.usgs.gov/sim/3150/

Tables

Table 1

Estimated Characteristics of EPAs Proposed Alternative Phase II UCR Sediment Sample Locations

Upper Columbia River RI/FS

Alternative Sample Location ID[1]	Location Priority	Proposed Analysis	Focus Area	TAI Station ID	Predicted TOC (mg/kg)[2]	Predicted mPECQ[3]	Latitude	Longitude	UTM Easting	UTM Northing	Teck Sediment Group	Elevation[4]	River Mile	Comments	Sample Description Rationale
1-B1	Primary	Bioassay	1		2926	7.4	48.9979500	-117.6355920	892302.62	5441106.64	Group 3	1288	745		See Table 2
1-B2	Primary	Bioassay	1	1-18	8706	6.1	48.9679110	-117.6606370	890707.14	5437639.94	Group 2	1266	742		
1-B3	Primary	Bioassay	1	1-2	11906	3.3	48.9536760	-117.6913840	888568.98	5435900.36	Group 1	1276	741		
1-B4	Primary	Bioassay	1		6148	7.6	48.9395120	-117.7414990	885011.42	5434071.00	Group 2	1272	738	500 feet from 2005 sample location	See Table 2
1-B5	Primary	Bioassay	1		10049	8.5	48.9409780	-117.7324650	885661.28	5434279.80	Group 1	1276	738		See Table 2
1-B6	Primary	Bioassay	1		3532	14.4	48.9383609	-117.7277856	886023.98	5434012.86	Group 3	1282	739		
1-C1	Primary	Chemistry-Only	1	1-19	4146	8.4	48.9347770	-117.7263200	886158.96	5433622.16	Group 3	1270	739		
1-C2	Primary	Chemistry-Only	1		7121	7.4	48.9442429	-117.7164213	886810.16	5434724.28	Group 2	1282	739		
1-C3	Primary	Chemistry-Only	1	1-3	11476	6.2	48.9479900	-117.7131160	887023.00	5435157.45	Group 1	1262	740		
1-C4	Primary	Chemistry-Only	1	1-17	4163	3.9	48.9824820	-117.6416850	891978.84	5439356.64	Group 3	1276	744		
1-R1	Reserve	Bioassay	1	1-1	2845	7.6	48.9964750	-117.6361520	892273.29	5440939.87	Group 3	1284	745		
1-R2	Reserve	Bioassay	1		3067	10.0	48.9734040	-117.6478210	891601.44	5438316.37	Group 3	1288	743	100 feet from 2005 sample location	See Table 2
1-R3	Reserve	Bioassay	1		4943	4.0	48.9899286	-117.6399550	892046.78	5440192.89	Group 3	1262	744	450 feet from 2005 sample location	
1-R4	Reserve	Bioassay	1		2859	4.2	48.9766226	-117.6416682	892026.14	5438705.77	Group 3	1272	744		
1-R5	Reserve	Bioassay	1		2711	7.3	48.9991799	-117.6345298	892370.58	5441248.78	Group 3	1286	745	400 feet from 2005 sample location	
1-R6	Reserve	Bioassay	1		8742	3.9	48.9648015	-117.6690225	890118.10	5437251.27	Group 2	1250	742	400 feet from 2005 sample location	
1-R7	Reserve	Bioassay	1		13431	5.0	48.9515526	-117.7053997	887559.98	5435592.69	Group 1	1250	740		
1-R8	Reserve	Bioassay	1	1-4	12643	6.6	48.9415830	-117.7338180	885557.59	5434340.13	Group 1	1276	738		
1-R9	Reserve	Bioassay	1	1-5	7423	8.4	48.9407420	-117.7387830	885200.71	5434221.46	Group 2	1258	738		
1-R10	Reserve	Bioassay	1		4250	13.0	48.9394459	-117.7357235	885434.63	5434093.02	Group 3	1278	738		
1B-C1	Primary	Chemistry-Only	1B		11284	6.6	48.9199711	-117.7793189	882392.97	5431708.61	Group 1	1286	735		See Table 2
1B-C2	Primary	Chemistry-Only	1B	1-20	6510	10.8	48.9196347	-117.7853270	881955.65	5431640.95	Group 2	1258	735		
1B-C3	Primary	Chemistry-Only	1B		7173	7.6	48.9220660	-117.7735650	882798.22	5431970.38	Group 2	1280	736		See Table 2
1B-C4	Primary	Chemistry-Only	1B		5924	10.3	48.9151698	-117.7970258	881133.13	5431086.03	Group 2	1254	734		
1B-R1	Reserve	Bioassay	1B		5104	15.1	48.9240085	-117.7758583	882615.44	5432174.62	Group 2	1252	736		
1B-R2	Reserve	Bioassay	1B		8794	9.1	48.9198269	-117.7813376	882246.27	5431682.41	Group 2	1286	735		
1B-R3	Reserve	Bioassay	1B		8043	8.2	48.9217976	-117.7749451	882699.23	5431933.59	Group 2	1286	736		
1B-R4	Reserve	Bioassay	1B		5571	14.3	48.9237944	-117.7704339	883014.21	5432178.22	Group 2	1244	736		
2-B1	Primary	Bioassay	2		5990	6.6	48.9061170	-117.8037110	880712.54	5430046.68	Group 2	1288	734		See Table 2
2-B2	Primary	Bioassay	2		7218	3.1	48.9011650	-117.8135220	880031.63	5429447.31	Group 2	1256	733		See Table 2
2-B3	Primary	Bioassay	2		7109	3.4	48.8860040	-117.8370260	878424.73	5427645.41	Group 2	1268	731		See Table 2
2-B4	Primary	Bioassay	2	1-6	5647	2.1	48.8786660	-117.8434120	878012.26	5426798.31	Group 2	1242	731		
2-B5	Primary	Bioassay	2	1-22	3556	7.9	48.8730960	-117.8607810	876781.39	5426093.09	Group 3	1212	730		
2-B6	Primary	Bioassay	2		3807	10.0	48.8719940	-117.8653970	876451.38	5425947.75	Group 3	1248	730		See Table 2
2-C1	Primary	Chemistry-Only	2		6818	2.6	48.8924730	-117.8212350	879532.63	5428443.00	Group 2	1266	732	Was at S10 - moved toward center of river to avoid gravel	
2-C2	Primary	Chemistry-Only	2		8937	2.0	48.8951440	-117.8260020	879163.16	5428715.92	Group 2	1270	732	Was at 1-21 - moved toward center of river and downstream to avoid bedrock	
2-C3	Primary	Chemistry-Only	2		5580	1.5	48.8767420	-117.8447640	877927.71	5426577.82	Group 2	1242	731		See Table 2
2-C4	Primary	Chemistry-Only	2		3897	2.1	48.8768756	-117.8501851	877529.43	5426565.68	Group 3	1252	730		
2-R1	Reserve	Bioassay	2		5932	7.9	48.9038750	-117.8042600	880689.40	5429794.84	Group 2	1272	733		See Table 2
2-R2	Reserve	Bioassay	2		5183	3.4	48.9057337	-117.8112762	880161.39	5429966.16	Group 2	1274	733		
2-R3	Reserve	Bioassay	2		8256	1.5	48.9001753	-117.8185097	879673.81	5429312.38	Group 5	1276	733		
2-R4	Reserve	Bioassay	2		6379	3.2	48.8906575	-117.8271139	879115.71	5428211.90	Group 2	1242	732		
2-R5	Reserve	Bioassay	2		9215	3.1	48.8911905	-117.8349566	878537.11	5428231.96	Group 2	1276	732		
2-R6	Reserve	Bioassay	2		5542	2.8	48.8868770	-117.8334280	878681.74	5427760.35	Group 2	1236	731		See Table 2

Table 1
Estimated Characteristics of EPAs Proposed Alternative Phase II UCR Sediment Sample Locations
Upper Columbia River RI/FS

Alternative Sample Location ID[1]	Location Priority	Proposed Analysis	Focus Area	TAI Station ID	Predicted TOC (mg/kg)[2]	Predicted mPECQ[3]	Latitude	Longitude	UTM Easting	UTM Northing	Teck Sediment Group	Elevation[4]	River Mile	Comments	Sample Description Rationale
2-R7	Reserve	Bioassay	2		6580	3.1	48.8830432	-117.8404388	878197.05	5427299.44	Group 2	1266	731		
2-R8	Reserve	Bioassay	2		0	0.0	48.8803200	-117.8445300	877917.84	5426976.50		1288	731	In Teck's ">2mm" zone therefore no interpolation.	See Table 2
2-R9	Reserve	Bioassay	2		3728	5.3	48.8739822	-117.8572664	877032.29	5426209.01	Group 3	1232	730		
2-R10	Reserve	Bioassay	2	1-7	3449	8.4	48.8728910	-117.8650870	876467.35	5426048.94	Group 3	1242	730		
2B-C1	Primary	Chemistry-Only	2B		9056	3.1	48.8595570	-117.8906990	874690.05	5424440.76	Group 2	1248	728		See Table 2
2B-C2	Primary	Chemistry-Only	2B	1-8	6933	4.4	48.8567206	-117.8971794	874236.17	5424093.66	Group 2	1216	728		
2B-C3	Primary	Chemistry-Only	2B		4788	4.3	48.8536795	-117.9040805	873752.92	5423721.78	Group 3	1216	727		
2B-C4	Primary	Chemistry-Only	2B		7218	4.7	48.8683783	-117.8780358	875552.20	5425483.42	Group 2	1222	729		
2B-R1	Reserve	Bioassay	2B		7766	4.2	48.8663899	-117.8794394	875464.23	5425255.55	Group 2	1240	729		
2B-R2	Reserve	Bioassay	2B		5465	6.5	48.8716924	-117.8750727	875744.51	5425866.28	Group 2	1234	729		
2B-R3	Reserve	Bioassay	2B		4686	4.9	48.8550441	-117.9013902	873939.98	5423886.64	Group 3	1216	727		
2B-R4	Reserve	Bioassay	2B		4862	1.7	48.8524708	-117.9083303	873450.35	5423566.58	Group 3	1240	727		
3-B1	Primary	Bioassay	3		5296	0.5	48.8440880	-117.9215730	872541.72	5422570.16	Group 5	1208	726		See Table 2
3-B2	Primary	Bioassay	3	1-10	3612	8.0	48.8259170	-117.9238700	872508.28	5420540.03	Group 3	1226	725		
3-B3	Primary	Bioassay	3	1-11	14148	8.9	48.8264190	-117.9309010	871988.78	5420561.34	Group 1	1274	725		
3-B4	Primary	Bioassay	3		4450	6.3	48.8166100	-117.9390890	871460.76	5419431.45	Group 3	1236	724	500 feet from 2005 sample location	See Table 2
3-B5	Primary	Bioassay	3	1-12	6211	6.7	48.8126710	-117.9464340	870950.97	5418957.92	Group 2	1222	723		
3-B6	Primary	Bioassay	3		6277	4.4	48.8163700	-117.9636260	869662.19	5419285.08	Group 2	1258	723		See Table 2
3-C1	Primary	Chemistry-Only	3		9642	4.5	48.8210000	-117.9344510	871768.53	5419941.89	Group 2	1284	724		See Table 2
3-C2	Primary	Chemistry-Only	3		4338	2.9	48.8190830	-117.9263510	872377.02	5419768.58	Group 3	1218	725	500 feet from 2005 sample location	See Table 2
3-C3	Primary	Chemistry-Only	3	1-23	4104	3.7	48.8152980	-117.9660800	869490.03	5419154.04	Group 3	1220	723		
3-C4	Primary	Chemistry-Only	3	1-13	4652	2.5	48.8174290	-117.9800500	868449.33	5419322.94	Group 3	1174	722		
3-R1	Reserve	Bioassay	3	1-9	6115	0.7	48.8497550	-117.9153050	872959.18	5423230.56	Group 5	1234	727		
3-R2	Reserve	Bioassay	3		7833	5.5	48.8374337	-117.9264801	872231.29	5421806.77	Group 2	1256	725		
3-R3	Reserve	Bioassay	3		4436	3.5	48.8314946	-117.9225969	872560.23	5421165.96	Group 3	1248	725		
3-R4	Reserve	Bioassay	3		19264	5.0	48.8244894	-117.9332569	871830.26	5420335.42	Group 1	1272	724		
3-R5	Reserve	Bioassay	3		3720	6.8	48.8178650	-117.9321147	871963.18	5419605.02	Group 3	1232	724		
3-R6	Reserve	Bioassay	3		8206	5.6	48.8170274	-117.9423178	871220.77	5419462.04	Group 2	1234	724		
3-R7	Reserve	Bioassay	3		9706	4.9	48.8136010	-117.9497037	870704.17	5419045.28	Group 2	1242	723		
3-R8	Reserve	Bioassay	3		5750	4.4	48.8141340	-117.9610490	869867.76	5419049.20	Group 2	1260	723		
3-R9	Reserve	Bioassay	3		8697	2.0	48.8193879	-117.9747546	868823.45	5419566.28	Group 2	1240	722	Just offshore from Flat Creek Beach 2011 beach samples	
3-R10	Reserve	Bioassay	3		10472	1.2	48.8189310	-117.9866329	867955.31	5419457.91	Group 7	1224	722		
3B-C1	Primary	Chemistry-Only	3B	1-24	13896	0.9	48.8149367	-117.9967163	867244.74	5418965.34	Group 7	1230	721		
3B-C2	Primary	Chemistry-Only	3B		15585	1.3	48.7912713	-118.0059266	866741.81	5416291.49	Group 1	1234	720	Didn't pick 1-25 or S24 because they are in gravel	See Table 2
3B-C3	Primary	Chemistry-Only	3B		23675	1.0	48.7591630	-118.0486524	863837.72	5412518.76	Group 4	1202	716		See Table 2
3B-C4	Primary	Chemistry-Only	3B		23451	1.2	48.7365209	-118.0588861	863249.48	5409954.16	Group 4	1234	715		See Table 2
3B-R1	Reserve	Bioassay	3B		14397	0.9	48.8103316	-118.0042636	866724.60	5418417.22	Group 4	1214	721		See Table 2
3B-R2	Reserve	Bioassay	3B		22834	1.7	48.7842356	-118.0089967	866567.78	5415494.98	Group 4	1206	719		See Table 2
3B-R3	Reserve	Bioassay	3B		21075	0.9	48.7736181	-118.0217889	865705.86	5414253.70	Group 4	1236	718		See Table 2
3B-R4	Reserve	Bioassay	3B	1-26	23352	0.9	48.7512319	-118.0582465	863190.24	5411591.69	Group 4	1220	716		
4-B1	Primary	Bioassay	4	2-1	12895	6.5	48.6903790	-118.0259140	866007.93	5404985.55	Group 1	1206	711		
4-B2	Primary	Bioassay	4	2-2	6629	5.1	48.6722780	-118.0553080	863976.41	5402833.49	Group 2	1202	709		
4-B3	Primary	Bioassay	4		9983	5.6	48.6707064	-118.0791717	862231.66	5402545.07	Group 2	1230	708		
4-B4	Primary	Bioassay	4		12039	2.6	48.6644370	-118.1004450	860711.02	5401747.50	Group 1	1208	707		See Table 2

Table 1
Estimated Characteristics of EPAs Proposed Alternative Phase II UCR Sediment Sample Locations
Upper Columbia River RI/FS

Alternative Sample Location ID[1]	Location Priority	Proposed Analysis	Focus Area	TAI Station ID	Predicted TOC (mg/kg)[2]	Predicted mPECQ[3]	Latitude	Longitude	UTM Easting	UTM Northing	Teck Sediment Group	Elevation[4]	River Mile	Comments	Sample Description Rationale
4-B5	Primary	Bioassay	4	2-9	2521	7.4	48.6487050	-118.1047700	860505.10	5399979.09	Group 3	1194	706		
4-B6	Primary	Bioassay	4		9012	3.9	48.6366860	-118.1010880	860862.09	5398661.13	Group 2	1232	705		See Table 2
4-C1	Primary	Chemistry-Only	4		18118	2.3	48.6794270	-118.0305390	865747.19	5403746.49	Group 4	1218	710		See Table 2
4-C2	Primary	Chemistry-Only	4	2-6	10547	0.3	48.6746720	-118.1098240	859947.68	5402840.29	Group 7	1226	1	450 feet from 2005 sample location, offshore from Kamloops Beach 2011 beach samples	
4-C3	Primary	Chemistry-Only	4	2-7	13601	2.5	48.6598360	-118.0940880	861211.83	5401266.43	Group 1	1234	707		
4-C4	Primary	Chemistry-Only	4		5340	7.4	48.6470490	-118.0987280	860961.76	5399823.71	Group 2	1216	706		See Table 2
4-C5	Primary	Chemistry-Only	4		20273	1.5	48.6365470	-118.0857430	861993.07	5398718.50	Group 4	1220	705		See Table 2
4-C6	Primary	Chemistry-Only	4	2-11	9444	0.9	48.6232760	-118.0863470	862043.72	5397241.14	Group 5	1236	705	In the same bay (Welty Bay) as a 2011 beach that was sampled; not close.	
4-R1	Reserve	Bioassay	4	1-16	18844	3.0	48.6968670	-118.0281730	865794.65	5405695.54	Group 1	1200	712		
4-R2	Reserve	Bioassay	4		8820	4.0	48.6742259	-118.0449244	864726.40	5403099.61	Group 2	1202	710		
4-R3	Reserve	Bioassay	4		17304	4.1	48.6753089	-118.0701023	862865.94	5403099.61	Group 1	1236	709		
4-R4	Reserve	Bioassay	4	2-4	11450	3.6	48.6723000	-118.0874400	861611.78	5402682.82	Group 1	1238	708		
4-R5	Reserve	Bioassay	4	2-5	18592	0.8	48.6735080	-118.0967160	860920.54	5402773.02	Group 4	1232	707		
4-R6	Reserve	Bioassay	4	2-8	6583	3.2	48.6583960	-118.1064920	860309.12	5401047.67	Group 2	1158	706		
4-R7	Reserve	Bioassay	4		5501	6.2	48.6520261	-118.0998826	860841.17	5400371.23	Group 2	1222	706		
4-R8	Reserve	Bioassay	4	2-12	9917	3.3	48.6362880	-118.0986140	861047.12	5398628.64	Group 2	1230	705		
4-R9	Reserve	Bioassay	4	2-16	20981	1.5	48.6507980	-118.0885980	861680.70	5400288.31	Group 4	1244	706		
4-R10	Reserve	Bioassay	4	2-10	42386	0.5	48.6181390	-118.0784120	862665.08	5396708.12	Group 7	1238	705	In the same bay (Welty Bay) as a 2011 beach that was sampled; not close.	
4-R11	Reserve	Bioassay	4	1-15	33530	1.0	48.7084060	-118.0346410	865235.25	5406946.52	Group 4	1196	713		
4-R12	Reserve	Bioassay	4	2-3	16703	0.2	48.6829270	-118.0868670	861577.72	5403866.27	Group 7	1230	708		

Notes:

[1] Alternative sample location ID begins with the focus area (B indicates station is between focus areas) then a letter following the dash indicaitng the planned analysis: B = Bioassay (and chemistry), C = Chemistry-only; R = Reserve; and the sample number (in sequence)

[2] TOC - Total Organic Carbon

[3] mPECQ - mean Probable Effects Concentratoin Quotient based on four metals (cadmium, copper, lead, and zinc). Data from TAI 2011.

[4] Elevation within 2 feet (based on 1940 bathymetry)

Table 2

Rationale for Selected Alternataive Phase 2 Sediment Sampling Locations (RM 745 to RM 695)

Upper Columbia River RI/FS

Alternative Sample Location ID[1]	Sample Station Type	TAI Group	Relational to Teck Stations	General Comment
1-B1	Pre-dam deposit/position	3	S1 can replace Teck 90	near Canadian border below mid-channel bedrock outcrops; river right
1-R2	Pre-dam deposit/position	3		opposite bank from Black Sand Beach; river right
1-B5	Pre-dam deposit/position	1	S3 can replace Teck 83	Deadmans Eddy; river right
1-B4	Pre-dam deposit/position	2		WDFWL observed mid-channel sand-sized slag enriched deposit - 'dead sheep'
1B-C3	Pre-dam deposit/position	2		Northport Launch; river left
1B-C1	Pre-dam deposit/position; flood way	1		floodway below Northport, downstream of bridge; river left
2-R1	Pre-dam deposit/position	2		bar just downstream of Northport; river left
2-B1	Post-dam inundation/possible pre-dam floodplain	2		bar just downstream of Northport; river left; floodway
2-B2	Pre-dam deposit/position	2		bar downstream of Northport; river right
2-B3	Pre-dam deposit/position	2		historic bar just upstream of Onion Cr.; river right
2-R6	Pre-dam deposit/position	2		WDFWL observed mid-channel sand-sized slag enriched deposit - 'onion creek'
2-R8	Post-dam inundation	2		reservoir side floodway; river right; upstream of Onion Cr.
2-C3	Pre-dam deposit/position	3		immediately upstream of Onion Cr. Mouth; river center-left
2-B6	Pre-dam deposit/position	2		historic cove on river left, just above the top of the Little Dalles
2B-C1	Pre-dam deposit/position	5	S16 can replace Teck 77	immediately downstream of Little Dalles; river right
3-B1	Pre-dam deposit/position	2		WDFWL observed mid-channel sand-sized slag enriched deposit - 'log boom'
3-C1	Post-dam inundation/possible pre-dam floodplain	3		on China Bend logboom island
3-C2	Pre-dam deposit/position	3		WDFWL[2] observed mid-channel sand-sized slag enriched deposit - 'china bend'
3-B4	Pre-dam deposit/position	3		downstream tip of China Bend Bar; river right;pre-dam bar
3-B6	Pre-dam deposit/position	1		further downstream from China Bend Bar; downstream of historic promontory; river right; bar evident
3B-R1	Pre-dam deposit/position	1	S23 can replace Teck 69	WDFWL observed mid-channel sand-sized slag enriched deposit - '15 mile creek'
3B-C2	Pre-dam deposit/position	4	S24 & S25 can replace Teck 68	just upstream of North Gorge Camp Ground; historic bar; river left; part of a proposed transect location
3B-R2	Pre-dam deposit/position	4	S26 & S27 can replace Teck 69	WDFWL observed mid-channel sand-sized slag enriched deposit - 'north gorge'
3B-R3	Pre-dam deposit/position	4		down stream of North Gorge; eddy behind bedrock promontory; river right
3B-C3	Pre-dam deposit/position	4	S30 can replace Teck 67	WDFWL observed mid-channel sand-sized slag enriched deposit - 'bossburg'

Table 2

Rationale for Selected Alternataive Phase 2 Sediment Sampling Locations (RM 745 to RM 695)

Upper Columbia River RI/FS

Alternative Sample Location ID[1]	Sample Station Type	TAI Group	Relational to Teck Stations	General Comment
3B-C4	Pre-dam deposit/position	4		offshore of Snag Cove Camp Ground; river right
4-C1	Pre-dam deposit/position	4		just upstream of Marcus Island CG; just downstream of sharp river bend; river right
4-B4	Pre-dam deposit/position	1	S33 Can replace Teck 61 or Teck 69	Marcus pointbar upstream of Kettle confluence; river left
4-C4	Pre-dam deposit/position	2 or 3		just upstream of historic Kettle Falls; river left
4-C5	Post-dam inundation area	4	S35 can replace Teck 56 (too close to Trib)	just upstream of historic Kettle Falls; side paleo flood channel; reservoir influence also; river left
4-B6	Post-dam inundation area	2	S36 can replace Teck 54	just upstream of historic Kettle Falls; side bench; reservoir influence also; river left

Notes:

[1]Alternative sample location IDs begin with the focus area (B indicates station is between focus areas) then a letter following the dash indicaitng the planned analysis: B = Bioassay (and chemistry), C = Chemistry-only; R = Reserve; and the sample number (in sequence)

[2] WDFWL - Washington Department of Fish and Wildlife

Table 3

Proposed Sample Location Viability based on site Reconnaissance (May-2012)

Upper Columbia River RI/FS

Alternative Sample Location ID[1]	Location Priority	Proposed Analysis	Focus Area	Date	Time	River Mile (observations location)	Observed	Station Below Water?[2]	Sampleable? (Yes/No)[3]	Location Change Recommended	Comments	Photos
1-B1	Primary	Bioassay	1	05/08/12	9:50 AM	744	Yes	Yes	Yes?	No	downstream of bedrock outcrop	P5080535, 536, IMGP0033
1-B2	Primary	Bioassay	1	-	-	-	No	-	-	-	-	-
1-B3	Primary	Bioassay	1	05/08/12	10:50 AM	739	Yes	Yes	?	No	move mid-channel if not sampleable	P5080545, 546
1-B4	Primary	Bioassay	1	05/08/12	11:55 AM	737	Yes	Yes	Yes?	No	viewed from road	P5080547-549, IMGP0048-50
1-B5	Primary	Bioassay	1	05/08/12	11:55 AM	737	Yes	Yes	Yes?	No	viewed from road	P5080547-549, IMGP0048-50
1-B6	Primary	Bioassay	1	05/08/12	11:55 AM	737	Yes	Yes	Yes?	No	viewed from road	P5080547-549, IMGP0048-50
1-C1	Primary	Chemistry-Only	1	-	-	-	No	-	-	-	-	-
1-C2	Primary	Chemistry-Only	1	05/08/12	10:50 AM	738	Yes	Yes	?	**Yes**	mid-channel to right of riffle on river left. Move station west toward opposite bank to avoid cobble substrate	P5080541-543, IMGP0041, 46
1-C3	Primary	Chemistry-Only	1	05/08/12	10:50 AM and 3:50 PM	738 and 729	Yes	Yes	?	No	upstream of riffle on river left	P5080544
1-C4	Primary	Chemistry-Only	1	-	-	-	No	-	-	-	-	-
1-R1	Reserve	Bioassay	1	05/08/12	9:50 AM	744	Yes	Yes	?	No	-	P5080536, IMGP0033
1-R2	Reserve	Bioassay	1	05/08/12	9:15 AM	742	Yes	Yes	Yes?	No	near black sand beach	P5080533, 534
1-R3	Reserve	Bioassay	1	-	-	-	No	-	-	-	-	-
1-R4	Reserve	Bioassay	1	05/08/12	9:15 AM	742	Yes	Yes	Yes?	No	near black sand beach	P5080530, 532, IMGP0028
1-R5	Reserve	Bioassay	1	05/08/12	9:50 AM	744	Yes	Yes	?	No	-	P5080536, IMGP0033
1-R6	Reserve	Bioassay	1	-	-	-	No	-	-	-	-	-
1-R7	Reserve	Bioassay	1	05/08/11	10:50 AM	739	Yes	Yes	?	No	-	IMGP0038
1-R8	Reserve	Bioassay	1	05/08/12	11:55 AM	737	Yes	Yes	Yes?	No	viewed from road	P5080547-549, IMGP0048-49
1-R9	Reserve	Bioassay	1	05/08/12	11:55 AM	737	Yes	Yes	Yes?	No	viewed from road	P5080547-549, IMGP0048-49
1-R10	Reserve	Bioassay	1	05/08/12	11:55 AM	737	Yes	Yes	Yes?	No	viewed from road	P5080547-549, IMGP0048-49
1B-C1	Primary	Chemistry-Only	1B	05/08/12	2:35 PM	734	Yes	No	Yes	No	sandy deposit	P5080561-563, IMGP00062-63
1B-C2	Primary	Chemistry-Only	1B	05/08/12	2:50 PM	734	Yes	Yes	?	No	mid-channel	P5080570
1B-C3	Primary	Chemistry-Only	1B	05/08/12	1:40 PM	734	Yes	Yes	No?	**Yes**	cobble armored river bed	P5080567
1B-C4	Primary	Chemistry-Only	1B	-	-	-	No	-	-	-	-	-
1B-R1	Reserve	Bioassay	1B	05/08/12	1:20 PM	734	Yes	Yes	?	**Yes**	move station into eddy downstream of bridge rather than in landslide area upstream of bridge	P5080550
1B-R2	Reserve	Bioassay	1B	05/08/11	2:00 PM	734	Yes	No	No	**Yes**	on cobble bar. Move 150m upstream to marked sandy location	IMGP0064-65
1B-R3	Reserve	Bioassay	1B	05/08/12	1:30 PM	734	Yes	No	No	**Yes**	cobble bar with slag fines. Sampleable with dry methods, but not with van veen. Move station to sandy spot near bridge	P5080557-558
1B-R4	Reserve	Bioassay	1B	05/08/12	2:30 PM	734	Yes	Yes	Yes?	No	pool above Northport boat launch	P5080564, 565
2-B1	Primary	Bioassay	2	05/08/12	3:25 AM	732	Yes	Yes	Yes?	No	viewed remotely from road	P5080574, IMG00066-67
2-B2	Primary	Bioassay	2	05/07/12	5:00 PM	731	Yes	Yes	Yes?	No	near sandy beach	P5070529
2-B3	Primary	Bioassay	2	-	-	-	No	-	-	-	-	-
2-B4	Primary	Bioassay	2	5/7 and 5/8	4:30 PM and 3:50 PM	729	Yes	Yes	Yes?	No	at Onion Creek eddy	P5070523, 578, 628, 629
2-B5	Primary	Bioassay	2	5/7 and 5/8	4:30 PM and 1:30 PM	729	Yes	Yes	?	No	likely challenging samples due to bedrock and cobble in this narrow part of the river. viewed from distance high on west side.	P5070522, 524, 525, 628, 629, IMGP0021
2-B6	Primary	Bioassay	2	05/07/12	4:30 PM	729	Yes	Yes	?	No		P5070525
2-C1	Primary	Chemistry-Only	2	05/09/12	12:50 PM	731	Yes	Yes	Yes?	No	-	P5090624
2-C2	Primary	Chemistry-Only	2	5/7 and 5/9	5:00 PM and 1:00 PM	731	Yes	Yes	Yes?	No	next to sandy beach	IMGP0022, P5070526
2-C3	Primary	Chemistry-Only	2	5/7 and 5/8	4:30 PM and 3:50 PM	729	Yes	Yes	Yes?	No	at Onion Creek eddy	IMGP0019, 71, P5070523,578, 580, 581
2-C4	Primary	Chemistry-Only	2	5/7 and 5/8	4:30 PM and 3:50 PM	729	Yes	Yes	?	No	-	IMGP0019, 69, 70, P5080579, 582
2-R1	Reserve	Bioassay	2	05/08/12	3:25 AM	732	Yes	Yes	Yes?	No	viewed remotely from road	P5080574, IMG00066-67
2-R2	Reserve	Bioassay	2	05/08/12	3:25 AM	732	Yes	Yes	Yes?	No	viewed remotely from road	P5080574, IMG00066-67
2-R3	Reserve	Bioassay	2	05/07/12	5:00 PM	731	Yes	No	Yes	No	sandy beach	P5070527-529, IMGP0023-27

Table 3

Proposed Sample Location Viability based on site Reconnaissance (May-2012)

Upper Columbia River RI/FS

Alternative Sample Location ID[1]	Location Priority	Proposed Analysis	Focus Area	Date	Time	River Mile (observations location)	Observed	Station Below Water?[2]	Sampleable? (Yes/No)[3]	Location Change Recommended	Comments	Photos
2-R4	Reserve	Bioassay	2	05/09/12	9:15 AM and 1:00 PM	731	Yes	Yes	?	No	-	P5090626
2-R5	Reserve	Bioassay	2	-	-	-	No	-	-	-	-	-
2-R6	Reserve	Bioassay	2	-	-	-	No	-	-	-	-	-
2-R7	Reserve	Bioassay	2	-	-	-	No	-	-	-	-	-
2-R8	Reserve	Bioassay	2	-	-	-	No	-	-	-	-	-
2-R9	Reserve	Bioassay	2	5/7 and 5/8	4:30 PM and 1:30 PM	729	Yes	Yes	?	No	likely challenging samples due to bedrock and cobble in this narrow part of the river. viewed from distance high on west side.	IMGP0020, P5070524, 622-624
2-R10	Reserve	Bioassay	2	5/7 and 5/9	4:30 PM and 1:30 PM	729	Yes	Yes	?	No		P5070525, 628, 629
2B-C1	Primary	Chemistry-Only	2B	-	-	-	No	-	-	-	-	-
2B-C2	Primary	Chemistry-Only	2B	-	-	-	No	-	-	-	-	-
2B-C3	Primary	Chemistry-Only	2B	-	-	-	No	-	-	-	-	-
2B-C4	Primary	Chemistry-Only	2B	-	-	-	No	-	-	-	-	-
2B-R1	Reserve	Bioassay	2B	-	-	-	No	-	-	-	-	-
2B-R2	Reserve	Bioassay	2B	-	-	-	No	-	-	-	-	-
2B-R3	Reserve	Bioassay	2B	-	-	-	No	-	-	-	-	-
2B-R4	Reserve	Bioassay	2B	-	-	-	No	-	-	-	-	-
3-B1	Primary	Bioassay	3	-	-	-	No	-	-	-	-	-
3-B2	Primary	Bioassay	3	05/09/12	11:50 AM	723	Yes	Yes	?	No	-	P5090621
3-B3	Primary	Bioassay	3	05/09/12	11:50 AM	723	Yes	Yes	?	No	USGS benthic images available	P5090621
3-B4	Primary	Bioassay	3	5/7 and 5/9	4:05 PM and 11:50 AM	723	Yes	Yes	?	No	USGS benthic images available	P5070521, 623
3-B5	Primary	Bioassay	3	5/7 and 5/9	4:05 PM and 11:25 AM	723 and 722	Yes	Yes	?	No	-	P5070521, 614-616, 619
3-B6	Primary	Bioassay	3	05/09/12	11:10 AM	721	Yes	Yes	?	No	USGS benthic images available	P5090607, 608, 612
3-C1	Primary	Chemistry-Only	3	05/09/12	11:25 AM	722	Yes	Yes	?	No	USGS benthic images available	P5070616, 623
3-C2	Primary	Chemistry-Only	3	05/09/12	11:50 AM	723	Yes	Yes	?	No	-	P5070620
3-C3	Primary	Chemistry-Only	3	05/09/12	11:10 AM	721	Yes	Yes	?	**Yes**	below steep armored bank where sampling is likely a challenge.	P5090607
3-C4	Primary	Chemistry-Only	3	05/07/12	3:35 AM	721	Yes	Yes	?	No	-	P5070519, IMGP0017
3-R1	Reserve	Bioassay	3	-	-	-	No	-	-	-	-	-
3-R2	Reserve	Bioassay	3	-	-	-	No	-	-	-	-	-
3-R3	Reserve	Bioassay	3	-	-	-	No	-	-	-	-	-
3-R4	Reserve	Bioassay	3	05/09/12	11:50 AM	723	Yes	Yes	?	No	USGS benthic images available	-
3-R5	Reserve	Bioassay	3	05/09/12	11:50 AM	723	Yes	Yes	?	No	-	P5090623
3-R6	Reserve	Bioassay	3	05/09/12	11:25 AM	722	Yes	Yes	?	**Yes**	Benthic map indicates bedrock; photo of new suggested location.	P5090615
3-R7	Reserve	Bioassay	3	05/09/12	11:25 AM	722	Yes	Yes	?	No	-	P5090614
3-R8	Reserve	Bioassay	3	05/09/12	11:10 AM	721	Yes	Yes	?	No	below steep armored bank where sampling is likely a challenge.	P5090610, 611, 613, 618
3-R9	Reserve	Bioassay	3	05/07/12	3:35 AM	721	Yes	Yes	?	**Yes**	Move station 100 meters upstream (east) closer into eddy due to cobble at proposed location	P5070517, IMGP0016
3-R10	Reserve	Bioassay	3	05/07/12	3:35 AM	721	Yes	Yes	?	No	viewed from China Bend road	P5070518, IMGP0017
3B-C1	Primary	Chemistry-Only	3B	-	-	-	No	-	-	-	-	P5070516
3B-C2	Primary	Chemistry-Only	3B	05/07/12	3:21 AM	720	Yes	Yes	?	No	viewed from a distance	P5070513, 514
3B-C3	Primary	Chemistry-Only	3B	05/08/12	4:30 PM	715	Yes	Yes	?	No	-	P5080583, IMGP0075, 77
3B-C4	Primary	Chemistry-Only	3B	05/07/12	2:50 PM	713	Yes	Yes	?	No	May be difficult to sample. Adjacent to Snag Cove. Bedrock and cobble present	P5070506-512, IMGP0009, 11, 15
3B-R1	Reserve	Bioassay	3B	-	-	-	No	-	-	-	-	P5070516
3B-R2	Reserve	Bioassay	3B	05/07/12	3:21 AM	720	Yes	Yes	?	No	viewed from a distance	P5070513, 514
3B-R3	Reserve	Bioassay	3B	-	-	-	No	-	-	-	-	-
3B-R4	Reserve	Bioassay	3B	05/08/12	4:30 PM	715	Yes	Yes	?	No	-	P5080584

Table 3

Proposed Sample Location Viability based on site Reconnaissance (May-2012)

Upper Columbia River RI/FS

Alternative Sample Location ID[1]	Location Priority	Proposed Analysis	Focus Area	Date	Time	River Mile (observations location)	Observed	Station Below Water?[2]	Sampleable? (Yes/No)[3]	Location Change Recommended	Comments	Photos
4-B1	Primary	Bioassay	4	05/09/12	10:30 AM	711	Yes	Yes	?	No	-	P5090605
4-B2	Primary	Bioassay	4	05/09/12	9:30 AM	707	Yes	Yes	?	No	-	P5090597, 601-604
4-B3	Primary	Bioassay	4	05/09/12	9:30 AM	707	Yes	Yes	?	No	-	P5090599
4-B4	Primary	Bioassay	4	05/09/12	9:10 AM	705	Yes	Yes	Yes?	No	USGS benthic images available	P5090589-90
4-B5	Primary	Bioassay	4	05/09/12	9:10 AM	705	Yes	Yes	Yes?	No	USGS benthic images available	P5090589-90
4-B6	Primary	Bioassay	4	05/07/12	12:50 PM	704	Yes	Yes	Yes?	No	-	P5070480-482
4-C1	Primary	Chemistry-Only	4	-	-	-	No	-	-	-	-	-
4-C2	Primary	Chemistry-Only	4	05/07/12	1:10 PM	706	Yes	Yes	?	**Yes**	Move 200 m north to depositional flats and out of Kettle River flows.	P5070484-487, 490, 495, IMGP0004
4-C3	Primary	Chemistry-Only	4	05/09/12	9:10 AM	705	Yes	Yes	Yes?	No	-	P5090589-90
4-C4	Primary	Chemistry-Only	4	05/09/12	9:10 AM	705	Yes	Yes	Yes?	No	USGS benthic images available	P5090589-90
4-C5	Primary	Chemistry-Only	4	05/09/12	9:00 AM	705	Yes	Yes	Yes?	No	-	P5090589
4-C6	Primary	Chemistry-Only	4	05/09/12	8:50 AM	703	Yes	Yes	Yes?	No	-	P5090586
4-R1	Reserve	Bioassay	4	05/09/12	10:30 AM	711	Yes	Yes	?	No	-	P5090606
4-R2	Reserve	Bioassay	4	05/09/12	9:30 AM	707	Yes	Yes	?	No	-	P5090597, 601-604
4-R3	Reserve	Bioassay	4	05/09/12	9:30 AM	707	Yes	Yes	?	No	-	P5090598
4-R4	Reserve	Bioassay	4	05/07/12	1:35 PM	706	Yes	Yes	Yes?	No	-	P5070488-, 491-492, 494
4-R5	Reserve	Bioassay	4	05/07/12	1:35 PM	706	Yes	Yes	Yes?	No	-	P5070488-489, 492, 494, IMGP0002
4-R6	Reserve	Bioassay	4	05/09/12	9:10 AM	705	Yes	Yes	Yes?	No	USGS benthic images available	P5090589-90
4-R7	Reserve	Bioassay	4	05/09/12	9:10 AM	705	Yes	Yes	Yes?	No	USGS benthic images available	P5090589-90
4-R8	Reserve	Bioassay	4	05/07/12	12:50 PM	704	Yes	Yes	Yes?	No	USGS benthic images available	P5070480-482
4-R9	Reserve	Bioassay	4	05/09/12	9:10 AM	705	Yes	Yes	Yes?	No	USGS benthic images available	P5090589-90
4-R10	Reserve	Bioassay	4	05/09/12	8:50 AM	703	Yes	Yes	Yes?	No	-	P5090587
4-R11	Reserve	Bioassay	4	05/07/12	2:10 PM	712	Yes	Yes	?	No	-	P5070499
4-R12	Reserve	Bioassay	4	05/07/12	1:35 PM	706	Yes	Yes	Yes?	No	-	P5070491-492, 496-498, IMGP0006

Notes:

[1] Alternative sample location ID begins with the focus area (B indicates station is between focus areas) then a letter following the dash indicaitng the planned analysis: B = Bioassay (and chemistry), C = Chemistry-only; R = Reserve; and the sample number (in

[2] Reconnaissance was conducted May 7-9 when reservoir was beginnig to fill from low-pool. Reservoir elevation was approximately 1239'-1240'.

[3] Stations where the substrate was not directly observed are denoted with "?" to indicate that conclusions regarding the potential for successful sampling are uncertain.

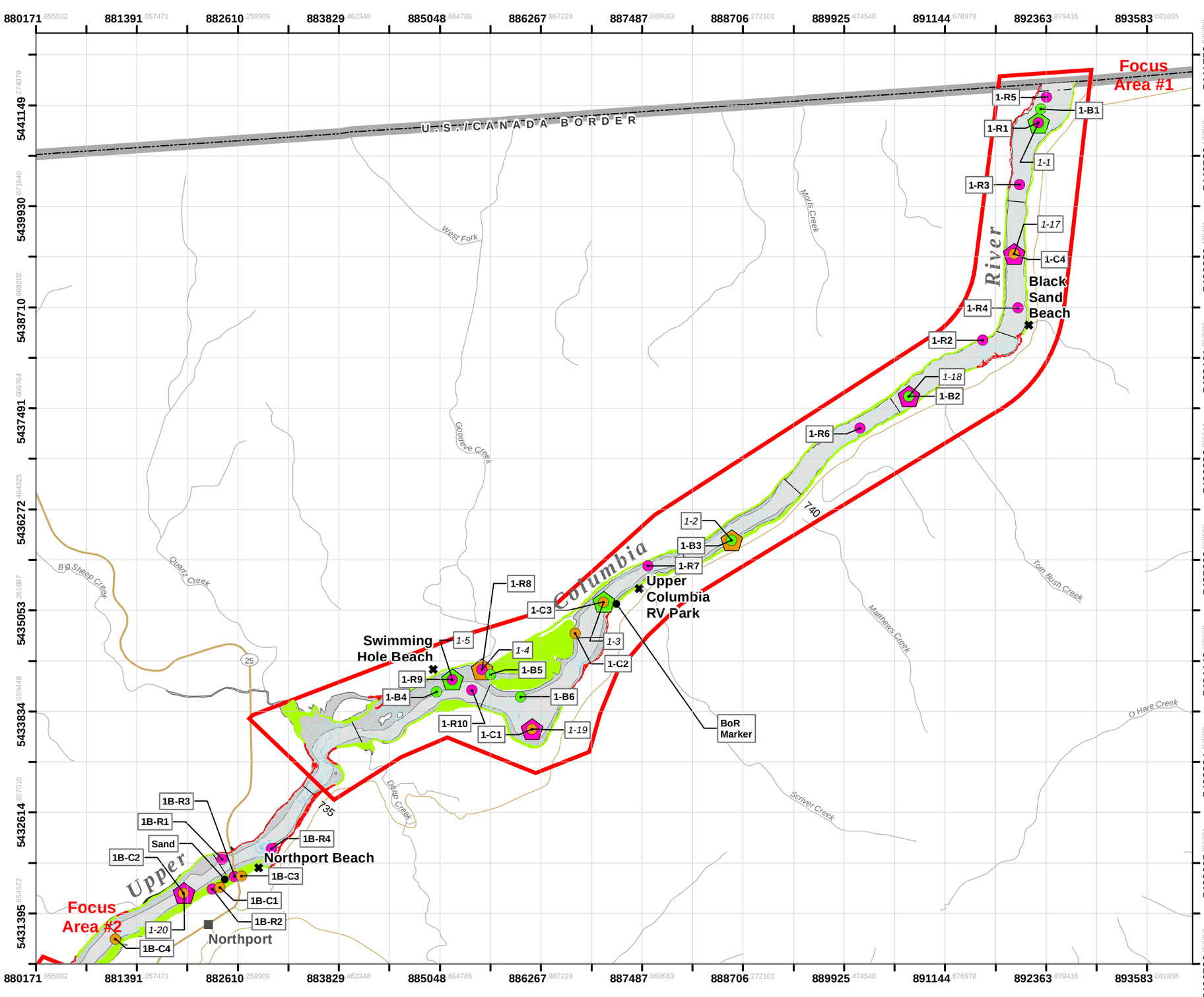
Table 4
Summary of Recommended Sample Location Changes
Upper Columbia River RI/FS

Alternative Sample Location ID[1]	Comments	(Estimated) Location	Alternative Northing (NAD83)	Alternative Easting (NAD83)	Alternative Lat.	Alternative Long.	Alternative UTM Northing	Alternative UTM Easting
1-C2	Mid-channel to right of riffle on river left. Move station west toward opposite bank to avoid cobble substrate.	hardcopy markup	724584.9729	2388930.605	48.94475648	-117.7181003	5434772.771	886683.3139
1B-C3	Cobble armored river bed. Move to sandy substrate nearby.	waypoint 1	715389.4309	2375454.41	48.92105556	-117.7756469	5431847.613	882653.5265
1B-R1	Move station into eddy downstream of bridge rather than in landslide area upstream of bridge.	hardcopy markup	716063.6072	2374716.697	48.92298209	-117.7786013	5432046.746	882422.4773
1B-R2	On cobble bar. Move 150 m upstream to marked sandy location.	waypoint 4	714903.1512	2374287.141	48.91985083	-117.7805778	5431688.896	882301.7259
1B-R3	Cobble bar with slag fines. Sampleable with dry methods, but not with van veen. Move station to sandy spot near bridge.	waypoint 2	715375.4988	2375177.89	48.9210475	-117.7767983	5431840.908	882569.2879
3-C3	Below steep armored bank where sampling is likely a challenge. Move upstream of China Bend boat launch depositional sediments on left bank.	hardcopy markup	673702.0623	2335400.72	48.81112288	-117.948603	5418775.327	870803.2532
3-R6	Move based on substrate map indicating bedrock.	hardcopy markup	675399.9702	2336864.93	48.815623	-117.942266	5419306.223	871234.9334
3-R9	Move station 100 meters upstream (east) closer into eddy due to cobble at proposed location.	hardcopy markup	676354.9327	2329062.606	48.81903695	-117.974478	5419528.638	868846.3338
4-C2	Move 200 m north to depositional flats and out of Kettle River flows.	hardcopy markup	622957.8288	2298344.415	48.67583092	-118.1097347	5402969.475	859945.9774
BoR Marker	BoR marker found downstream of UCR RV Park.	waypoint logged	725717.7955	2390591.767	48.947674	-117.711003	5435133.155	887180.0587
Sampleable Substrate	Potential alternate sample locations (sand).	waypoint 3	715272.507	2374791.403	48.920808	-117.778421	5431806.057	882452.2906

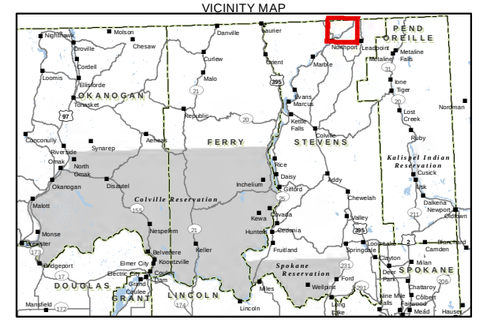
Notes:

[1] Alternative sample location ID begins with the focus area (B indicates station is between focus areas) then a letter following the dash indicaitng the planned analysis: B = Bioassay (and chemistry), C = Chemistry-only; R = Reserve; and the sample number (in sequence)

Figures



VICINITY MAP



LEGEND

- Primary Internal Reference
- Alternate Internal Reference
- Tributary Reference
- EPA Primary Bioassay
- EPA Primary Chemistry-Only
- EPA Alternate Bioassay
- Teck Primary Bioassay
- Teck Primary Chemistry-Only
- Teck Alternate Bioassay
- Bedrock Substrate
- Gravel Substrate
- M-S Substrate
- Sand Substrate
- Cobble Substrate

Bottom Elevation

- 880 - 930
- 931 - 980
- 981 - 1030
- 1031 - 1080
- 1081 - 1130
- 1131 - 1180
- 1181 - 1230
- 1231 - 1280

Other Features

- Tribal Lands
- Water
- Original River Channel
- Landslides
- Beach Location
- Cities
- Transect Lines
- Highway
- Major Road

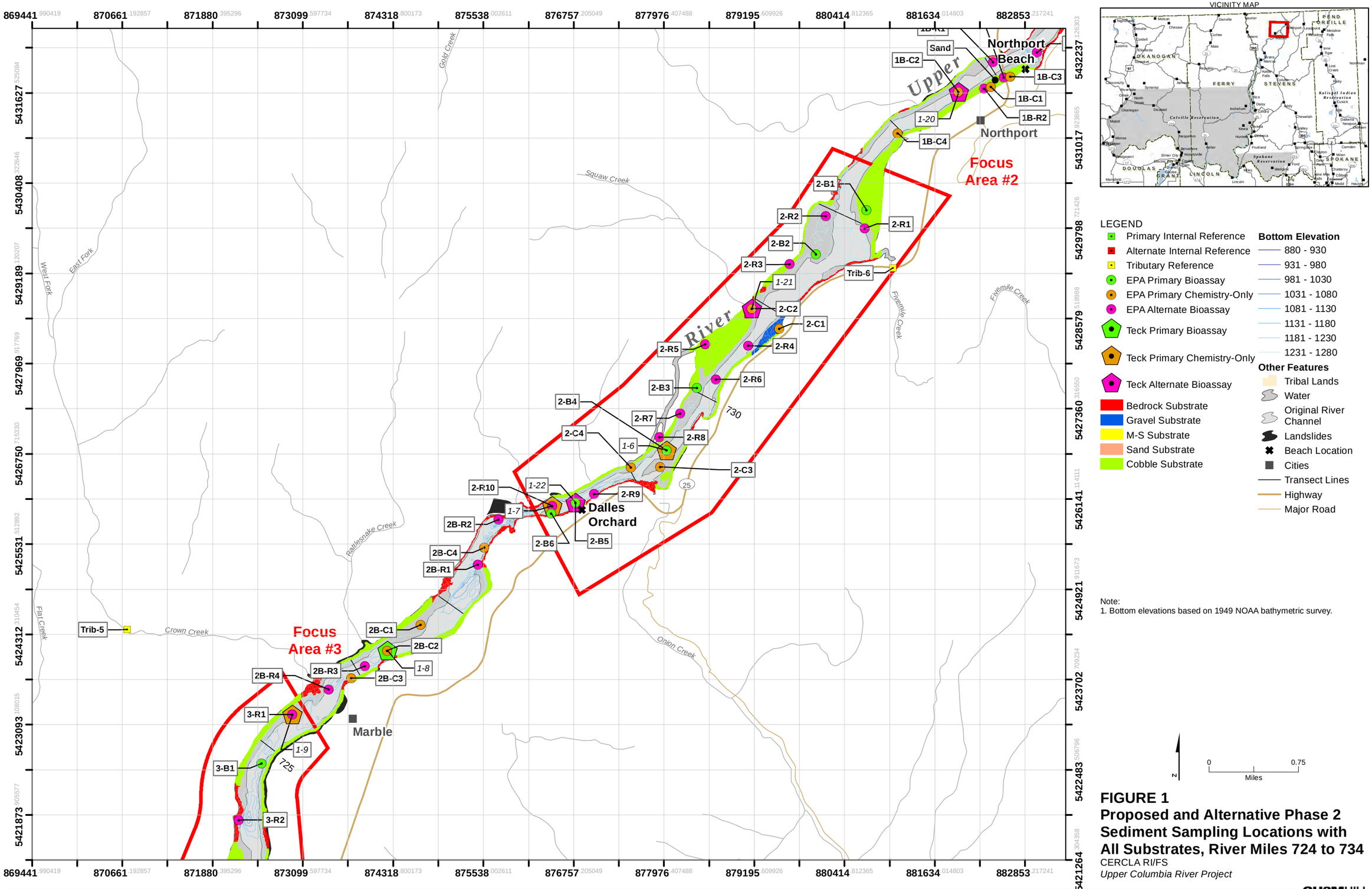
Note:
1. Bottom elevations based on 1949 NOAA bathymetric survey.

N

0 0.75 Miles

FIGURE 1
Proposed and Alternative Phase 2 Sediment Sampling Locations with All Substrates, River Miles 733 to 744
CERCLA RI/FS
Upper Columbia River Project

CH2MHILL



VICINITY MAP

LEGEND

- Primary Internal Reference
- Alternate Internal Reference
- Tributary Reference
- EPA Primary Bioassay
- EPA Primary Chemistry-Only
- EPA Alternate Bioassay
- Teck Primary Bioassay
- Teck Primary Chemistry-Only
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Other Features

- Tribal Lands
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- Landslides
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- Transect Lines
- Highway
- Major Road

Note:
1. Bottom elevations based on 1949 NOAA bathymetric survey.

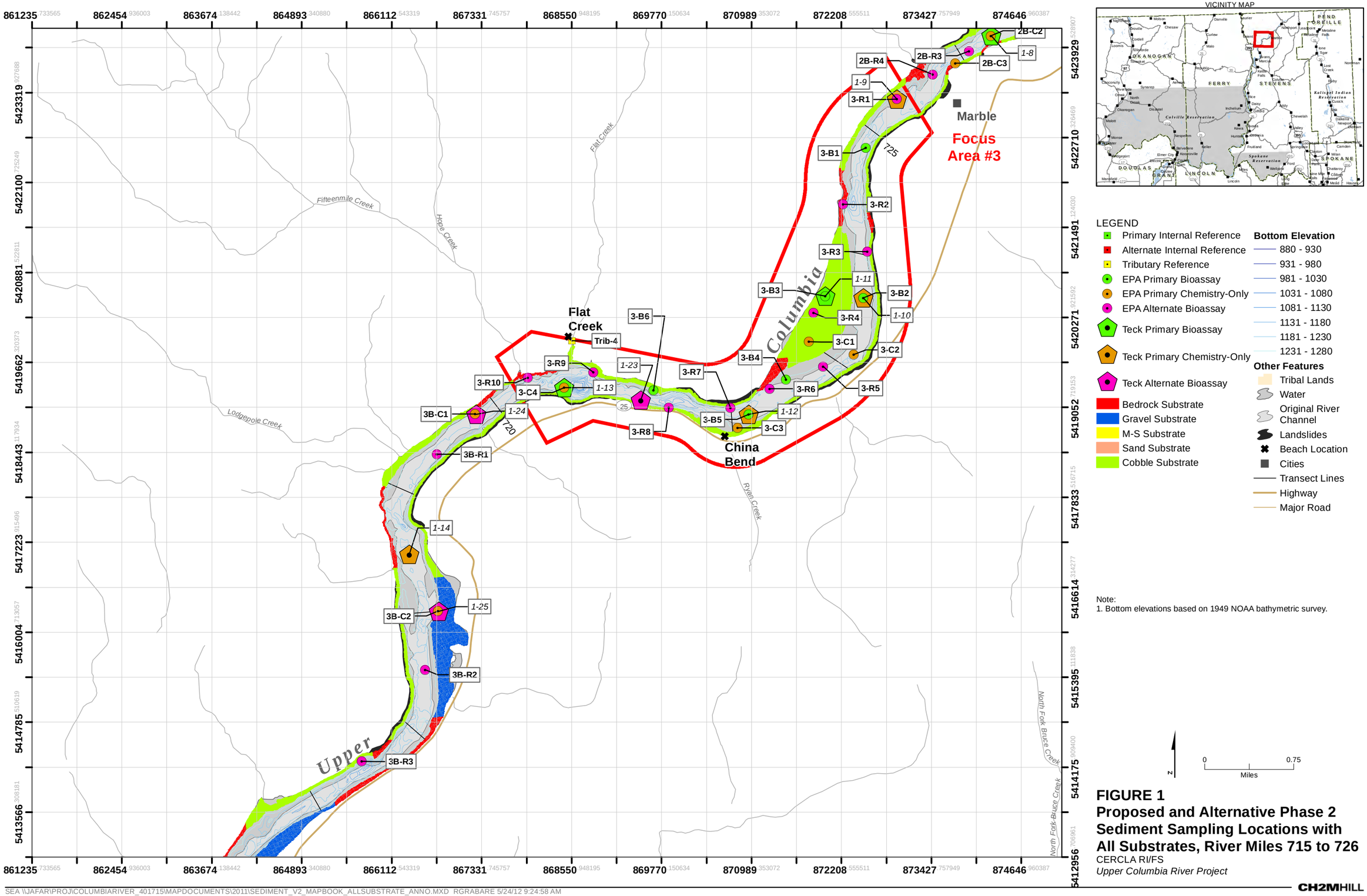
N

0 0.75 Miles

FIGURE 1
Proposed and Alternative Phase 2 Sediment Sampling Locations with All Substrates, River Miles 724 to 734
CERCLA RI/FS
Upper Columbia River Project

CH2MHILL

SEA \\JAFAR\PROJ\COLUMBIARIVER_401715\MAPDOCUMENTS\2011\SEDIMENT_V2_MAPBOOK_ALLSUBSTRATE_ANNO.MXD RGRABARE 5/24/12 9:24:58 AM



VICINITY MAP

LEGEND

- Primary Internal Reference
- Alternate Internal Reference
- Tributary Reference
- EPA Primary Bioassay
- EPA Primary Chemistry-Only
- EPA Alternate Bioassay
- Teck Primary Bioassay
- Teck Primary Chemistry-Only
- Teck Alternate Bioassay
- Bedrock Substrate
- Gravel Substrate
- M-S Substrate
- Sand Substrate
- Cobble Substrate

Bottom Elevation

- 880 - 930
- 931 - 980
- 981 - 1030
- 1031 - 1080
- 1081 - 1130
- 1131 - 1180
- 1181 - 1230
- 1231 - 1280

Other Features

- Tribal Lands
- Water
- Original River Channel
- Landslides
- Beach Location
- Cities
- Transect Lines
- Highway
- Major Road

Note:
1. Bottom elevations based on 1949 NOAA bathymetric survey.

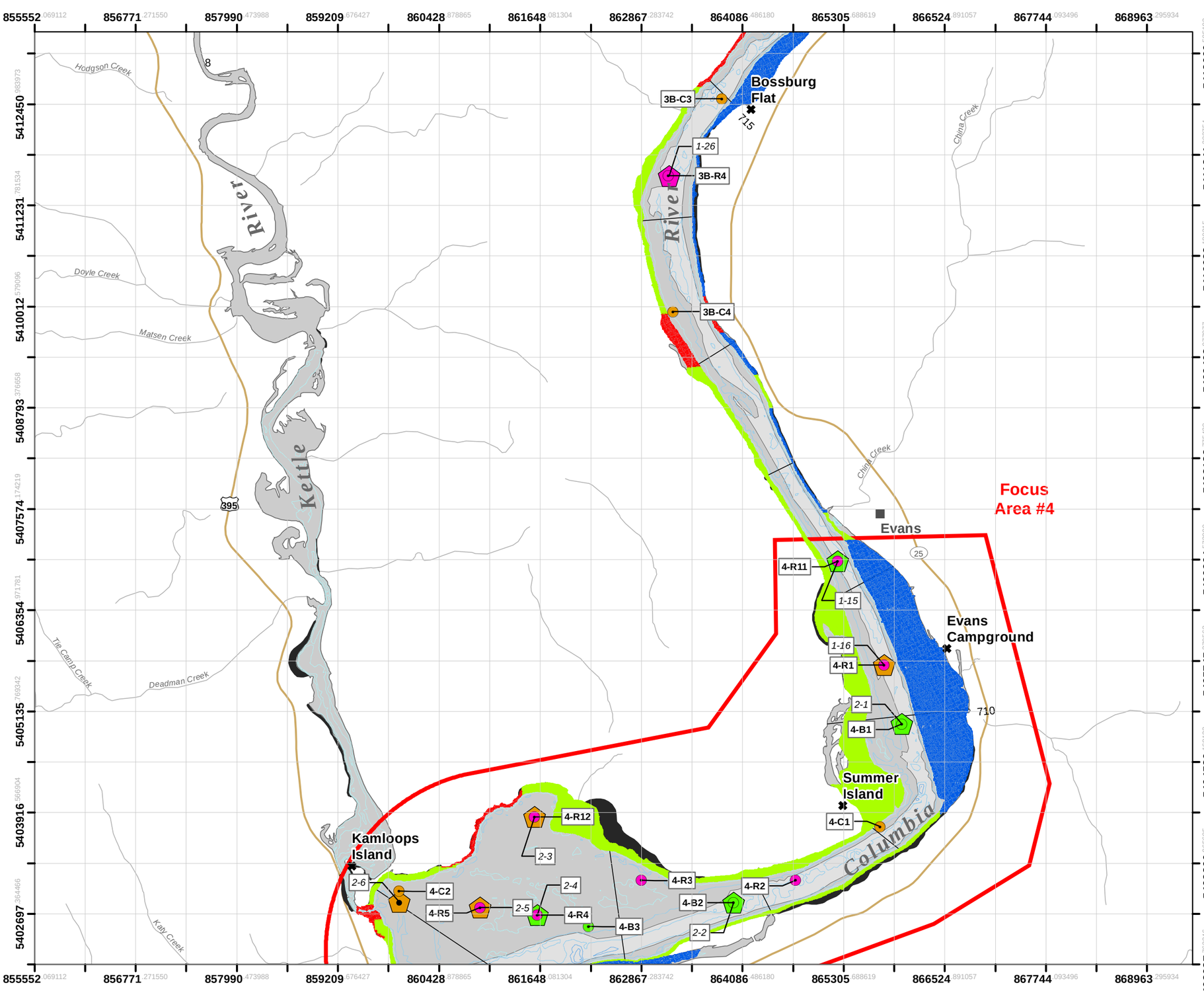
N

0 0.75 Miles

FIGURE 1
Proposed and Alternative Phase 2 Sediment Sampling Locations with All Substrates, River Miles 715 to 726
CERCLA RI/FS
Upper Columbia River Project

CH2MHILL

SEA \\JAFAR\PROJ\COLUMBIARIVER_401715\MAPDOCUMENTS\2011\SEDIMENT_V2_MAPBOOK_ALLSUBSTRATE_ANNO.MXD RGRABARE 5/24/12 9:24:58 AM



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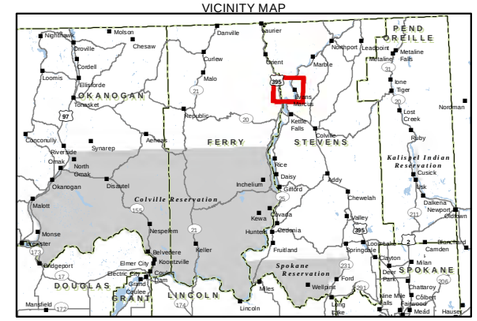


LEGEND

- Primary Internal Reference
- Alternate Internal Reference
- Tributary Reference
- EPA Primary Bioassay
- EPA Primary Chemistry-Only
- EPA Alternate Bioassay
- Teck Primary Bioassay
- Teck Primary Chemistry-Only
- Teck Alternate Bioassay
- Bedrock Substrate
- Gravel Substrate
- M-S Substrate
- Sand Substrate
- Cobble Substrate

Bottom Elevation

- 880 - 930
- 931 - 980
- 981 - 1030
- 1031 - 1080
- 1081 - 1130
- 1131 - 1180
- 1181 - 1230
- 1231 - 1280

Other Features

- Tribal Lands
- Water
- Original River Channel
- Landslides
- Beach Location
- Cities
- Transect Lines
- Highway
- Major Road

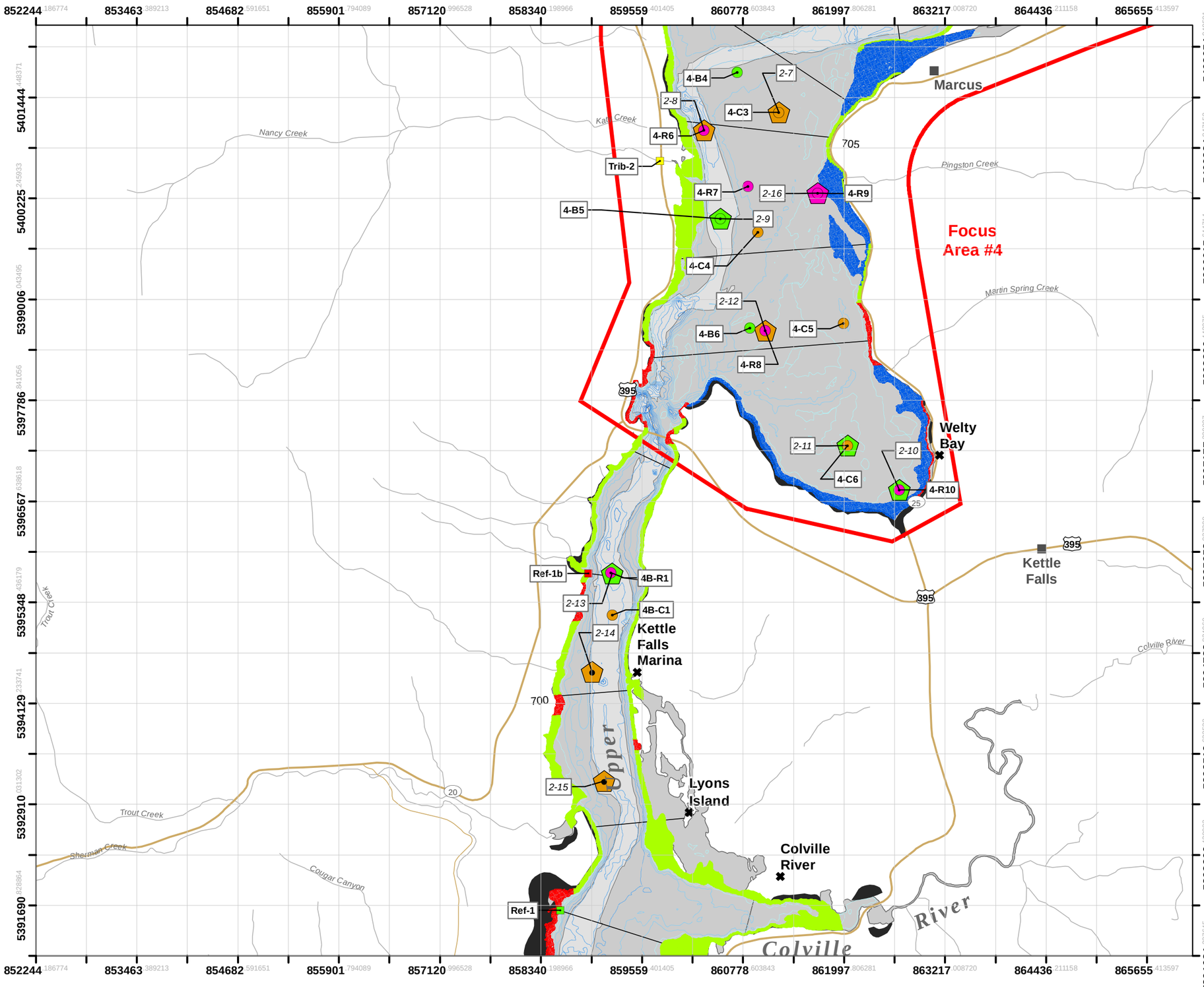
Note:
1. Bottom elevations based on 1949 NOAA bathymetric survey.

N

0 0.75
Miles

FIGURE 1
Proposed and Alternative Phase 2 Sediment Sampling Locations with All Substrates, River Miles 704 to 715
CERCLA RI/FS
Upper Columbia River Project

CH2MHILL



Note:
1. Bottom elevations based on 1949 NOAA bathymetric survey.

FIGURE 1
Proposed and Alternative Phase 2 Sediment Sampling Locations with All Substrates, River Miles 698 to 706
CERCLA RI/FS
Upper Columbia River Project

(1)

EXHIBIT 1. FIELD OBSERVATION FORM

Project: Phase II Sediment Sample Location Reconnaissance **Project Number:** 350521.FI.01

Date: 05/ 7 /2012 **Time:** 1250

Observer(s): Cameron Irvine/SAC

Sample Location ID: 4-B6/4-R8 **River Mile:** 704

Observed Characteristic	On Station	Adjacent
Bank Nearest Bank (L/R):	-	R
Slope Estimate:	u/w	flat
Bed Material (p – present / est. % abundance)		
Bedrock		
Cobble		
Gravels		✓
Sand		✓
Silt		✓
Depositional?	✓	✓

Notes: H_2O level at 1240. Station under water. Sand/gravels exposed in flats adjacent to stations. Seems depositional.

Sample Possible (based on BPJ)? Yes. If similar to exposed areas.

Photo #	Direction Facing	Description
70480	E	marcus flat from Hwy 395
70481	SE	|
70482	SE	|
70483	—	field team

EXHIBIT 1. FIELD OBSERVATION FORM

Project: Phase II Sediment Sample Location Reconnaissance **Project Number:** 350521.FI.01

(2) move

Date: 05/ 7 /2012 **Time:** 1310

Observer(s): Cameron Irvine/SAC

Sample Location ID: 4-C2 **River Mile:** 706

Observed Characteristic	On Station	Adjacent	
Bank Nearest Bank (L/R):	-	flats	Right Bank
Slope Estimate:	u/w	—	Moderate
Bed Material (p – present / est. % abundance)			
Bedrock		—	✓
Cobble		—	✓
Gravels		—	✓
Sand		✓	✓
Silt		✓	—
Depositional?	?	✓	X

Notes:

- Pull out N. of Bridge from Kamloops Is.
- Station may be in the middle of Kettle River mouth where enters Marcus Flats. + could be armored / indicative of Kettle R. sediments / deposits

Sample Possible (based on BPJ)?

? Move to depositional sed N. of boom ~200m

Photo #	Direction Facing	Description
70484-85	S	Kettle R. confluence w/ Marcus Flat
86-87	-	bank material

EXHIBIT 1. FIELD OBSERVATION FORM

Project: Phase II Sediment Sample Location Reconnaissance **Project Number:** 350521.FI.01

(3)

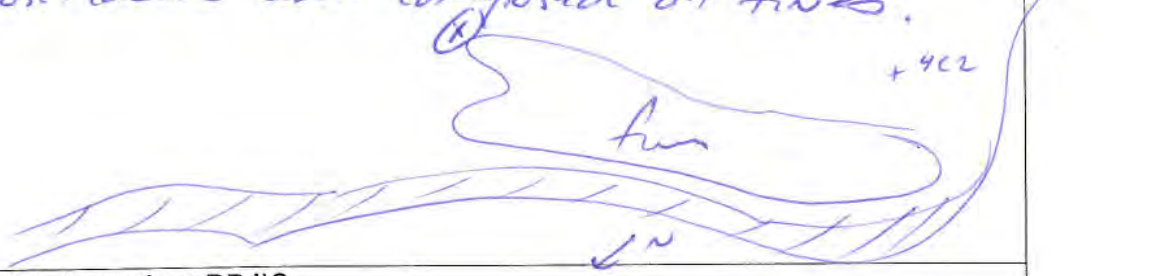
Date: 05/ 7 /2012 **Time:** 1335

Observer(s): Cameron Irvine/SAC

Sample Location ID: 4R4/4-R5 **River Mile:** 706

Observed Characteristic	On Station	Adjacent	
Bank Nearest Bank (L/R):		R	
Slope Estimate:	u/w	flat	bank moderately steep.
Bed Material (p – present / est. % abundance)			
Bedrock		—	—
Cobble		—	✓
Gravels		—	✓
Sand		✓	✓
Silt		✓	—
Depositional?	✓	✓	x

Notes: Viewed from River Rt after walking u/s from Kamloops Is. Stations wet just beyond depositional bar composed of fines.



Sample Possible (based on BPJ)? Yes.

Photo #	Direction Facing	Description
488-89	SE	looking toward narrows fines/wet
+494	SE	"
+491-492	E	looking along Rt bank to 4R12

(4)

EXHIBIT 1. FIELD OBSERVATION FORM

Project: Phase II Sediment Sample Location Reconnaissance **Project Number:** 350521.FI.01

Date: 05/ 7 /2012 **Time:** 1340

Observer(s): Cameron Irvine/SAC

Sample Location ID: 4-R12 **River Mile:** _____

Observed Characteristic	On Station	Adjacent
Bank Nearest Bank (L/R):	-	RB
Slope Estimate:	U/W	moderate
Bed Material (p – present / est. % abundance)		
Bedrock		—
Cobble		—
Gravels		—
Sand		✓
Silt		✓
Depositional?		✓

Notes:

- Bedrock on high bank
- gravel / cobble / sand below from high water to 1240 1250'
- sandy / silty bar above water

—

Sample Possible (based on BPJ)? yes.

Photo #	Direction Facing	Description
491-492	NE	to station from w shoreline
493	N	Clay bank
496-498	W	toward Kuttle River

(5)

EXHIBIT 1. FIELD OBSERVATION FORM

Project: Phase II Sediment Sample Location Reconnaissance **Project Number:** 350521.FI.01

Date: 05/ 7 /2012 **Time:** 14:10

Observer(s): Cameron Irvine/SAC

Sample Location ID: 4-R11 **River Mile:** 711.5

Observed Characteristic	On Station	Adjacent
Bank Nearest Bank (L/R):	-	R
Slope Estimate:	wet	moderate
Bed Material (p – present / est. % abundance)		
Bedrock		—
Cobble		✓
Gravels		✓
Sand		✓
Silt		—
Depositional?		—

Notes: Station viewed from Hwy 395 at distance. Channel full of water so cannot confirm sampleability.

Sample Possible (based on BPJ)? ?

Photo #	Direction Facing	Description
10499	SE	Viewed from Road (barely)

(6)

EXHIBIT 1. FIELD OBSERVATION FORM

Project: Phase II Sediment Sample Location Reconnaissance **Project Number:** 350521.FI.01

Date: 05/ 7 /2012 **Time:** 250

Observer(s): Cameron Irvine/SAC

Sample Location ID: 3B-C4 **River Mile:** 713

Observed Characteristic	On Station	Adjacent
Bank Nearest Bank (L/R):		R
Slope Estimate:	wet	low
Bed Material (p – present / est. % abundance)		
Bedrock		✓
Cobble		✓
Gravels		✓
Sand		✓
Silt		✓
Depositional?	?	~~No~~ mixed silts+armor

Notes:
- Adjacent to snag cove rec. area.
- Walked along River Right bank + saw bedrock outcrop (marked w/ buoy), treestumps + mussel shells.
- Station wet + cobble/gravel nearby
- Sample may be challenging.

Sample Possible (based on BPJ)? ?

Photo #	Direction Facing	Description
70500-505	—	approaching station
506-512	—	near station

(7)

EXHIBIT 1. FIELD OBSERVATION FORM

Project: Phase II Sediment Sample Location Reconnaissance **Project Number:** 350521.FI.01

Date: 05/ 7 /2012 **Time:** 3:21

Observer(s): Cameron Irvine/SAC

Sample Location ID: 3B-C2/3B-R2 **River Mile:** ~~720~~ 718.5

Observed Characteristic	On Station	Adjacent
Bank Nearest Bank (L/R):		3B C2 near Rm ~~left~~ right 3B R2 near river ~~left~~ right.
Slope Estimate:	wet	moderate
Bed Material (p – present / est. % abundance)		
Bedrock		—
Cobble		✓
Gravels		✓
Sand		✓
Silt		—
Depositional?		—

Notes:
- Viewed from ~~Hoog~~ Northport - Flat Creek Road pullout. At distance.
- Stations appear to be in thalweg with some cobble armoring on Rt. bank & maybe fines at left bank
- likely a challenging sample location!
- 3BR2 seems to ~~Be~~ in a riffle at river right.

Sample Possible (based on BPJ)?
?

Photo #	Direction Facing	Description
70513	SW	Stations viewed from road
70514	SW	/
~~70071~~		

(8)

EXHIBIT 1. FIELD OBSERVATION FORM

Project: Phase II Sediment Sample Location Reconnaissance **Project Number:** 350521.FI.01

Date: 05/ 7 /2012 **Time:** 3:35 - 3:40

Observer(s): Cameron Irvine/SAC

Sample Location ID: 3-C4/3R10 **River Mile:** 721

Observed Characteristic	On Station	Adjacent
Bank Nearest Bank (L/R):	-	3-C4 @ River left 3-R10 @ River Rt.
Slope Estimate:	wet	mod.
Bed Material (p – present / est. % abundance)		
Bedrock		✓
Cobble		✓
Gravels		—
Sand		✓
Silt		—
Depositional?		NO

Notes: Viewed from China bend road turnout near flat Creek confluence. Stations located adjacent to main river channel / thalweg. + cobble/gravel-R mixed bars - bedrock outcropping suggests a challenging sample location.

Sample Possible (based on BPJ)? Yes?

Photo #	Direction Facing	Description
~~516~~	~~SW~~	~~from China bend Rd.~~
518	SW	3R10 " w/ 3R10 in distance behind Rock outcrop at river right.
519	W	3-C4 viewed across river.

9

moor

EXHIBIT 1. FIELD OBSERVATION FORM

Project: Phase II Sediment Sample Location Reconnaissance **Project Number:** 350521.FI.01

Date: 05/ 7 /2012 **Time:** ~~335~~ 340

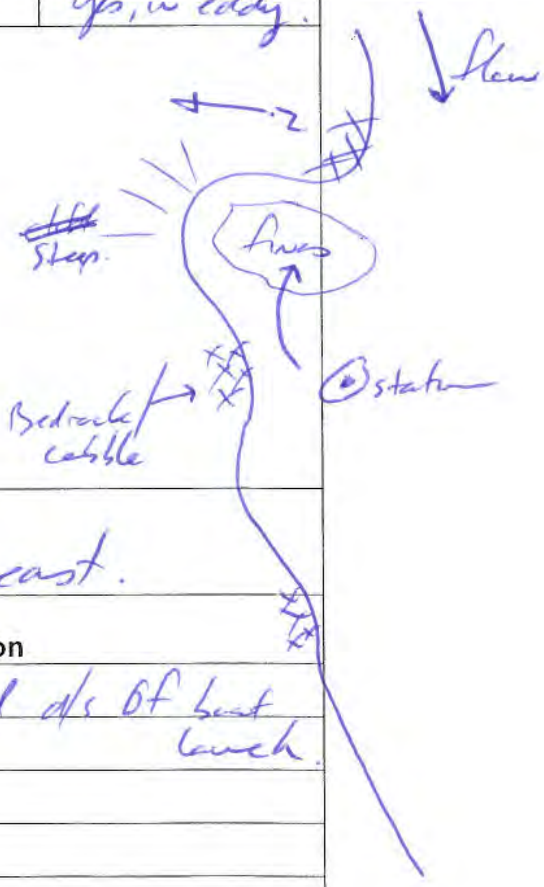
Observer(s): Cameron Irvine/SAC

Sample Location ID: 3R9 **River Mile:** 721

Observed Characteristic	On Station	Adjacent
Bank Nearest Bank (L/R):		Rt.
Slope Estimate:	u/w	moderate
Bed Material (p – present / est. % abundance)		
Bedrock		—
Cobble		✓
Gravels		✓
Sand		✓
Silt		✓
Depositional?		yes, in eddy.

Notes:

- Access off china bend Road
- Good location but seemed to be outside of Eddy where depositional fines observed.
- Move 100 m u/s (east) into reach



Sample Possible (based on BPJ)?

? move station to eddy 100m east.

Photo #	Direction Facing	Description
70517	E	facing china Bend d/s of last reach.
70520	E	

(10)

EXHIBIT 1. FIELD OBSERVATION FORM

Project: Phase II Sediment Sample Location Reconnaissance **Project Number:** 350521.FI.01

Date: 05/ 7 /2012 **Time:** 405

Observer(s): Cameron Irvine/SAC

Sample Location ID: 3-B4 / 3-B5 **River Mile:** 723

Observed Characteristic	On Station	Adjacent
Bank Nearest Bank (L/R):		mid channel
Slope Estimate:	wet	mod.
Bed Material (p – present / est. % abundance)		
Bedrock		✓
Cobble		✓
Gravels		✓
Sand		✓
Silt		—
Depositional?		

Notes:
- accessed from chuna bend road before gate. Stations viewed at distance + were mid-channel/wet.
- Bed rock present on left bank + cobbles so sampling may be challenging.

Sample Possible (based on BPJ)? ?

Photo #	Direction Facing	Description
PS070521	W	Looking across chuna bend to left (east) bank u/s of boat launch.

(11)

EXHIBIT 1. FIELD OBSERVATION FORM

Project: Phase II Sediment Sample Location Reconnaissance **Project Number:** 350521.FI.01

Date: 05/ 7 /2012 **Time:** 4:30

Observer(s): Cameron Irvine/SAC

Sample Location ID: 2B4 2B5/2-B6 **River Mile:** 728.5

Observed Characteristic	On Station	Adjacent
Bank Nearest Bank (L/R):	-	—
Slope Estimate:	wet	steep
Bed Material (p – present / est. % abundance)		
Bedrock		✓
Cobble		✓
Gravels		✓
Sand		✓
Silt		—
Depositional?		NO

Notes:
- Locations viewed from west side at pullout off Northpoint. Flat Creek Road - just N. of switchback (RM 728.5).
- All stations wet from canon creek (viewed u/s) to Bossberg bend (d/s of view point) +
- likely challenging sample collection due to narrow channel + bedrock present.

Sample Possible (based on BPJ)? ?

Photo #	Direction Facing	Description
70522	S	@ 2-B5 + 2R9
70523	E	@ 2-R9 upstream + 2B4 + 2C3
70524	S	@ 2-B5 + 2R9
70525	SW	@ 2-B6 + 2R10
~~70526~~		
~~70527~~		

EXHIBIT 1. FIELD OBSERVATION FORM

Project: Phase II Sediment Sample Location Reconnaissance **Project Number:** 350521.FI.01

(12)

Date: 05/ 7 /2012 **Time:** 500

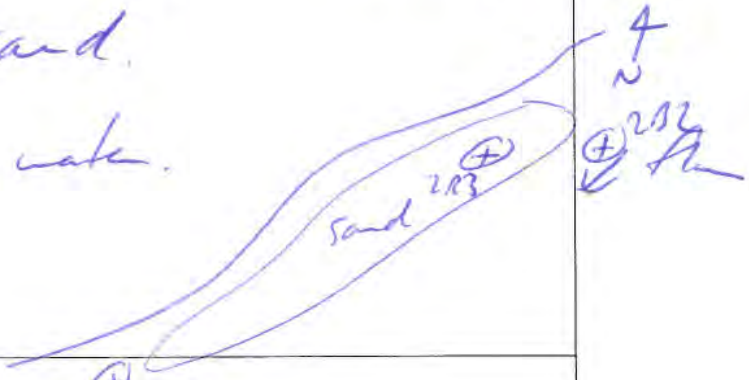
Observer(s): Cameron Irvine/SAC

Sample Location ID: 2-R3 / 2-C2 / 2B2 **River Mile:** _____

Observed Characteristic	On Station	Adjacent
Bank Nearest Bank (L/R):	-	River Right.
Slope Estimate:	Flat 2-R3	low
Bed Material (p – present / est. % abundance)		
Bedrock	—	—
Cobble	—	—
Gravels	—	—
Sand	✓	✓
Silt	—	—
Depositional?	✓	✓

Notes:

- 2-R3 on beach - stood on station (pic)
- / nice sand.
- 2B2 + 2C2 in water.



Sample Possible (based on BPJ)? yes

Photo #	Direction Facing	Description
70526	SW	Sandy beach on river right 2-C2
527	SE	looking across river to 2R3
528	SW	on target 2-R3
529	NE	@ 2-R3 - 2-B2

EXHIBIT 1. FIELD OBSERVATION FORM

Project: Phase II Sediment Sample Location Reconnaissance **Project Number:** 350521.FI.01 (1)

Date: 05/ 8 /2012 **Time:** 915

Observer(s): Cameron Irvine/SAC

Sample Location ID: IR4 **River Mile:** 7.42

Observed Characteristic	On Station	Adjacent
Bank Nearest Bank (L/R):	L/R	station @ contr channel
Slope Estimate:		mod
Bed Material (p – present / est. % abundance)		
Bedrock		✓
Cobble		✓
Gravels		✓
Sand		✓
Silt		—
Depositional?		NO

Notes: Viewed from blk sand beach. appeared indurate - John indicated loc ≃ based on historical maps & observations re Cus Sampling Dwts for slag

Sample Possible (based on BPJ)? ?

Photo #	Direction Facing	Description
80530	N	from black sand beach
80532	N	"

EXHIBIT 1. FIELD OBSERVATION FORM

Project: Phase II Sediment Sample Location Reconnaissance **Project Number:** 350521.FI.01

(2)

1239.20

Date: 05/ 8 /2012 **Time:** 915

Observer(s): Cameron Irvine/SAC

Sample Location ID: 1R2 **River Mile:** 7.42

Observed Characteristic	On Station	Adjacent
Bank Nearest Bank (L/R): (R)	-	R
Slope Estimate:	u/w	low
Bed Material (p – present / est. % abundance)		
Bedrock		—
Cobble		✓
Gravels		✓
Sand		✓
Silt		✓
Depositional?		

Notes: Observations from R/L sand beach

Station on opposite bank where area of sandy beach visible 200m d/s of residence/dock.

low ISD during low water recon.

Reservoir elevation @ 1239.'

Sample Possible (based on BPJ)? yes

Photo #	Direction Facing	Description
00533	S	from blade - sand beach
00534	S	"

EXHIBIT 1. FIELD OBSERVATION FORM

Project: Phase II Sediment Sample Location Reconnaissance **Project Number:** 350521.FI.01

(3)

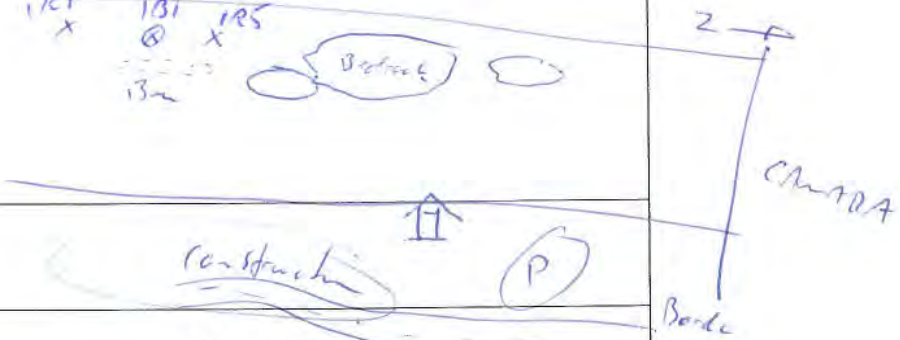
Date: 05/ 8 /2012 **Time:** 950

Observer(s): Cameron Irvine/SAC

Sample Location ID: IBI (IR1, IR5) **River Mile:** 744

Observed Characteristic	On Station	Adjacent
Bank Nearest Bank (L/R):	-	Rt bank / bedrock outcrop
Slope Estimate:	L/M	Low - Mod
Bed Material (p – present / est. % abundance)		
Bedrock		✓ ✓
Cobble		✓
Gravels		✓
Sand		✓ L-M%
Silt		—
Depositional?	Yes	NO

Notes:
- Parked at wayside crossing construction area.
- Sample locations d/s of large rock/cliff close to RB in eddy that stretches ≥ 500m d/s covering all 3 points.



Sample Possible (based on BPJ)?

Photo #	Direction Facing	Description
80535	W	IBI from parking area for construction
80536	SW	all stations down stream of bedrock,
80537	NW	up stream of bedrock outcrop.
80538	S	Left bank detail

(4)

EXHIBIT 1. FIELD OBSERVATION FORM

Project: Phase II Sediment Sample Location Reconnaissance **Project Number:** 350521.FI.01

Date: 05/ 8 /2012 **Time:** 1050

Observer(s): Cameron Irvine/SAC

Sample Location ID: 1-R7 **River Mile:** 759

Observed Characteristic	On Station	Adjacent
Bank Nearest Bank (L/R):	wet	Rt.
Slope Estimate:		Steep
Bed Material (p – present / est. % abundance) Bedrock		—
Cobble		✓ small cobble
Gravels		✓
Sand		✓
Silt		✓
Depositional?		maybe

Notes:

- Access location from RV Park on east side along Northpart - Wareta Rd.
- * Map label for RV park is correct - move 1 mi dls.
- Station located across from RV park beach to the left (downstream) of photo image

Sample Possible (based on BPJ)? Yes?

Photo #	Direction Facing	Description
80539	NE	u/s of 1-R7 from Beach
80540	N	Beach detail

(5)

★ move

EXHIBIT 1. FIELD OBSERVATION FORM

Project: Phase II Sediment Sample Location Reconnaissance **Project Number:** 350521.FI.01

Date: 05/ 8 /2012 **Time:** 1116

Observer(s): Cameron Irvine/SAC

Sample Location ID: 1C2 **River Mile:** 739.

Observed Characteristic	On Station	Adjacent
Bank Nearest Bank (L/R):	-	(L)
Slope Estimate:	4	steep
Bed Material (p – present / est. % abundance)		
Bedrock		—
Cobble		✓
Gravels		✓
Sand		✓
Silt		—
Depositional?		NO

Notes: high energy spot. Expect hard to hold position + has lots of cobble armouring
- Recommend moving closer to calmer water near W side grassy slope/s of cobble island.

x 1C3

(x) 1C2

Sample Possible (based on BPJ)? NO - move 50m across R. to west.

Photo #	Direction Facing	Description
80541	SW	viewing station looking d/s
80542	SW	from left bank. station
80543	SW	beyond riffle to mid-channel.

(6)

EXHIBIT 1. FIELD OBSERVATION FORM

Project: Phase II Sediment Sample Location Reconnaissance **Project Number:** 350521.FI.01

Date: 05/ 8 /2012 **Time:** 1105

Observer(s): Cameron Irvine/SAC

Sample Location ID: 103 **River Mile:** 739

Observed Characteristic	On Station	Adjacent
Bank Nearest Bank (L/R):		mid
Slope Estimate:	u | w	—
Bed Material (p – present / est. % abundance)		
Bedrock		—
Cobble		✓
Gravels		✓
Sand		✓
Silt		✓
Depositional?		mixed

Notes: Viewed from RV park dtn walk d/s from Beach. stn is mid channel as river widens there is cobble armored rt bk near Left Bank - could be tough to sample.

Sample Possible (based on BPJ)? ? tng

Photo #	Direction Facing	Description
80544	u/s - NE	station mid channel d/s of beaver chewed tree.

(7)

EXHIBIT 1. FIELD OBSERVATION FORM

Project: Phase II Sediment Sample Location Reconnaissance **Project Number:** 350521.FI.01

Date: 05/ 8 /2012 **Time:** 1135

Observer(s): Cameron Irvine/SAC

Sample Location ID: 133 **River Mile:** 739

Observed Characteristic	On Station	Adjacent
Bank Nearest Bank (L/R):	u/w	LB
Slope Estimate:		
Bed Material (p – present / est. % abundance) Bedrock		—
Cobble		✓ lg+sm
Gravels		✓
Sand		✓
Silt		✓
Depositional?		L/Hrocks

Notes: Viewed from RU Bank. The mid channel location is in calm water so trey sampling D/s chan + reserve locations would be good alternats if sample refused.

Sample Possible (based on BPJ)? yes

Photo #	Direction Facing	Description
80545	u/s	view u/s from left bank. station
80546	u/s	1km from view point. no access

(8)

EXHIBIT 1. FIELD OBSERVATION FORM

Project: Phase II Sediment Sample Location Reconnaissance **Project Number:** 350521.FI.01

Date: 05/ 8 /2012 **Time:** 1155

Observer(s): Cameron Irvine/SAC

185/186/184 + IR 8,9,10

Sample Location ID: DME/Swimming hole **River Mile:** 737

Observed Characteristic	On Station	Adjacent
Bank Nearest Bank (L/R):	-	—
Slope Estimate:	wet?	flat.
Bed Material (p – present / est. % abundance)		
Bedrock	—	—
Cobble	~	~
Gravels	~	~
Sand	~	~
Silt	~	~
Depositional?	yes	yes

Notes:

- Poor viewing access. from high ridge ~~(SE)~~ US on road above DME complex. See that samples should be able to be collected.
- Key will be flexibility in permitting to allow field teams to make decisions to increase sample success

Sample Possible (based on BPJ)? Y.

Photo #	Direction Facing	Description
80547	d/s (W)	DME complex from road.
80548	d/s (W)	"
80549	d/s (W)	"

(9)

EXHIBIT 1. FIELD OBSERVATION FORM

Project: Phase II Sediment Sample Location Reconnaissance **Project Number:** 350521.FI.01

Date: 05/ 8 /2012 **Time:** 120

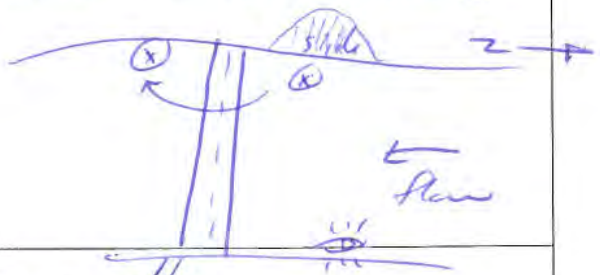
Observer(s): Cameron Irvine/SAC

move

Sample Location ID: 1B R1 **River Mile:** 734

Observed Characteristic	On Station	Adjacent
Bank Nearest Bank (L/R):	L/W	RB
Slope Estimate:		steep
Bed Material (p – present / est. % abundance)		
Bedrock		✓
Cobble		✓
Gravels		✓
Sand		✓
Silt		—
Depositional?		X

Notes: move station to eddy d/s of Bridge ~500 feet. Viewed from LeRoi smelter / Boat Launch in NorPoint & from viewpoint on Waverly Rd N of NP.



Sample Possible (based on BPJ)? N - move d/s

Photo #	Direction Facing	Description
80550	NW	looking across river to station from old LeRoi smelter area.

EXHIBIT 1. FIELD OBSERVATION FORM

Project: Phase II Sediment Sample Location Reconnaissance **Project Number:** 350521.FI.01

(10)

Date: 05/ 8 /2012 **Time:** 1 25

Observer(s): Cameron Irvine/SAC

* mark

Sample Location ID: 1B-R3 **River Mile:** 734

Observed Characteristic	On Station	Adjacent
Bank Nearest Bank (L/R):	-	Left
Slope Estimate:	flat	low grade
Bed Material (p – present / est. % abundance)		
Bedrock	—	some nearby
Cobble	✓	✓
Gravels	✓	✓
Sand	✓	✓
Silt	—	✓
Depositional?	✓	small pockets of depositional

Notes:

- Sample location on cobble bar with sandy blanket (slag?) embedded.
- Could be sampled in dry conditions with alternative methods. or

or

- move station to sandy deposits nearby

waypoint
1 48°55'15.8"N 117°46'132.329"W
2 " 15.771N " 36.474
3 " 14.907N " 42.317W
4 " 11.463N " 50.080W

Sample Possible (based on BPJ)? NO, unless sampled when dry with alternative methods.

Photo #	Direction Facing	Description
80553	SW	Sandy deposit near 1BR3
80554-555	—	sand detail waypoint 1.
80556	NE	bank adjacent to sand
80557-559	—	on station - cobble bar.

(11)

EXHIBIT 1. FIELD OBSERVATION FORM

Project: Phase II Sediment Sample Location Reconnaissance **Project Number:** 350521.FI.01

Date: 05/ 8 /2012 **Time:** 1:25-1:40

Observer(s): Cameron Irvine/SAC

moved

Sample Location ID: 13C3 **River Mile:** 7.34

Observed Characteristic	On Station	Adjacent
Bank Nearest Bank (L/R):	-	L
Slope Estimate:	wet	flat
Bed Material (p – present / est. % abundance)		
Bedrock		—
Cobble		✓
Gravels		✓
Sand		✓
Silt		—
Depositional?		yes

Notes: Northpoint boat launch area. Sample location d/s of cobble armored bar. Low likelihood of successful sample collection.

Sample Possible (based on BPJ)? NO - too much cobble armor use alternate waypoints on 13-03 sheet.

Photo #	Direction Facing	Description
—	—	—
80567	SW	From cobble breakwater d/s of boat launch looking d/s

(12)

EXHIBIT 1. FIELD OBSERVATION FORM

Project: Phase II Sediment Sample Location Reconnaissance **Project Number:** 350521.FI.01

Date: 05/ 8 /2012 **Time:** 2:05

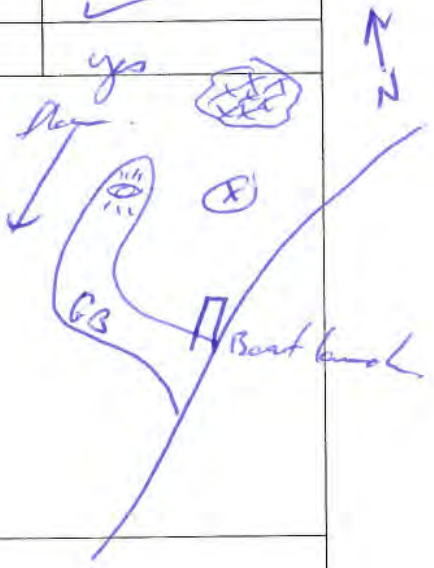
Observer(s): Cameron Irvine/SAC

Sample Location ID: 1B-R4 **River Mile:** 734

Observed Characteristic	On Station	Adjacent
Bank Nearest Bank (L/R):	-	L
Slope Estimate:	wet	mod
Bed Material (p – present / est. % abundance)		
Bedrock		✓
Cobble		✓
Gravels		✓
Sand		✓
Silt		✓
Depositional?	yes	yes

Notes:

@ North part boat launch.
- Station is adjacent to island in protected cove.
- good depositional area



Sample Possible (based on BPJ)? Yes.

Photo #	Direction Facing	Description
564	NE	from boat launch
565	NE	
566	N	Boat Launch

EXHIBIT 1. FIELD OBSERVATION FORM

Project: Phase II Sediment Sample Location Reconnaissance **Project Number:** 350521.FI.01

(13)

Date: 05/ 8 /2012 **Time:** 235

Observer(s): Cameron Irvine/SAC

Sample Location ID: 1B-C1 **River Mile:** 7.34

Observed Characteristic	On Station	Adjacent
Bank Nearest Bank (L/R):		Left
Slope Estimate:	flat	low
Bed Material (p – present / est. % abundance) Bedrock	—	—
Cobble	—	✓
Gravels	✓	✓
Sand	✓ 99%	✓
Silt	—	—
Depositional?	✓	some

Notes:

- On station south of Northport bridge.
- good sandy substrate
- center of sand deposit only 5m from marked location.
- John R. thought 60% slag content.
- Way point recorded (see 1B-23 sheet)

Sample Possible (based on BPJ)? Yes.

Photo #	Direction Facing	Description
80561	NE	sand deposit at station
80562	SW	/
80563	NE	/
IMGP0006	2-63 E	helmets pic at me on station (cam)

(14)

EXHIBIT 1. FIELD OBSERVATION FORM

Project: Phase II Sediment Sample Location Reconnaissance **Project Number:** 350521.FI.01

Date: 05/ 8 /2012 **Time:** 245

Observer(s): Cameron Irvine/SAC

Sample Location ID: 1BR2 **River Mile:** 734

move

Observed Characteristic	On Station	Adjacent
Bank Nearest Bank (L/R):	-	LB
Slope Estimate:	0	low
Bed Material (p – present / est. % abundance)		
Bedrock	— 70	grass
Cobble	✓	trees
Gravels	✓	✓
Sand	✓ 30	✓
Silt	✓ 10	—
Depositional?	yes	—

Notes:

- On cobble in sand embedded
- move u/s 150m to silty sand
- could be terrestrial site as wetlands opposite @ full pool

Sample Possible (based on BPJ)?

NO. move 150m u/s

Photo #	Direction Facing	Description
✓	S	Helen photo
IMG0064-65	W	of Cam on station

(15)

EXHIBIT 1. FIELD OBSERVATION FORM

Project: Phase II Sediment Sample Location Reconnaissance **Project Number:** 350521.FI.01

Date: 05/ 8 /2012 **Time:** 250

Observer(s): Cameron Irvine/SAC

Sample Location ID: IBC2 **River Mile:** 734

Observed Characteristic	On Station	Adjacent
Bank Nearest Bank (L/R):	-	Mid
Slope Estimate:	u/w	low
Bed Material (p – present / est. % abundance) Bedrock	|	-
Cobble	|	✓ 100% in dry channel banks.
Gravels	|	-
Sand	|	-
Silt	|	-
Depositional?	?	mixed.

Notes:

Mid channel. Viewed from d/s of NP bridge.

Sample Possible (based on BPJ)? ?

Photo #	Direction Facing	Description
P5080570	SW / d/s	from cobble bar station IBC2

EXHIBIT 1. FIELD OBSERVATION FORM

Project: Phase II Sediment Sample Location Reconnaissance **Project Number:** 350521.FI.01

(16)

Date: 05/ 8 /2012 **Time:** 325

Observer(s): Cameron Irvine/SAC

Sample Location ID: 2B1/2R1 + 2R2/2B2 **River Mile:** 732

Observed Characteristic	On Station	Adjacent
Bank Nearest Bank (L/R):	-	—
Slope Estimate:	wet	low grade
Bed Material (p – present / est. % abundance)		
Bedrock		—
Cobble		✓
Gravels		✓
Sand		✓
Silt		—
Depositional?		yes

Notes: @ overlook on Hwy 25 leading South.
View multi stations in sand/gravel bar on LB (2B-1 + 2R1) + in hummocky gravel/cobble bars on RB (2R2 2B2). not clear/too far to tell if stations under water or on bar.

Sample Possible (based on BPJ)? Yes?

Photo #	Direction Facing	Description
P5080574	W	from road. distant
IMG0086-67	W	"

EXHIBIT 1. FIELD OBSERVATION FORM

Project: Phase II Sediment Sample Location Reconnaissance **Project Number:** 350521.FI.01

Date: 05/ 8 /2012 **Time:** 340-350

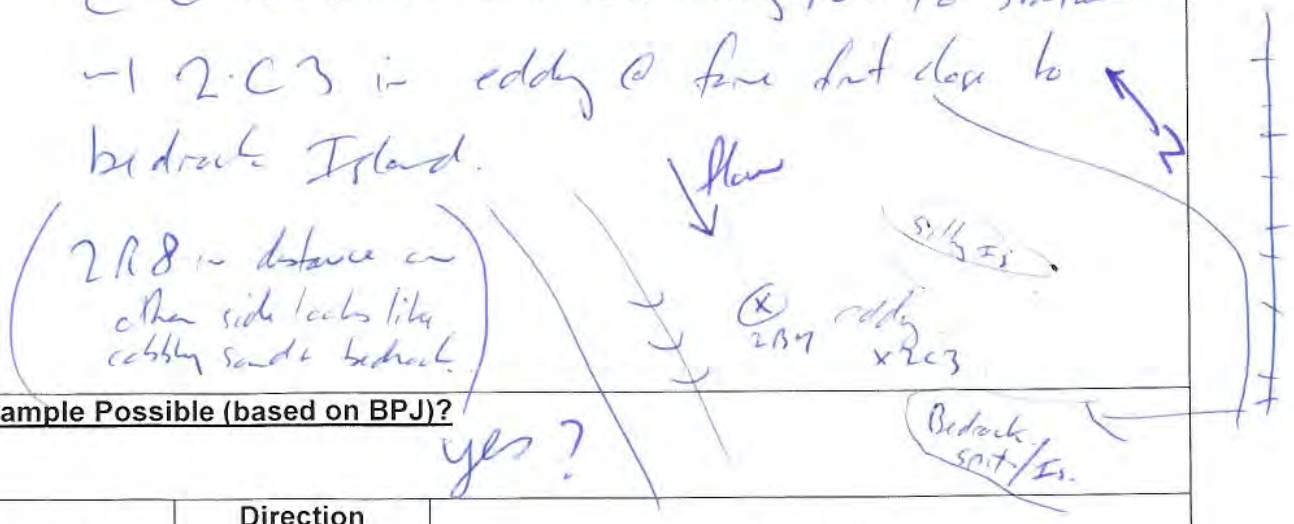
(17)

Observer(s): Cameron Irvine/SAC

Sample Location ID: 2-B4 / 2-C3 **River Mile:** 729

Observed Characteristic	On Station	Adjacent
Bank Nearest Bank (L/R):	-	Left
Slope Estimate:	u/u	moderate
Bed Material (p – present / est. % abundance)		
Bedrock		✓
Cobble		✓
Gravels		✓
Sand		✓
Silt		—
Depositional?	?	yes

Notes: @ ~~Ehna~~ Onion Creek looking N. to station. -1 2-C3 is eddy @ fan but close to bedrock Island.



Sample Possible (based on BPJ)? yes?

Photo #	Direction Facing	Description
80578	u/s	both stations viewed from Bedrock spit.
80580	"	2-C3 from bedrock spit
80581	"	"

EXHIBIT 1. FIELD OBSERVATION FORM

Project: Phase II Sediment Sample Location Reconnaissance **Project Number:** 350521.FI.01

(1K)

Date: 05/ 8 /2012 **Time:** 350

Observer(s): Cameron Irvine/SAC

Sample Location ID: 2·C4/2·R8 **River Mile:** 729

Observed Characteristic	On Station	Adjacent
Bank Nearest Bank (L/R):	-	Right
Slope Estimate:	wet	mod.
Bed Material (p – present / est. % abundance)		
Bedrock		—
Cobble		—
Gravels		~
Sand		~
Silt		—
Depositional?		No

Notes:

- Viewed from Onion Cr. confluence on opposite side.
- Appears very cobble armored.
- Sampling may be challenging
- 2·R8 has patches of sand nearby

Sample Possible (based on BPJ)? Yes.?

Photo #	Direction Facing	Description
80579	d/s	@ 2·C4 from Onion Cr.
80582	across R to	West @ 2·R8 "

EXHIBIT 1. FIELD OBSERVATION FORM

Project: Phase II Sediment Sample Location Reconnaissance **Project Number:** 350521.FI.01

Date: 05/ 8 /2012 **Time:** 435

(19)

Observer(s): Cameron Irvine/SAC

Sample Location ID: 3B-C3/3B-A4 **River Mile:** 715

Observed Characteristic	On Station	Adjacent
Bank Nearest Bank (L/R):		mid
Slope Estimate:	wet	moderate
Bed Material (p – present / est. % abundance)		
Bedrock		—
Cobble		✓
Gravels		✓
Sand		✓
Silt		✓
Depositional?		—

Notes:

- from Bossburg Flat Beach. cobble armored.
- layers of fines + cobble on step banks
- Stations mid-channel.

Sample Possible (based on BPJ)? ?

Photo #	Direction Facing	Description
5070583	N	@ Bossburg beach facing u/s
5070584	SW	" d/s

EXHIBIT 1. FIELD OBSERVATION FORM

Project: Phase II Sediment Sample Location Reconnaissance **Project Number:** 350521.FI.01

Date: 05/ 28 CR /2012 **Time:** 850

(1)

Observer(s): Cameron Irvine/SAC

Sample Location ID: 4-C6 / 4-R10 **River Mile:** 703

Observed Characteristic	On Station	Adjacent
Bank Nearest Bank (L/R):		L
Slope Estimate:	0 u/w	flat
Bed Material (p – present / est. % abundance)		
Bedrock		—
Cobble		—
Gravels		✓
Sand		✓
Silt		✓
Depositional?		yes

Notes: Stopped at Welty Bay turnout off Hwy 25 to view stations from distance. cobbles close to bank but otherwise depositional within the bay. Large braided channels with areas of exposed substrate.

Sample Possible (based on BPJ)? Yes.

Photo #	Direction Facing	Description
P5090585	E NW	marcus flats
90586	E SW	Station 4-C6
90587	E S	Station 4-R10
90588	E N	marcus flats

(2)

EXHIBIT 1. FIELD OBSERVATION FORM

Project: Phase II Sediment Sample Location Reconnaissance **Project Number:** 350521.FI.01

Date: 05/ 9 /2012 **Time:** 09:00

Observer(s): Cameron Irvine/SAC

Sample Location ID: (4R-6,7,8)(4C3+4-C4) 4-C5/4-B4/4-B5 **River Mile:** 705

Observed Characteristic	On Station	Adjacent
Bank Nearest Bank (L/R):		mid marcus flat
Slope Estimate:	flat	flat
Bed Material (p – present / est. % abundance)		
Bedrock	—	—
Cobble	~1%	~1%
Gravels	little	little
Sand	✓	✓
Silt	✓	✓
Depositional?	Y	Y

Notes: Overlook from Hwy 25 viewing Marcus flat/ Welty Bay @ NPS historic info sign. UCR channels braided through complex of exposed sediments. Viewed stations from a distance so not sure if they are exposed or not. #22 on near marking map.

Sample Possible (based on BPJ)? Y

Photo #	Direction Facing	Description
P5090589	W	4-C5, ~~4-B4~~ + 4-B5
90590	NW	4-B4 + 4-B5
		+ 4R6,7,8 W distance.
		+ 4C3+4C4 in distance

(3)

EXHIBIT 1. FIELD OBSERVATION FORM

Project: Phase II Sediment Sample Location Reconnaissance **Project Number:** 350521.FI.01

Date: 05/ 9 /2012 **Time:** 930

Observer(s): Cameron Irvine/SAC

Sample Location ID: 433/432/4R3/4R2 **River Mile:** 708/707

Observed Characteristic	On Station	Adjacent
Bank Nearest Bank (L/R):		Exposed banks
Slope Estimate:	wet/	45%
Bed Material (p – present / est. % abundance)	4R3	
Bedrock		—
Cobble	—	✓
Gravels	✓	✓
Sand	✓	✓
Silt	✓	—
Depositional?	yes	NO

Notes: Viewed from Marcus Island (@ old town site)

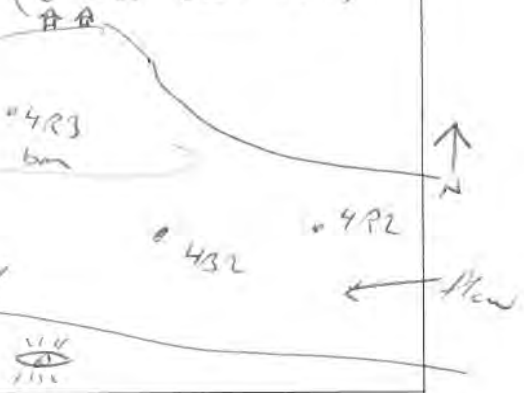
all sites underwater sand channel

except 4R3 where there are sandbars

nearby (low sandbar b/t RB + gravel bars with wet in between

- banks adjacent to main river channel are steep, cobble armored 40' high

- H_2O elevation @ 1240



Sample Possible (based on BPJ)? yes?

Photo #	Direction Facing	Description
PS090591-96	W	old marcus town site
90597	NE	Rt bank @ marcus: 4-R2 + 4-R2
90598	N	view across River from marcus: 4-R3
90599	W	d/s from marcus: 4:R3

EXHIBIT 1. FIELD OBSERVATION FORM

Project: Phase II Sediment Sample Location Reconnaissance **Project Number:** 350521.FI.01

Date: 05/ 9 /2012 **Time:** 1030

(4)

Observer(s): Cameron Irvine/SAC

Sample Location ID: 4B1/4R1 **River Mile:** 710

Observed Characteristic	On Station	Adjacent
Bank Nearest Bank (L/R):	Not exposed yet?	flats
Slope Estimate:		0
Bed Material (p – present / est. % abundance)		
Bedrock		—
Cobble		—
Gravels		—
Sand		✓
Silt		✓
Depositional?		

Notes: at Evans Campground boat launch where reservoir is dry for several 100s meters to the main channel. Sample points in main channel were not viewed directly as they were too far (950m) through mud flats & were inaccessible. Expect mud/sand flats w/ cobble armored banks of main channel.

Sample Possible (based on BPJ)? Yes?

Photo #	Direction Facing	Description
5090605	S	accessed river from boat launch 4:B1
5090606	W	" 4-R1

EXHIBIT 1. FIELD OBSERVATION FORM

Project: Phase II Sediment Sample Location Reconnaissance **Project Number:** 350521.FI.01

(5)

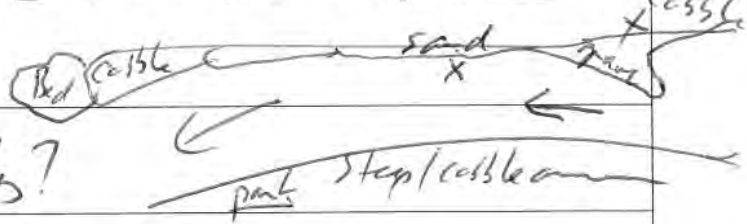
Date: 05/ 9 /2012 **Time:** 1110

Observer(s): Cameron Irvine/SAC

Sample Location ID: 3.B6 **River Mile:** 21

Observed Characteristic	On Station	Adjacent
Bank Nearest Bank (L/R):	under water. u/w	RB
Slope Estimate:		mod.
Bed Material (p – present / est. % abundance)		
Bedrock		—
Cobble		✓
Gravels		✓
Sand		✓
Silt		✓
Depositional?		

Notes: Pull off bank at china bend beach (#24) at gravel mound. Viewed site from across the river. Site below raptor nesting area marked w/ FWS signs. Cobble spit upstr. of low w/ fines on bank @ site & downstream



Sample Possible (based on BPJ)? Yes?

Photo #	Direction Facing	Description
~~P5040607~~	N	View of station from Left bank
608	N	down stream of china bend.
5040612	NW	"

EXHIBIT 1. FIELD OBSERVATION FORM

Project: Phase II Sediment Sample Location Reconnaissance **Project Number:** 350521.FI.01

Date: 05/ 9 /2012 **Time:** 1115

Observer(s): Cameron Irvine/SAC

(6)

Sample Location ID: 3C3 / 3R8 **River Mile:** 72.1

Observed Characteristic	On Station	Adjacent
Bank Nearest Bank (L/R):		LB
Slope Estimate:	u/w	Step
Bed Material (p – present / est. % abundance)		
Bedrock		✓
Cobble		✓
Gravels		✓
Sand		—
Silt		—
Depositional?	N	N

Notes: ~~Facing~~ Viewed from LB parking at side of Hwy 25 - gravel pit. Both sample locations at base of step slope armored w/ cobble. Seem to likely have armoring @ sample locations as high flows occur + scour around bank/bend. also viewed from China Bend boat launch + bank v. rocky

Sample Possible (based on BPJ)? N ? move u/s at boat launch where sandy silt dep. on bank.

Photo #	Direction Facing	Description
P5090607	N	from pullout viewing 3-C3
✓		from China Bend boat launch
P0509061[illegible]-612	NE	Step cobble bank on river left
5090611	E	downstream of China bend @ 3-R8
[5090612/618	NW	@ Station 3-R8 from CB boat launch]

EXHIBIT 1. FIELD OBSERVATION FORM

Project: Phase II Sediment Sample Location Reconnaissance **Project Number:** 350521.FI.01

Date: 05/ 9 /2012 **Time:** 1125

Observer(s): Cameron Irvine/SAC

7

Sample Location ID: 3-B5 / 3R6-3R8 / 3-C1 **River Mile:** 722

Observed Characteristic	On Station	Adjacent
Bank Nearest Bank (L/R):	-	LB d/s / c/s
Slope Estimate:	u/w	
Bed Material (p – present / est. % abundance)		
Bedrock		✓
Cobble		✓
Gravels		✓
Sand		✓
Silt		✓
Depositional?		

Notes: @ China bend boat launch. Good sandy bank u/s of boat launch on LB. d/s of Boat launch is rocky + bedrock/cobble + steep.
- 3B5 is mid channel + viability unknown.
- an alternative station could be the deposited sediments u/s of boat launch @ River left.

Sample Possible (based on BPJ)? Y?

Photo #	Direction Facing	Description
PS090613+618	W	Left bank from china bend boat launch @ 3-R8
90614	N	across to 3-B5 + 3-R7
90615	NE	view u/s of LB 3B5 + 3R6
90616	E	" 3B5 (mid channel) + 3-C1 (river right)
90617	E	detail of soft sample able sed u/s of
90619	N	across to 3-B5 from boat launch Boat launch

EXHIBIT 1. FIELD OBSERVATION FORM

Project: Phase II Sediment Sample Location Reconnaissance **Project Number:** 350521.FI.01

(8)

Date: 05/ 9 /2012 **Time:** 1150

Observer(s): Cameron Irvine/SAC

Sample Location ID: 3C2 / 3C1 | 3R5 | 3R4 | 3B3 / 3B2 | 3-B4 **River Mile:** ______

Observed Characteristic	On Station	Adjacent	
Bank Nearest Bank (L/R):	- 3B2 u/w 3 3R4	3C2	3B3 3R4. 3C1
Slope Estimate:			
Bed Material (p – present / est. % abundance)			
Bedrock		—	—
Cobble		✓ some	✓ some
Gravels		✓	—
Sand		✓	✓
Silt		✓	—
Depositional?	?	N	Y

Notes: Viewed from LB @ 3-C2 (step #25)

- Large gravel/sand bar across Rom on RB (3C1, 3R4, 3B3)
- Steep bank @ 3C2 but all gravel + sand.
- 3R5 + 3B2 mid channel.
- challenging sample locations

buoy markers; 3B3 / eddy; 3R4; 3B2; 3C2; sand/gravel/c; 3C1; 3R5; 3C2 sand/g/c

Sample Possible (based on BPJ)? yes?

Photo #	Direction Facing	Description
P5090620	W	@ 3-C1, 3-R5, 3-C2
P5090621	NW	@ 3-R4, 3-B3, 3-B2
P5090623	SW	@ 3-R5, 3-C1, 3-B4

EXHIBIT 1. FIELD OBSERVATION FORM

Project: Phase II Sediment Sample Location Reconnaissance **Project Number:** 350521.FI.01

Date: 05/ 9 /2012 **Time:** 1250

(9)

Observer(s): Cameron Irvine/SAC

Sample Location ID: 2 C1 **River Mile:** 731

Observed Characteristic	On Station	Adjacent
Bank Nearest Bank (L/R):	u/s	LB
Slope Estimate:	flat	Steep bank
Bed Material (p – present / est. % abundance)		
Bedrock	—	~~Sand~~ —
Cobble	—	small cobble
Gravels	✓	✓
Sand	✓	✓
Silt	✓	✓
Depositional?	yes	yes

Notes: accessed from pullout on Hwy 25

2 C1 is in an eddy N/A bank. ~~water~~ was standing water present.

Sample Possible (based on BPJ)? yes?

Photo #	Direction Facing	Description
90624	NE	looking upstream
90625	NW	from GB
		→ view u/s from river left
		at gravel/cobble bar.

EXHIBIT 1. FIELD OBSERVATION FORM

Project: Phase II Sediment Sample Location Reconnaissance **Project Number:** 350521.FI.01

Date: 05/ 9 /2012 **Time:** 1:00

(10)

Observer(s): Cameron Irvine/SAC

Sample Location ID: 2R4 **River Mile:** 731

Observed Characteristic	On Station	Adjacent
Bank Nearest Bank (L/R):	n/a	RB
Slope Estimate:		
Bed Material (p – present / est. % abundance)		
Bedrock		—
Cobble		✓
Gravels		✓
Sand		✓
Silt		✓
Depositional?		

Notes: 2R4 - viewed from LB gravel bar off Hwy 25 turnout - mid channel. Gravel bar/cobble on LB + Cobble/Gravel on RB embedded w/ silts/sand.

Sample Possible (based on BPJ)? yes maybe ?

Photo #	Direction Facing	Description
90626	SW	@ 2-R4 in mid channel
90627	NE	@ 2-C2 in distance @ river ~~left~~ right ~~on opposite~~ (river rt) ~~bank~~. on opposite (far) bank

EXHIBIT 1. FIELD OBSERVATION FORM

Project: Phase II Sediment Sample Location Reconnaissance **Project Number:** 350521.FI.01

Date: 05/ 9 /2012 **Time:** 1:30

Observer(s): Cameron Irvine/SAC

(11)

Sample Location ID: 2-B4/2-B5/2-R9/2-R10 **River Mile:** 729

Observed Characteristic	On Station	Adjacent
Bank Nearest Bank (L/R):		mid channel,
Slope Estimate:	wet	steep banks.
Bed Material (p – present / est. % abundance)		
Bedrock		✓
Cobble		✓
Gravels		✓
Sand		✓
Silt		—
Depositional?		NO

Notes: Viewed stations from distance atop Rt. bank @ pullout from NonRegrant-Flat Creek Road (West Bank). Same location as on 5/7.
- Sampling may be challenging

Sample Possible (based on BPJ)? yes?

Photo #	Direction Facing	Description
P5090628	}	} Viewed stations from west bank toward Dalles.
P5090629	}	

Photo Log **Project** UCR Phase II sediment Sample Location Recon
Photographer: Marilyn Gauthier **Project No.** 350521.FI.01
Upper Columbia River RI/FS

Photo No.	Date	Time	River Mile	Bank	Proposed Sample Location	Heading	Description
P5070480	5/7/12	12:50 PM	704	West	4-B6/4-R8	E	Marcus Flat
P5070481	5/7/12	12:50 PM	704	West	4-B6/4-R8	SE	Marcus Flat
P5070482	5/7/12	12:50 PM	704	West	4-B6/4-R8	SE	Marcus Flat
P5070483	5/7/12	12:50 PM	704	West	-	S	Field Team
P5070484	5/7/12	1:10 PM	706	West	4-C2	S	Kettle River confluence with Marcus Flat
P5070485	5/7/12	1:10 PM	706	West	4-C2	S	Kettle River confluence with Marcus Flat
P5070486	5/7/12	1:10 PM	706	West	4-C2	-	gravel/cobble/sand bank meterial
P5070487	5/7/12	1:10 PM	706	West	4-C2	W	field team on north bank
P5070488	5/7/12	1:35 PM	706	West	4-R4/4-R5	E	fine deposits in Marcus Flat
P5070489	5/7/12	1:35 PM	706	West	4-R5	E	fine deposits in Marcus Flat
P5070490	5/7/12	1:35 PM	706	West	4-C2	W	Kettle River confluence with Marcus Flat
P5070491	5/7/12	1:35 PM	706	West	4-R4/4-C12	E	fine deposits in Marcus Flat/Cobble banks
P5070492	5/7/12	1:35 PM	706	West	4-R4/4-C12	E	fine deposits in Marcus Flat/Cobble banks
P5070493	5/7/12	1:35 PM	706	West	-	N	Cliff Bank
P5070494	5/7/12	1:35 PM	706	West	4-R4/4-R5	SE	fine deposits in Marcus Flat/Cobble banks
P5070495	5/7/12	1:35 PM	706	West	4-C2	SW	Bank at Kettle River confluence with Marcus Flat
P5070496	5/7/12	2:00 PM	706.5	West	4-R12	S	Marcus Flat from the road N of Kettle River
P5070497	5/7/12	2:00 PM	706.5	West	4-R12	NE	Marcus Flat from the road N of Kettle River
P5070498	5/7/12	2:00 PM	706.5	West	4-R12	S	Marcus Flat from the road N of Kettle River
P5070499	5/7/12	2:10 PM	711.5	West	4-R11	SE	UCR from road north
P5070500	5/7/12	2:50 PM	713	West	-	NE	south of Snag Cove
P5070501	5/7/12	2:50 PM	713	West	-	SE	south of Snag Cove
P5070502	5/7/12	2:50 PM	713	West	-	E	south of Snag Cove
P5070503	5/7/12	2:50 PM	713	West	-	S	field team on bedrock south of Snag Cove
P5070504	5/7/12	2:50 PM	713	West	-	N	from bedrock south of Snag Cove
P5070505	5/7/12	2:50 PM	713	West	-	-	fine substrate (among areas with cobbles/gravels) south of Snag Cove
P5070506	5/7/12	2:50 PM	713	West	3B-C4	N	view toward 3B-C4
P5070507	5/7/12	2:50 PM	713	West	3B-C4	N	view of dry right bank near 3B-C4
P5070508	5/7/12	2:50 PM	713	West	3B-C4	E	tree stumps/roots d/s of 3B-C4
P5070509	5/7/12	2:50 PM	713	West	3B-C4	SW	field team south of 3B-C4
P5070510	5/7/12	2:50 PM	713	West	3B-C4	NW	from RB toward 3B-C4
P5070511	5/7/12	2:50 PM	713	West	3B-C4	SE	UCR d/s of 3B-C4
P5070512	5/7/12	2:50 PM	713	West	3B-C4	W	Cam taking notes on boulder near 3B-C4
P5070513	5/7/12	3:21 PM	718	West	3B-C2, 3B-R2	SW	Northport-flat creek road looking d/s from Road. 3B-R2 may be in riffle at river right
P5070514	5/7/12	3:21 PM	718	West	3B-C2, 3B-R2	SW	
P5070515	5/7/12	3:21 PM	718	West	-	-	time check
P5070516	5/7/12	3:35 PM	721	West	3B-C1, 3B-R1	SW	Looking downstream from Northport-Flat Creek Road. 3B-C1 at river right appears depositional.
P5070517	5/7/12	3:40 PM	721	West	3-R9	E	China Bend Rd. - looking upstream to eddy
P5070518	5/7/12	3:40 PM	721	West	3-R10	SW	China Bend Rd - looking downstream

Photo Log **Project** UCR Phase II sediment Sample Location Recon
Photographer: Marilyn Gauthier **Project No.** 350521.FI.01
Upper Columbia River RI/FS

Photo No.	Date	Time	River Mile	Bank	Proposed Sample Location	Heading	Description
P5070519	5/7/12	3:40 PM	722	West	3-C4	S	China Bend Rd - looking across
P5070520	5/7/12	3:40 PM	722	West	3-R9	NE	China Bend Rd. - looking upstream to eddy
P5070521	5/7/12	4:05 PM	723	West	3-B4, 3-B5	S	from end of China Bend Road
P5070522	5/7/12	4:30 PM	728.5	West	2-B5/2-R9	S	looking d/s from Northport-Flat Creek Road to Dalles Beach
P5070523	5/7/12	4:30 PM	728.5	West	2-R9/2-B4/2-C3	E	looking u/s from Northport-Flat Creek Road at Onion Creek
P5070524	5/7/12	4:30 PM	728.5	West	2-B5/2-R9	S	looking d/s from Northport-Flat Creek Road to Dalles Beach
P5070525	5/7/12	4:30 PM	728.5	West	2-B6/2R-10	SW	looking d/s from Northport-Flat Creek Road past Dalles Beach
P5070526	5/7/12	5:00 PM	731	West	2-C2	SW	sandy beach looking d/s from 2-R3 to 2-C2
P5070527	5/7/12	5:00 PM	731	West	2-R3	SE	sandy beach looking across river
P5070528	5/7/12	5:00 PM	731	West	2-R3	SW	On station at 2-R3
P5070529	5/7/12	5:00 PM	731	West	2-R3, 2-B2	NE	looking u/s from 2-R3
P5080530	5/8/12	9:15 AM	742	East	1-R4	N	at Black Sand Beach looking upstream to 1-R4
P5080531	5/8/12	9:15 AM	742	East	-	W	at Black Sand Beach looking across
P5080532	5/8/12	9:15 AM	742	East	1-R4	N	at Black Sand Beach looking upstream to 1-R4
P5080533	5/8/12	9:15 AM	742	East	1-R2	S	at Black Sand Beach looking d/s to 1-R2
P5080534	5/8/12	9:15 AM	742	East	1-R2	S	at Black Sand Beach looking d/s to 1-R2
P5080535	5/8/12	9:50 AM	744	East	1-B1	W	looking across from east bank near Waneta
P5080536	5/8/12	9:50 AM	744	East	1-B1, 1-R5, 1-R1	SW	looking across from east bank - stations d/s of bedrock outcrop
P5080537	5/8/12	9:50 AM	744	East	-	NW	looking u/s from east bank near Waneta
P5080538	5/8/12	9:50 AM	744	East	-	S	east (left) bank detail
P5080539	5/8/12	10:50 AM	739	East	-	NE	view u/s from RV Park Beach on east bank
P5080540	5/8/12	10:50 AM	739	East	-	NE	detail of RV Park beach
P5080541	5/8/12	10:50 AM	738	East	1-C2	SW	station 1-C2 is d/s of riffle (at left of photo)
P5080542	5/8/12	10:50 AM	738	East	1-C2	SW	
P5080543	5/8/12	10:50 AM	738	East	1-C2	SW	station 1-C2 is d/s of riffle
P5080544	5/8/12	10:50 AM	738	East	1-C3	NE	station 1-C3 mid-channel; beaver chewed tree
P5080545	5/8/12	10:50 AM	739	East	1-B3	NE	Station 1-B3 in distance near (river) left bank
P5080546	5/8/12	10:50 AM	739	East	1-B3	NE	Station 1-B3 in distance near (river) left bank
P5080547	5/8/12	11:55 AM	737	East	1-B4, 1-B5, 1-B6, 1-R8, 1-R9, 1-R10	W	DME viewed from road on east bank
P5080548	5/8/12	11:55 AM	737	East		W	DME viewed from road on east bank
P5080549	5/8/12	11:55 AM	737	East		W	DME viewed from road on east bank
P5080550	5/8/12	1:20 AM	734	East	1B-R1	NW	Northport - from old smelter site/Boat launch
P5080551	5/8/12	1:20 AM	734	East	-	N	Northport - viewing u/s from 1B-R4
P5080552	5/8/12	1:20 AM	734	East	-	N	Northport - viewing left bank toward boat launch
P5080553	5/8/12	1:30 PM	734	East	waypoint 1	SW	Northport - deposition/sand
P5080554	5/8/12	1:30 PM	734	East	waypoint 1	-	Northport - deposition/sand
P5080555	5/8/12	1:30 PM	734	East	waypoint 1	-	Northport - deposition/sand

Photo Log **Project** UCR Phase II sediment Sample Location Recon
Photographer: Marilyn Gauthier **Project No.** 350521.FI.01
Upper Columbia River RI/FS

Photo No.	Date	Time	River Mile	Bank	Proposed Sample Location	Heading	Description
P5080556	5/8/12	1:30 PM	734	East	waypoint 1	NE	Northport - deposition/sand
P5080557	5/8/12	1:30 PM	734	East	1B-R3	-	toward 1B-R3 (dry/slag embedded/cobble)
P5080558	5/8/12	1:40 PM	734	East	1B-R3	-	on station at 1B-r3 (dry/cobble/slag)
P5080559	5/8/12	1:40 PM	734	East	-	-	from 1B-r3 (dry/slag embedded/cobble)
P5080560	5/8/12	2:00 PM	734	East	waypoint 2	SE	Northport - deposition/sand
P5080561	5/8/12	2:00 PM	734	East	1B-C1	NE	Northport - deposition/sand
P5080562	5/8/12	2:00 PM	734	East	1B-C1	SW	Northport - deposition/sand d/s of bridge
P5080563	5/8/12	2:00 PM	734	East	1B-C1	NE	Northport - deposition/sand d/s of bridge
P5080564	5/8/12	2:30 PM	734	East	1B-R4	NE	Northport - viewing 1B-R4 from boat launch
P5080565	5/8/12	2:30 PM	734	East	1B-R4	NE	Northport - viewing 1B-R4 from boat launch
P5080566	5/8/12	2:40 PM	734	East	-	E	Northport - viewing boat launch
P5080567	5/8/12	2:40 PM	734	East	1B-C3	SW	Northport - viewing from boat launch
P5080568	5/8/12	2:40 PM	734	East	-	E	Northport - viewing boat launch
P5080569	5/8/12	2:40 PM	734	East	-	NW	Northport - gravel bar south of boat launch and north of bridge
P5080570	5/8/12	2:50 PM	734	East	1B-C2	SW	Northport - viewing d/s from gravel bar south of bridge
P5080571	5/8/12	3:10 PM	734	East	-	-	Northport - brick pipe work
P5080572	5/8/12	3:10 PM	734	East	-	-	Northport - brick pipe work
P5080573	5/8/12	3:10 PM	734	East	-	-	Northport - brick pipe work
P5080574	5/8/12	3:25 PM	732	East	2-B1, 2-R1, 2-R2, and 2-B2	W	distant view of statoins from Hwy 25
P5080575	5/8/12	3:50 PM	729	East	-	N	Access Onion Creek confluence with UCR
P5080576	5/8/12	3:50 PM	729	East	-	NE	eddy u/s of Onion Creek confluence
P5080577	5/8/12	3:50 PM	729	East	-	-	Onion Creek train bridge
P5080578	5/8/12	3:50 PM	729	East	2-C3, 2-B4	NE	eddy u/s of Onion Creek confluence
P5080579	5/8/12	3:50 PM	729	East	2-C4	W	facing d/s of Onion Creek confluence
P5080580	5/8/12	3:50 PM	729	East	2-C3	NE	eddy u/s of Onion Creek confluence
P5080581	5/8/12	3:50 PM	729	East	2-C3	NE	field team viewing eddy u/s of Onion Creek confluence
P5080582	5/8/12	3:50 PM	729	East	2-C4	W	facing d/s of Onion Creek confluence
P5080583	5/8/12	4:30 PM	715	East	3B-C3	N	Bossburg Beach - facing u/s
P5080584	5/8/12	4:30 PM	715	East	3B-R4	SW	Bossburg Beach - facing d/s
P5090585	5/9/12	8:50 AM	703	East	-	NW	Marcus Flats from Hwy 25 at Welty Bay turnoff
P5090586	5/9/12	8:50 AM	703	East	4-C6	SW	Marcus Flats from Hwy 25 at Welty Bay turnoff
P5090587	5/9/12	8:50 AM	703	East	4-R10	S	Marcus Flats from Hwy 25 at Welty Bay turnoff
P5090588	5/9/12	8:50 AM	703	East	-	N	Marcus Flats from Hwy 25 at Welty Bay turnoff
P5090589	5/9/12	9:00 AM	705	East	4-C5, 4-B4, 4-B5	W	Marcus Flats from Hwy 25 at Welty Bay turnoff
P5090590	5/9/12	9:00 AM	705	East	4-B4, 4-B5	NW	Marcus Flats from Hwy 25 at Welty Bay turnoff
P5090591	5/9/12	9:30 AM	707	East	-	W	Old Marcus townsite
P5090592	5/9/12	9:30 AM	707	East	-	W	Old Marcus townsite
P5090593	5/9/12	9:30 AM	707	East	-	E	Old Marcus townsite

Photo Log | **Project** UCR Phase II sediment Sample Location Recon
Photographer: Marilyn Gauthier | **Project No.** 350521.FI.01
Upper Columbia River RI/FS

Photo No.	Date	Time	River Mile	Bank	Proposed Sample Location	Heading	Description
P5090594	5/9/12	9:30 AM	707	East	-	-	Old Marcus townsite
P5090595	5/9/12	9:30 AM	707	East	-	W	Old Marcus townsite
P5090596	5/9/12	9:30 AM	707	East	-	W	Old Marcus townsite
P5090597	5/9/12	9:30 AM	707	East	4-B2, 4-R2	NE	UCR right bank at Marcus; stations mid-channel
P5090598	5/9/12	9:30 AM	707	East	4-R3	N	view across river from Marcus
P5090599	5/9/12	9:30 AM	707	East	4-B3	W	view d/s from Marcus
P5090600	5/9/12	9:30 AM	707	East	-	W	Old Marcus townsite
P5090601	5/9/12	9:30 AM	707	East	4-B2, 4-R2	NE	UCR right bank at Marcus; stations mid-channel
P5090602	5/9/12	9:30 AM	707	East	4-B2, 4-R2	NE	UCR right bank at Marcus; stations mid-channel
P5090603	5/9/12	9:30 AM	707	East	4-B2, 4-R2	NE	UCR right bank at Marcus; stations mid-channel
P5090604	5/9/12	9:30 AM	707	East	4-B2, 4-R2	NE	UCR right bank at Marcus; stations mid-channel
P5090605	5/9/12	10:30 AM	711	East	4-B1	S	View across river to 4-B1 from Evans boat launch
P5090606	5/9/12	10:30 AM	711	East	4-R1	W	View across river to 4-R1 from Evans boat launch
P5090607	5/9/12	11:10 AM	721	East	3-B6, 3-C3	N	view across River below China Bend from road
P5090608	5/9/12	11:10 AM	721	East	3-B6	N	below China Bend to raptor nesting area
P5090609	5/9/12	11:10 AM	721	East	-	NE	below China Bend to raptor nesting area
P5090610	5/9/12	11:10 AM	721	East	3-R8	NE	steep cobble bank below China Bend boat launch
P5090611	5/9/12	11:10 AM	721	East	3-R8	E	steep cobble bank below China Bend boat launch
P5090612	5/9/12	11:10 AM	721	East	3-B6	NW	below China Bend to raptor nesting area
P5090613	5/9/12	11:25 AM	722	East	3-R8	W	left bank d/s of China Bend boat launch
P5090614	5/9/12	11:25 AM	722	East	3-B5, 3-R7	N	view across from China Bend boat launch
P5090615	5/9/12	11:25 AM	722	East	3-B5, 3-R6	NE	left bank u/s of China Bend boat launch
P5090616	5/9/12	11:25 AM	722	East	3-B5, 3-C1	E	left bank u/s of China Bend boat launch
P5090617	5/9/12	11:25 AM	722	East	-	E	left bank (detail) u/s of China Bend boat launch. Sampleable sediments to relocate station 3-C3
P5090618	5/9/12	11:25 AM	722	East	3-R8	W	left bank d/s of China Bend boat launch
P5090619	5/9/12	11:25 AM	722	East	3-B5	N	view across from China Bend boat launch
P5090620	5/9/12	11:50 AM	723	East	3-C2	W	view across China Bend from left bank/Hwy 25
P5090621	5/9/12	11:50 AM	723	East	3-B3	NW	view across China Bend from left bank/Hwy 25
P5090622	5/9/12	11:50 AM	723	East	-	-	China Bend left bank/Hwy 25
P5090623	5/9/12	11:50 AM	723	East	3-R5, 3-C1, 3-B4	SW	view across China Bend from left bank/Hwy 25
P5090624	5/9/12	12:50 PM	731	East	2-C1	N	station 2C-1 in eddy
P5090625	5/9/12	12:50 PM	731	East	-	NW	sand/gravel bar on left bank with steep cobble armored
P5090626	5/9/12	1:00 PM	731	East	2-R4	SW	mid-channel station viewed from gravel/cobble bar
P5090627	5/9/12	1:00 PM	731	East	2-C2	NE	view u/s from gravel/cobble bar across to 2-C2
P5090628	5/9/12	1:30 PM	729	West	2-B4, 2-B5, 2-R9, 2-R10	S	view from Northport-Flat Creek Road to Dalles Beach
P5090629	5/9/12	1:30 PM	729	West		S	view from Northport-Flat Creek Road to Dalles Beach

CH2M HILL Photo#1 - Marcus Flat (P5070480)

CH2M HILL Photo#2 - Marcus Flat (P5070481)

CH2M HILL Photo#3 - Marcus Flat (P5070482)

CH2M HILL Photo#4 - Field Team (P5070483)

CH2M HILL Photo#5 - Kettle River confluence with Marcus Flat (P5070484)

CH2M HILL Photo#6 - Kettle River confluence with Marcus Flat (P5070485)

CH2M HILL Photo#7 - gravel/cobble/sand bank material (P5070486)

CH2M HILL Photo#8 field team on north bank (P5070487)

CH2M HILL Photo#9 - fine deposits in Marcus Flat (P5070488)

CH2M HILL Photo#10 - fine deposits in Marcus Flat (P5070489)

CH2M HILL Photo#11 - Kettle River confluence with Marcus Flat (P5070490)

CH2M HILL Photo#12 - fine deposits in Marcus Flat/Cobble banks (P5070491)

CH2M HILL Photo#13 - fine deposits in Marcus Flat/Cobble banks (P5070491)

CH2M HILL Photo#14 - Cliff Bank (P5070493)

CH2M HILL Photo#15 - fine deposits in Marcus Flat/Cobble banks (P5070494)

CH2M HILL Photo#16 - Bank at Kettle River confluence with Marcus Flat (P5070495)

CH2M HILL Photo#17 - Marcus Flat from the road N of Kettle River (P5070496)

CH2M HILL Photo#18 - Marcus Flat from the road N of Kettle River (P5070497)

CH2M HILL Photo#19 - Marcus Flat from the road N of Kettle River (P5070498)

CH2M HILL Photo#20 - UCR from road north (P5070499)

CH2M HILL Photo#21 - south of Snag Cove (P5070500)

CH2M HILL Photo#22 - south of Snag Cove (P5070501)

CH2M HILL Photo#23 - south of Snag Cove (P5070502)

CH2M HILL Photo#24 - field team on bedrock south of Snag Cove (P5070503)

CH2M HILL Photo#25 - from bedrock south of Snag Cove (P5070504)

CH2M HILL Photo#26 - fine substrate (among areas with cobbles/gravels) south of Snag Cove (P5070505)

CH2M HILL Photo#27 - view toward 3B-C4 (P5070506)

CH2M HILL Photo#28 - view of dry right bank near 3B-C4 (P5070507)

CH2M HILL Photo#29 - tree stumps/roots d/s of 3B-C4 (P5070508)

CH2M HILL Photo#30 - field team south of 3B-C4 (P5070509)

CH2M HILL Photo#31 - from RB toward 3B-C4 (P5070510)

CH2M HILL Photo#32 - UCR d/s of 3B-C4 (P5070511)

CH2M HILL Photo#33 - Cam taking notes on boulder near 3B-C4 (P5070512)

CH2M HILL Photo#34 - Northport-flat creek road looking d/s from Road. 3B-R2 may be in riffle at river right (P5070513)

CH2M HILL Photo#35 - Northport-flat creek road looking d/s from Road. 3B-R2 may be in riffle at river right (P5070514)

CH2M HILL Photo#36 - time check (P5070515)

CH2M HILL Photo#37 - Looking downstream from Northport-Flat Creek Road. 3B-C1 at river right appears depositional. (P5070516)

CH2M HILL Photo#38 - China Bend Rd. - looking upstream to eddy (P5070517)

CH2M HILL Photo#39 - China Bend Rd - looking downstream (P5070518)

CH2M HILL Photo#40 - China Bend Rd - looking across (P5070519)

CH2M HILL Photo#41 - China Bend Rd. - looking upstream to eddy (P5070520)

CH2M HILL Photo#42 - from end of China Bend Road (P5070521)

CH2M HILL Photo#43 - looking d/s from Northport-Flat Creek Road to Dalles Beach (P5070522)

CH2M HILL Photo#44 - looking u/s from Northport-Flat Creek Road at Onion Creek (P5070523)

CH2M HILL Photo#45 - looking d/s from Northport-Flat Creek Road to Dalles Beach (P5070524)

CH2M HILL Photo#46 - looking d/s from Northport-Flat Creek Road past Dalles Beach (P5070525)

CH2M HILL Photo#47 - sandy beach looking d/s from 2-R3 to 2-C2 (P5070526)

CH2M HILL Photo#48 - sandy beach looking across river (P5070527)

CH2M HILL Photo#49 - On station at 2-R3 (P5070528)

CH2M HILL Photo#50 - looking u/s from 2-R3 (P5070529)

CH2M HILL Photo#51 - at Black Sand Beach looking upstream to 1-R4 (P5080530)

CH2M HILL Photo#52 - at Black Sand Beach looking across (P5080531)

CH2M HILL Photo#53 - at Black Sand Beach looking upstream to 1-R4 (P5080532)

CH2M HILL Photo#54 - at Black Sand Beach looking d/s to 1-R2 (P5080533)

CH2M HILL Photo#55 - at Black Sand Beach looking d/s to 1-R2 (P5080534)

CH2M HILL Photo#56 - looking across from east bank near Waneta (P5080535)

CH2M HILL Photo#57 - looking across from east bank - stations d/s of bedrock Outcrop (P5080536)

CH2M HILL Photo#58 - looking u/s from east bank near Waneta (P5080537)

CH2M HILL Photo#59 - east (left) bank detail (P5080538)

CH2M HILL Photo#60 - view u/s from RV Park Beach on east bank (P5080539)

CH2M HILL Photo#61 - detail of RV Park beach (P5080540)

CH2M HILL Photo#62 - station 1-C2 is d/s of riffle (at left of photo) (P5080541)

CH2M HILL Photo#63 - station 1-C2 is d/s of riffle (at left of photo) (P5080542)

CH2M HILL Photo#64 - station 1-C2 is d/s of riffle (P5080543)

CH2M HILL Photo#65 - station 1-C3 mid-channel; beaver chewed tree (P5080544)

CH2M HILL Photo#66 - Station 1-B3 in distance near (river) left bank (P5080545)

CH2M HILL Photo#67 - Station 1-B3 in distance near (river) left bank (P5080546)

CH2M HILL Photo#68 - DME viewed from road on east bank (P5080547)

CH2M HILL Photo#69 - DME viewed from road on east bank (P5080548)

CH2M HILL Photo#70 - DME viewed from road on east bank (P5080549)

CH2M HILL Photo#71 - Northport - from old smelter site/Boat launch (P5080550)

CH2M HILL Photo#72 - Northport - viewing u/s from 1B-R4 (P5080551)

CH2M HILL Photo#73 - Northport - viewing left bank toward boat launch (P5080552)

CH2M HILL Photo#74 - Northport - deposition/sand (P5080553)

CH2M HILL Photo#75 - Northport - deposition/sand (P5080554)

CH2M HILL Photo#76 - Northport - deposition/sand (P5080555)

CH2M HILL Photo#77 - Northport - deposition/sand (P5080556)

CH2M HILL Photo#78 - toward 1B-R3 (dry/slag embedded/cobble) (P5080557)

CH2M HILL Photo#79 - on station at 1B-r3 (dry/cobble/slag) (P5080558)

CH2M HILL Photo#80 - from 1B-r3 (dry/slag embedded/cobble) (P5080559)

CH2M HILL Photo#81 - Northport - deposition/sand (P5080560)

CH2M HILL Photo#82 - Northport - deposition/sand (P5080561)

CH2M HILL Photo#83 - Northport - deposition/sand d/s of bridge (P5080562)

CH2M HILL Photo#84 - Northport - deposition/sand d/s of bridge (P5080563)

CH2M HILL Photo#85 - Northport - viewing 1B-R4 from boat launch (P5080564)

CH2M HILL Photo#86 - Northport - viewing 1B-R4 from boat launch (P5080565)

CH2M HILL Photo#87 - Northport - viewing boat launch (P5080566)

CH2M HILL Photo#88 - Northport - viewing from boat launch (P5080567)

CH2M HILL Photo#89 - Northport - viewing boat launch (P5080568)

CH2M HILL Photo#90 - Northport - gravel bar south of boat launch and north of bridge (P5080569)

CH2M HILL Photo#91 - Northport - viewing d/s from gravel bar south of bridge (P5080570)

CH2M HILL Photo#92 - Northport - brick pipe work (P5080571)

CH2M HILL Photo#93 - Northport - brick pipe work (P5080572)

CH2M HILL Photo#94 - Northport - brick pipe work (P5080573)

CH2M HILL Photo#95 - distant view of statoins from Hwy 25 (P5080574)

CH2M HILL Photo#96 - Access Onion Creek confluence with UCR (P5080575)

CH2M HILL Photo#97 - eddy u/s of Onion Creek confluence (P5080576)

CH2M HILL Photo#98 - Onion Creek train bridge (P5080577)

CH2M HILL Photo#99 - eddy u/s of Onion Creek confluence (P5080578)

CH2M HILL Photo#100 - facing d/s of Onion Creek confluence (P5080579)

CH2M HILL Photo#101 - eddy u/s of Onion Creek confluence (P5080580)

CH2M HILL Photo#102 - field team viewing eddy u/s of Onion Creek confluence (P5080581)

CH2M HILL Photo#103 - facing d/s of Onion Creek confluence (P5080582)

CH2M HILL Photo#104 - Bossburg Beach - facing u/s (P5080583)

CH2M HILL Photo#105 - Bossburg Beach - facing d/s (P5080584)

CH2M HILL Photo#106 - Marcus Flats from Hwy 25 at Welty Bay turnoff (P5090585)

CH2M HILL Photo#107 - Marcus Flats from Hwy 25 at Welty Bay turnoff (P5090586)

CH2M HILL Photo#108 - Marcus Flats from Hwy 25 at Welty Bay turnoff (P5090587)

CH2M HILL Photo#109 - Marcus Flats from Hwy 25 at Welty Bay turnoff (P5090588)

CH2M HILL Photo#110 - Marcus Flats from Hwy 25 at Welty Bay turnoff (P5090589)

CH2M HILL Photo#111 - Marcus Flats from Hwy 25 at Welty Bay turnoff (P5090590)

CH2M HILL Photo#112 - Old Marcus townsite (P5090591)

CH2M HILL Photo#113 - Old Marcus townsite (P5090592)

CH2M HILL Photo#114 - Old Marcus townsite (P5090593)

CH2M HILL Photo#115 - Old Marcus townsite (P5090594)

CH2M HILL Photo#116 - Old Marcus townsite (P5090595)

CH2M HILL Photo#117 - Old Marcus townsite (P5090596)

CH2M HILL Photo#118 - UCR right bank at Marcus; stations mid-channel (P5090597)

CH2M HILL Photo#119 - view across river from Marcus (P5090598)

CH2M HILL Photo#120 - view d/s from Marcus (P5090599)

CH2M HILL Photo#121 - Old Marcus townsite (P5090600)

CH2M HILL Photo#122 - UCR right bank at Marcus; stations mid-channel (P5090601)

CH2M HILL Photo#123 - UCR right bank at Marcus; stations mid-channel (P5090602)

CH2M HILL Photo#124 - UCR right bank at Marcus; stations mid-channel (P5090603)

CH2M HILL Photo#125 - UCR right bank at Marcus; stations mid-channel (P5090604)

CH2M HILL Photo#126 - View across river to 4-B1 from Evans boat launch (P5090605)

CH2M HILL Photo#127 - View across river to 4-R1 from Evans boat launch (P5090606)

CH2M HILL Photo#128 - view across River below China Bend from road (P5090607)

CH2M HILL Photo#129 - below China Bend to raptor nesting area (P5090608)

CH2M HILL Photo#130 - below China Bend to raptor nesting area (P5090609)

CH2M HILL Photo#131 - steep cobble bank below China Bend boat launch (P5090610)

CH2M HILL Photo#132 - steep cobble bank below China Bend boat launch (P5090611)

CH2M HILL Photo#133 - below China Bend to raptor nesting area (P5090612)

CH2M HILL Photo#134 - left bank d/s of China Bend boat launch (P5090613)

CH2M HILL Photo#135 - view across from China Bend boat launch (P5090614)

CH2M HILL Photo#136 - left bank u/s of China Bend boat launch (P5090615)

CH2M HILL Photo#137 - left bank u/s of China Bend boat launch (P5090616)

CH2M HILL Photo#138 - left bank (detail) u/s of China Bend boat launch. Sampleable sediments to relocate station 3-C3 (P5090617)

CH2M HILL Photo#139 - left bank d/s of China Bend boat launch (P5090618)

CH2M HILL Photo#140 - view across from China Bend boat launch (P5090619)

CH2M HILL Photo#141 - view across China Bend from left bank/Hwy 25 (P5090620)

CH2M HILL Photo#142 - view across China Bend from left bank/Hwy 25 (P5090621)

CH2M HILL Photo#143 - China Bend left bank/Hwy 25 (P5090622)

CH2M HILL Photo#144 - view across China Bend from left bank/Hwy 25 (P5090623)

CH2M HILL Photo#145 - station 2C-1 in eddy (P5090624)

CH2M HILL Photo#146 - sand/gravel bar on left bank with steep cobble armored (P5090625)

CH2M HILL Photo#147 - mid-channel station viewed from gravel/cobble bar (P5090626)

CH2M HILL Photo#148 - view u/s from gravel/cobble bar across to 2-C2 (P5090627)

CH2M HILL Photo#149 - view from Northport-Flat Creek Road to Dalles Beach (P5090628)

CH2M HILL Photo#150 - view from Northport-Flat Creek Road to Dalles Beach (P5090629)

Photo Log **Project** UCR Phase II sediment Sample Location Recon
Photographer: Helen Bottcher **Project No.** 350521.FI.01

Photo No.	Date	Time	River Mile	Bank	Proposed Sample Location	Heading	Description
IMGP0001	5/7/12	1:35 PM	706	West	-	-	Marcus Flat - Tribal sign
IMGP0002	5/7/12	1:35 PM	706	West	4-R5	NE	Marcus Flat from Kettle River confluence
IMGP0003	5/7/12	1:35 PM	706	West	-	E	Kettle River confluence with Marcus Flat
IMGP0004	5/7/12	1:35 PM	706	West	4-C2	SW	Kettle River confluence with Marcus Flat
IMGP0005	5/7/12	1:35 PM	706	West	-	N	clay bank
IMGP0006	5/7/12	1:35 PM	706	West	4-R12	NE	view toward 4-R12
IMGP0007	5/7/12	2:50 PM	713	West	-	-	Marker on Rock south of Snag Cove
IMGP0008	5/7/12	2:50 PM	713	West	-	NW	river right bank at Snag Cove boat launch
IMGP0009	5/7/12	2:50 PM	713	West	3B-C4	N	river right bank at Snag Cove boat launch
IMGP0010	5/7/12	2:50 PM	713	West	-	NW	river right bank at Snag Cove boat launch
IMGP0011	5/7/12	2:50 PM	713	West	3B-C4	N	river right bank at Snag Cove boat launch
IMGP0012	5/7/12	2:50 PM	713	West	-	N	fielt team at Snag Cove boat launch
IMGP0013	5/7/12	2:50 PM	713	West	-	E	tree trunks at Snag Cove
IMGP0014	5/7/12	2:50 PM	713	West	-	S	boulder on bank at Snag Cove
IMGP0015	5/7/12	2:50 PM	713	West	3B-C4	-	cobbles embedded with silt/sand near 3B-C4
IMGP0016	5/7/12	3:40 PM	721	West	3-R9	E	China Bend Rd. looking upstream to eddy
IMGP0017	5/7/12	3:40 PM	721	West	3-C4	SW	China Bend Rd - looking across to 3-C4
IMGP0018	5/7/12	4:09 PM	-	West	-	-	Stedy's Coffee
IMGP0019	5/7/12	4:30 PM	729	West	2-C4, 2-C3	E	looking u/s from Northport-Flat Creek Road at Onion Creek
IMGP0020	5/7/12	4:30 PM	729	West	2-R9	S	looking across from Northport-Flat Creek Road
IMGP0021	5/7/12	4:30 PM	729	West	2-B5	S	looking d/s from Northport-Flat Creek Road to Dalles Beach
IMGP0022	5/7/12	5:00 PM	731	West	2-C2	SW	sandy beach looking d/s from 2-R3 to 2-C2
IMGP0023	5/7/12	5:00 PM	731	West	2-R3	NE	sandy beach looking d/s to 2-R3
IMGP0024	5/7/12	5:00 PM	731	West	2-R3	S	On station at 2-R3
IMGP0025	5/7/12	5:00 PM	731	West	2-R3	E	On station at 2-R3
IMGP0026	5/7/12	5:00 PM	731	West	2-R3	E	On station at 2-R3
IMGP0027	5/7/12	5:00 PM	731	West	2-R3	E	On station at 2-R3
IMGP0028	5/8/11	9:15 AM	742	East	1-R4	N	Black Sand Beach looking upstream to 1-R4
IMGP0029	5/8/11	9:15 AM	742	East	-	-	bedrock outcrop at black sand beach
IMGP0030	5/8/11	9:15 AM	742	East	-	-	cobbles embedded with silt/sand/at black
IMGP0031	5/8/11	9:15 AM	742	East	-	-	left bank downstream of black sand beach
IMGP0032	5/8/12	9:50 AM	744	East	-	W	looking across from east bank near Waneta
IMGP0033	5/8/11	9:50 AM	744	East	1-B1, 1-R5, 1-R1	W	looking across from east bank - stations d/s of bedrock outcrop
IMGP0034	5/8/11	9:50 AM	744	East	-	-	field group on east bank
IMGP0035	5/8/11	9:50 AM	744	East	-	NW	upstream end of bedrock outcrop
IMGP0036	5/8/11	9:50 AM	744	East	-	N	cobble armored east bank (River left)
IMGP0037	5/8/11	9:50 AM	744	East	-	NW	cobble armored east bank (River left)
IMGP0038	5/8/11	10:50 AM	739	East	1-R7	N	from RV Park beach

Photo Log **Project** UCR Phase II sediment Sample Location Recon
Photographer: Helen Bottcher **Project No.** 350521.FI.01

Photo No.	Date	Time	River Mile	Bank	Proposed Sample Location	Heading	Description
IMGP0039	5/8/11	10:50 AM	739	East	-	SW	Marilyn at RV park beach
IMGP0040	5/8/11	10:50 AM	739	East	-	-	tracks at RV park beach
IMGP0041	5/8/11	10:50 AM	738	East	1-C2	SW	station 1-C2 is d/s of riffle
IMGP0042	5/8/11	10:50 AM	738	East	-	SW	detail of riffle
IMGP0043	5/8/11	10:50 AM	738	East	-	-	beaver chewed tree
IMGP0044	5/8/11	10:50 AM	738	East	-	-	field team: Cam, Marilyn, JR
IMGP0045	5/8/11	10:50 AM	738	East	-	-	field team: Cam, John
IMGP0046	5/8/11	10:50 AM	738	East	1-C2	SW	station 1-C2 is in riffle
IMGP0047	5/8/11	10:50 AM	739	East	1-B3	NE	Station 1-B3 in distance near (river) left bank
IMGP0048	5/8/11	11:55 AM	737	East	1-B4, 1-B5, 1-B6, 1-R8, 1-R9, 1-R10	W	DME viewed from road on east bank
IMGP0049	5/8/11	11:55 AM	737	East		SW	DME viewed from road on east bank
IMGP0050	5/8/11	11:55 AM	737	East	-	N	DME viewed from road on east bank
IMGP0051	5/8/11	1:40 PM	734	East	1B-C3	NW	dry/cobble-gravel/slag embedded bar
IMGP0052	5/8/11	1:40 PM	734	East	-	NW	dry/cobble-gravel/slag embedded bar
IMGP0053	5/8/11	1:40 PM	734	East	-	NW	dry/cobble-gravel/slag embedded bar
IMGP0054	5/8/11	1:40 PM	734	East	-	N	dry/cobble-gravel/slag embedded bar
IMGP0055	5/8/11	1:40 PM	734	East	-	N	dry/cobble-gravel/slag embedded bar
IMGP0056	5/8/11	1:40 PM	734	East	-	N	dry/cobble-gravel/slag embedded bar
IMGP0057	5/8/11	1:40 PM	734	East	-	N	dry/cobble-gravel/slag embedded bar
IMGP0058	5/8/11	1:40 PM	734	East	-	N	dry/cobble-gravel/slag embedded bar
IMGP0059	5/8/11	1:40 PM	734	East	-	N	dry/cobble-gravel/slag embedded bar
IMGP0060	5/8/11	2:00 PM	734	East	waypoint 2	E	John - deposition/sand d/s of bridge
IMGP0061	5/8/11	2:00 PM	734	East		NE	Marilyn - deposition/sand d/s of bridge
IMGP0062	5/8/11	2:00 PM	734	East	waypoint 2	E	Cam - deposition/sand d/s of bridge
IMGP0063	5/8/11	2:00 PM	734	East	waypoint 3	NE	Cam - deposition/sand d/s of bridge
IMGP0064	5/8/11	2:00 PM	734	East	1B-R2	NW	Cam - cobble bar d/s of bridge
IMGP0065	5/8/11	2:00 PM	734	East	1B-R2	-	dry/cobble-gravel/slag embedded bar
IMGP0066	5/8/11	3:25 PM	732	East	-	W	no river access from Hwy 25
IMGP0067	5/8/11	3:25 PM	732	East	-	W	no river access from Hwy 25
IMGP0068	5/8/11	3:50 PM	729	East	-	-	Onion Creek train bridge
IMGP0069	5/8/11	3:50 PM	729	East	2-C4	W	facing d/s of Onion Creek confluence
IMGP0070	5/8/11	3:50 PM	729	East	2-C4	W	facing d/s of Onion Creek confluence
IMGP0071	5/8/11	3:50 PM	729	East	2-C3	N	Bedrock at Onion Creek confluence
IMGP0072	5/8/11	4:00 PM	718	East	-	N	North Gorge boat launch
IMGP0073	5/8/11	4:30 PM	715	East	-	-	Bossburg Beach - remnants of ferry
IMGP0074	5/8/11	4:30 PM	715	East	-	-	Bossburg Beach - closure sign
IMGP0075	5/8/11	4:30 PM	715	East	3B-C3	NW	Bossburg Beach - river left bank
IMGP0076	5/8/11	4:30 PM	715	East	-	-	Bossburg Beach - closure sign
IMGP0077	5/8/11	4:30 PM	715	East	3B-C3	SW	Bossburg Beach - steep/cobble-armored river left bank
IMGP0078	5/8/11	4:30 PM	715	East	-	-	Bossburg Beach - remnants of ferry

Photo Log **Project** UCR Phase II sediment Sample Location Recon
Photographer: Helen Bottcher **Project No.** 350521.FI.01

Photo No.	Date	Time	River Mile	Bank	Proposed Sample Location	Heading	Description
IMGP0079	5/8/11	4:30 PM	715	East	-	-	Bossburg Beach - remnants of ferry
IMGP0080	5/8/11	4:30 PM	715	East	-	-	Bossburg Beach - remnants of ferry

EPA Photo #1 - Marcus Flat - Tribal sign (IMGP0001)

EPA Photo #2 - Marcus Flat from Kettle River confluence (IMGP0002)

EPA Photo #3 - Kettle River confluence with Marcus Flat (IMGP0003)

EPA Photo #4 - Kettle River confluence with Marcus Flat (IMGP0004)

EPA Photo #5 - clay bank (IMGP0005)

EPA Photo #6 - view toward 4-R12 (IMGP0006)

EPA Photo #7 - Marker on Rock south of Snag Cove (IMGP0007)

EPA Photo #8 - river right bank at Snag Cove boat launch (IMGP0008)

EPA Photo #9 - river right bank at Snag Cove boat launch (IMGP0009)

EPA Photo #10 - river right bank at Snag Cove boat launch (IMGP0010)

EPA Photo #11 - river right bank at Snag Cove boat launch (IMGP0011)

EPA Photo #12 - fielt team at Snag Cove boat launch (IMGP0012)

EPA Photo #13 - tree trunks at Snag Cove (IMGP0013)

EPA Photo #14 - boulder on bank at Snag Cove (IMGP0014)

EPA Photo #15 - cobbles embedded with silt/sand near 3B-C4 (IMGP0015)

EPA Photo #16 - China Bend Rd. looking upstream to eddy (IMGP0016)

EPA Photo #17 - China Bend Rd - looking across to 3-C4 (IMGP0017)

EPA Photo #18 - Stedy's Coffee (IMGP0018)

EPA Photo #19 - looking u/s from Northport-Flat Creek Road at Onion Creek (IMGP0019)

EPA Photo #20 - looking across from Northport-Flat Creek Road (IMGP0020)

EPA Photo #21 - looking d/s from Northport-Flat Creek Road to Dalles Beach (IMGP0021)

EPA Photo #22 - sandy beach looking d/s from 2-R3 to 2-C2 (IMGP0022)

EPA Photo #23 - sandy beach looking d/s to 2-R3 (IMGP0023)

EPA Photo #24 - On station at 2-R3 (IMGP0024)

EPA Photo #25 - On station at 2-R3 (IMGP0025)

EPA Photo #26 - On station at 2-R3 (IMGP0026)

EPA Photo #27 - On station at 2-R3 (IMGP0027)

EPA Photo #28 - Black Sand Beach looking upstream to 1-R4 (IMGP0028)

EPA Photo #29 - bedrock outcrop at black sand beach (IMGP0029)

EPA Photo #30 - cobbles embedded with silt/sand/at black (IMGP0030)

EPA Photo #31 - left bank downstream of black sand beach (IMGP0031)

EPA Photo #32 - looking across from east bank near Waneta (IMGP0032)

EPA Photo #33 - looking across from east bank - stations d/s of bedrock outcrop (IMGP0033)

EPA Photo #34 - field group on east bank (IMGP0034)

EPA Photo #35 - upstream end of bedrock outcrop (IMGP0035)

EPA Photo #36 - cobble armored east bank (River left) (IMGP0036)

EPA Photo #37 - cobble armored east bank (River left) (

EPA Photo #38 - from RV Park beach (IMGP0038)

EPA Photo #39 - Marilyn at RV park beach (IMGP0039)

EPA Photo #40 - tracks at RV park beach (IMGP0040)

EPA Photo #41 - station 1-C2 is d/s of riffle (IMGP0041)

EPA Photo #42 - detail of riffle (IMGP0042)

EPA Photo #43 - beaver chewed tree (IMGP0043)

EPA Photo #44 - field team: Cam, Marilyn, JR (IMGP0044)

EPA Photo #45 - field team: Cam, John (IMGP0045)

EPA Photo #46 - station 1-C2 is in riffle (IMGP0046)

EPA Photo #47 - Station 1-B3 in distance near (river) left bank (IMGP0047)

EPA Photo #48 - DME viewed from road on east bank (IMGP0048)

EPA Photo #49 - DME viewed from road on east bank (IMGP0049)

EPA Photo #50 - DME viewed from road on east bank (IMGP0050)

EPA Photo #51 - dry/cobble-gravel/slag embedded bar (IMGP0051)

EPA Photo #52 - dry/cobble-gravel/slag embedded bar (IMGP0052)

EPA Photo #53 - dry/cobble-gravel/slag embedded bar (IMGP0053)

EPA Photo #54 - dry/cobble-gravel/slag embedded bar (IMGP0054)

EPA Photo #55 - dry/cobble-gravel/slag embedded bar (IMGP0055)

EPA Photo #56 - dry/cobble-gravel/slag embedded bar (IMGP0056)

EPA Photo #57 - dry/cobble-gravel/slag embedded bar (IMGP0057)

EPA Photo #58 - dry/cobble-gravel/slag embedded bar (IMGP0058)

EPA Photo #59 - dry/cobble-gravel/slag embedded bar (IMGP0059)

EPA Photo #60 - John - deposition/sand d/s of bridge (IMGP0060)

EPA Photo #61 - Marilyn - deposition/sand d/s of bridge (IMGP0061)

EPA Photo #62 - Cam - deposition/sand d/s of bridge (IMGP0062)

EPA Photo #63 - Cam - deposition/sand d/s of bridge (IMGP0063)

EPA Photo #64 - Cam - cobble bar d/s of bridge (IMGP0064)

EPA Photo #65 - dry/cobble-gravel/slag embedded bar (IMGP0065)

EPA Photo #66 - no river access from Hwy 25 (IMGP0066)

EPA Photo #67 - no river access from Hwy 25 (IMGP0067)

EPA Photo #68 - Onion Creek train bridge (IMGP0068)

EPA Photo #69 - facing d/s of Onion Creek confluence (IMGP0069)

EPA Photo #70 - facing d/s of Onion Creek confluence (IMGP0070)

EPA Photo #71 - Bedrock at Onion Creek confluence (IMGP0071)

EPA Photo #72 - North Gorge boat launch (IMGP0072)

EPA Photo #73 - Bossburg Beach - remnants of ferry (IMGP0073)

EPA Photo #74 - Bossburg Beach - closure sign (IMGP0074)

EPA Photo #75 - Bossburg Beach - river left bank (IMGP0075)

EPA Photo #76 - Bossburg Beach - closure sign (IMGP0076)

EPA Photo #77 - Bossburg Beach - steep/cobble-armored river left bank (IMGP0077)

EPA Photo #78 - Bossburg Beach - remnants of ferry (IMGP0078)

EPA Photo #79 - Bossburg Beach - remnants of ferry (IMGP0079)

EPA Photo #80 - Bossburg Beach - remnants of ferry (IMGP0080)