FINAL

Monte Cristo Mining Area

Aquatic Baseline Monitoring

Mt. Baker-Snoqualmie
National Forest

Prepared for
Washington State
Department of Ecology

March 31, 2015
17800-35

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1.0 EXECUTIVE SUMMARY

Hart Crowser conducted two field sampling trips in the Monte Cristo Mining Area (MCMA) from July 8 to July 10, 2013, and from August 22 to August 28, 2013. The objectives of these trips were to:

- Characterize the physical habitat conditions of selected stream reach and riparian zones in the vicinity of the site;
- Characterize and evaluate fish, macroinvertebrate, and periphyton assemblages; and
- Characterize sediment (toxicity testing and chemical analysis) and surface water quality (chemical analysis).

During these sampling trips, we characterized seven stream reaches in the upper South Fork Sauk River and two of the three watersheds that form its headwaters: Glacier Creek and Seventysix Gulch. The dual purpose of sampling was to assess impacts to surface water and sediments from discharge of mine tailings and adit water, and establish baseline conditions prior to the planned mine waste removal action by the USDA Forest Service. Ideally, these sampling locations will serve as long-term aquatic stations to monitor changes following the removal action.

Bioassessment characterization, analytical results, and sediment toxicity results (in accordance with the Washington Administrative Code [WAC] 173-204-563) are presented in this report.

1.1 Field Work and Findings

Salmonids were observed in five of the seven sampling reaches. Bull trout (*Salvelinus confluentus*) were the predominant species, with a school of adults observed in Monte Cristo Lake in August. No fish were observed in the reference location, HC-GC-01, which was expected because it is located upstream of Glacier Falls, a likely migration barrier for fish. No fish were observed in Seventysix Gulch at HC-76-02 either, which may be because of the steep slope and velocity of the confined channel at the time of sampling. There were no obvious fish barriers downstream of this sampling reach, but that should be verified in subsequent sampling.

In general, the macroinvertebrate community at six of the seven sampling reaches scored moderately well using the benthic index of biotic integrity (B-IBI) metrics, a common scoring system for assessing the health of aquatic systems. However, the sampling location in Monte Cristo Lake (HC-MCL) scored poorly with both the B-IBI and other metrics. The lake is an assumed settling area for contaminated sediment moving downstream from the mining-impacted areas in the upper watershed near the Old Townsite. However, the habitat and substrate at HC-MCL are so different from a typical stream that the results may underestimate the biotic integrity, as discussed further in Section 5.6.

Periphyton communities are more difficult to assess than macroinvertebrates. There is currently no standard assessment similar to B-IBI for assessing periphyton health. However, several metrics can be indicators of contamination or stress. All seven locations scored high for the pollution index, indicating the least polluted conditions. Additionally, heavy metal contamination can cause deformed or abnormal cells, but virtually no abnormal diatom cells were observed. Discussions with Ecology (Chad Larson pers. comm. January 16, 2014), indicate the Agency is currently working on developing a scoring system for periphyton, which we plan to incorporate into our analysis in subsequent sampling.

Sediment was collected for toxicity testing at each of the seven sampling reaches. Four endpoints were analyzed: amphipod (*Hyalella azteca*) for 28-day mortality and growth, and chironomid (*Chironomus dilutus*) for 20-day mortality and growth. Based on bioassay results, five of the seven sites met the criteria for sediment cleanup levels based on protection of the benthic community in freshwater sediment at all four endpoints (Ecology 2013; Sediment Management Standards [SMS] WAC 173-204-563, Table VII). The bioassay for 20-day chironomid mortality at HC-76-02 failed to meet the sediment cleanup objective (SCO) criteria, but the result was not statistically significant and was below the cleanup screening level (CSL). Additionally, the bioassay for 20-day growth at HC-MCL failed to meet the SCO, but also was not statistically significant and was below the CSL.

For sediment chemistry, four constituents of potential concern (COPCs) were identified based on the analytical results, with metals concentrations generally increasing in downstream reaches. The COPCs include arsenic, cadmium, nickel, and silver.

For surface water, five COPCs were identified based on the analytical results, with no obvious association of higher metals concentrations for reaches in close proximity to mining sites or roadways. The only COPC for total metals was arsenic, and it exceeded criteria for protection of human health at all seven locations. For dissolved metals, the COPCs include arsenic, cadmium, copper, lead, and zinc. Hardness, sulfate concentration, and alkalinity (in bicarbonate form) generally increased in downstream areas.

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* Tables 3 through 13 are at the end of the document

ACRONYMS

ARAR	applicable or relevant and appropriate requirements
B-IBI	benthic index of biotic integrity
CES	Cascade Earth Sciences
COPC	constituent of potential concern
CPR	cardiopulmonary resuscitation
CSL	Cleanup Screening Level
Ecology	Washington State Department of Ecology
EPA	US Environmental Protection Agency
EPT	Ephemera, Plecoptera, and Tricoptera
GPS	global positioning system
HBI	Hilsenhoff biotic index
MCMA	Monte Cristo Mining Area
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mL	milliliter
QAMP	Quality Assurance Monitoring Plan
RBP	Rapid Bioassessment Protocol
SAP	Sampling and Analysis Plan
SCO	Sediment Cleanup Objective
SFSR	South Fork Sauk River
SMS	sediment management standards
WAC	Washington Administrative Code

2.0 INTRODUCTION

Hart Crowser staff conducted two sampling trips in the Monte Cristo Mining Area (MCMA) near Granite Falls, Washington (Figure 1), from July 8 through July 10, and August 22 through 28, 2013. Hart Crowser performed this investigation for the Washington State Department of Ecology (Ecology) under Contract No. C1100144. Work was conducted in general accordance with the Ecology Statement of Work (Ecology 2012) and project Sampling and Analysis Plan (SAP) prepared by Hart Crowser (Hart Crowser 2013a). The purpose of the sampling was to characterize baseline conditions in the South Fork Sauk River (SFSR) and two of its headwater tributaries, Glacier Creek and Seventysix Gulch.

Aquatic sampling reaches were identified during a reconnaissance in October 2012 and were intended to coincide with surface water, pore water, and sediment sampling conducted by Cascade Earth Sciences (CES) as part of the Monte Cristo Mining Area Engineering Evaluation/Cost Analysis (CES 2010). These stream reaches were identified and sampled to collect baseline information before the planned mine waste removal action. These sampling locations are intended to serve as long-term aquatic stations to monitor changes following the mine waste removal action.

The objectives of this investigation were to:

- Characterize the physical habitat conditions of the stream reach (100 meters long) and riparian zone near the site;
- Characterize and evaluate fish, macroinvertebrate, and periphyton assemblages;
- Characterize surface water and sediment quality (chemical analysis);
- Collect sediment for toxicity testing (bioassays);
- Collect general water quality parameters at each site; and
- Update the existing MCMA geodatabase with information gathered during this phase of the remedial investigation.

A limited, early-summer sampling effort was conducted from July 8 through 10, 2013, and a complete, late-season sampling effort was conducted from August 22 through August 28, 2013. This report summarizes the results of both sampling trips. Table 1 summarizes activities completed during these sampling efforts in chronological order. Table 2 presents the project team members and their roles and responsibilities for this investigation.

Table 1 – Daily Activities Summary

Day	Activity	Samples collected
July 7	▪ Mobilization – Michelle Havey, Beth Sosik, and Chris Hartman (Ecology) ▪ Drove to Monte Cristo Lake (HC-MCL-01) ▪ Set four minnow traps ▪ Drove to Darrington to stay for the night	None
July 8	▪ Picked up Old Townsite cabin key at Darrington Ranger Station ▪ Met Jason Shira (Ecology) at Monte Cristo Lake ▪ Sampled HC-MCL-01	Snorkel survey and retrieved minnow traps; macroinvertebrates; periphyton; habitat data; surface water
July 9	▪ Traveled to Monte Cristo Old Townsite by helicopter ▪ Hiked up Glacier Basin Trail ▪ Located and sampled HC-GC-01	Snorkel survey; macroinvertebrates; periphyton; habitat data; surface water
July 10	▪ Hiked down the South Fork Sauk River ▪ Sampled HC-SFSR-03 ▪ Picked up from the Old Townsite ▪ Demobilization	Snorkel survey; macroinvertebrates; periphyton; habitat data; surface water
August 22	▪ Mobilization – Michelle Havey, Beth Sosik ▪ Drove to SFSR-07, met Jason Shira (Ecology) ▪ Sampled SFSR-07 ▪ Drove to Darrington to stay for the night	Snorkel survey; macroinvertebrates; periphyton; habitat data; surface water; sediment
August 23	▪ Travelled to Old Townsite by helicopter ▪ Hiked down South Fork Sauk River ▪ Sampled SFSR-03	Snorkel survey; macroinvertebrates; periphyton; habitat data; surface water; sediment
August 24	▪ Hiked up Glacier Basin Trail ▪ Sampled HC-GC-01	Snorkel survey; macroinvertebrates; periphyton; habitat data; surface water; sediment
August 25	▪ Hiked up Glacier Creek from camp ▪ Sampled HC-GC-05	Snorkel survey; macroinvertebrates; periphyton; habitat data; surface water; sediment
August 26	▪ Hiked up Silver Lake Trail ▪ Sampled HC-76-02 ▪ Picked up from the Old Townsite ▪ Stayed the night in Darrington	Snorkel survey; macroinvertebrates; periphyton; habitat data; surface water; sediment

Day	Activity	Samples collected
August 27	▪ Drove to Monte Cristo Lake ▪ Sampled HC-MCL-01 ▪ Drove to Darrington to stay the night	Snorkel survey; macroinvertebrates; periphyton; habitat data; surface water; sediment
August 28	▪ Drove to HC-SFSR-09 ▪ Sampled HC-SFSR-09 ▪ Demobilization	Snorkel survey; macroinvertebrates; periphyton; habitat data; surface water; sediment

Table 2 – Project Team Roles and Responsibilities

Project Role	Personnel Assignment	Roles/Responsibilities
Ecology Project Manager	Mary Monahan Ecology (509) 454-7840	Client Project Manager
Program Manager	Mike Bailey Hart Crowser (206) 324-9530	Ensures that all work is carried out in accordance with contractual obligations and the Delivery Order statement of work. Assists the Project Manager as needed with technical decisions and in resolving issues. Final reviewer.
Project/Task Manager	Michelle Havey Hart Crowser (206) 324-9530	Overall responsibility for execution of the Work Plan. Coordinate with Client, Field Manager, and Program Manager as necessary to resolve issues.
Corporate Health and Safety Officer (HSO)	Echo Summers Hart Crowser (206) 324-9530	Overall responsibility for review and answering questions regarding health and safety.
Field Manager and Site Safety Coordinator (SSC)	Michelle Havey Hart Crowser (206) 324-9530	Ensures that field activities are conducted in accordance with project specifications. Coordinates field activities with Project and Program Managers.

2.1 Background

The MCMA is located approximately 38 air miles east of Everett, Washington, on the steep mountainsides of the Cascade Range at the head of the South Fork Sauk River. The abandoned or inactive mine workings include about 54 mine entries, prospects, and related facilities. The principal commodities produced were gold and silver, with an estimated 310,000 tons of ore produced between 1889 and the closure of the mines in 1907.

The MCMA was discovered by Joe Pearsall and Frank Peabody during the summer of 1889. A townsite was quickly established, consisting of stores, hotels, a school, and a newspaper. A railroad was completed in 1893 to transport ore to the smelter in Everett. Mineral production flourished for a few years until massive floods destroyed rail access in 1897. After closure in 1907, several smaller companies made intermittent attempts to revive mining operations at a reduced effort until 1920 (Woodhouse 1997). Currently, the area is a popular hiking destination during the summer, as it has an extensive network of trails.

2.2 Glacier Creek Watershed

Glacier Creek Watershed habitat is characterized by bare rock and boulder substrate that is frequently covered by snow and ice, with little riparian shading. The low elevation portions of the watershed contain forested areas with a shrub-dominated understory. Forested vegetation is dominated by grand fir (*Abies grandis*), subalpine fir (*A. lasiocarpa*), and western redcedar (*Thuja plicata*), with understory vegetation consisting of blueberry and huckleberry (*Vaccinium* spp.), with devil's club (*Oplopanax horridus*), vine maple (*Acer circinatum*), and salmonberry (*Rubus spectabilis*) being common near drainages and seeps. High-elevation areas are dominated by rock, snow (seasonally), and ice, with small forested stands and low-growing shrubs such as mountain-heather (*Phyllodoce* spp. and *Cassiope* spp.), lichen, and moss. Talus slopes and rocky outcrops are common features in this watershed.

Glacier Creek flows in a northerly and westerly direction into the SFSR from its headwaters (Figure 1). Glacier Falls is a steep, tiered cascade waterfall located approximately where the creek starts flowing west. The creek loses approximately 250 feet in elevation over a run of 500 feet, with the tallest drop estimated at 104 feet[1]. A waterfall of this size would likely act as a barrier to fish migration within the creek. Snowmelt serves as the primary water source for Glacier Creek, and approximately 20 miles of streams are documented in the 1,800-acre watershed. Some of the snowmelt likely enters the creek as groundwater base flow and seasonal seeps.

Mining activity in the Glacier Creek Watershed is described in the Monte Cristo Mining Area Remedial Investigation Phase 2 Summary Report (Hart Crowser 2012).

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[1] Source: http://www.waterfallsnorthwest.com/nws/falls.php?num=3612

2.3 Seventysix Gulch Watershed

The Seventysix Gulch Watershed is characterized by a predominantly forested landscape interspersed with rock, snow, and ice. Dominant vegetation is similar to the Weden Creek and Glacier Creek watersheds, and consists of an overstory of Douglas fir (*Pseudotsuga menziesii*), true firs (*Abies* spp.), hemlock (*Tsuga* spp.), and cedar within an understory of shrubs. Evidence of historical timber harvest can be observed near established trails. High elevation areas contain a combination of forest stands, talus slopes, and rocky outcrops.

Seventysix Gulch generally flows in a northerly direction into the SFSR (Figure 1). It is the smallest watershed at approximately 1,330 acres with 15 miles of streams. Snowmelt serves as the primary water source for Seventysix Gulch, which is reported to go dry during the late summer months (personal communication, USDA Forest Service volunteer, July 2011). Groundwater base flow and seasonal seepage likely contribute to surface water flows during the spring and early summer. Silver Lake, a popular destination for recreational users, is located just west of Seventysix Gulch Watershed, over Poodle Dog Pass.

Mining activity in the Seventysix Gulch Watershed is described in the Monte Cristo Mining Area Remedial Investigation Phase 2 Summary Report (Hart Crowser 2012).

2.4 Weden Creek Watershed

Weden Creek is the third component of the SFSR headwaters, draining 31 miles of streams into the SFSR just upstream of Barlow Pass. The Weden Creek Watershed was not included as part of this investigation, so it is not discussed further in this report. In the event that future observations and sampling in Weden Creek are necessary to characterize water quality in the SFSR, we anticipate work would be similar to that discussed herein.

3.0 SITE INVESTIGATION ACTIVITIES

Hart Crowser characterized habitat conditions and collected baseline water and sediment quality data that will be used to monitor the effects of the USDA Forest Service mine waste removal action on water quality and aid in determining the potential need for additional remediation in the future.

A site reconnaissance to identify aquatic sampling reaches was conducted in the fall of 2012, and findings from that reconnaissance are discussed in the Monte Cristo Mining Area Remedial Investigation Phase 3 Characterization of Aquatic Sampling Reaches Reconnaissance Report (Hart Crowser 2013b). Seven sampling reaches were selected based on adequate flow, habitat diversity, sediment availability, accessibility, and safety as determined from the reconnaissance (Figure 1):

- Glacier Creek and Seventysix Gulch – two locations (HC-GC-05, HC-76-02) and one reference reach (HC-GC-01);
- SFSR between the Old Townsite and Monte Cristo Lake – two locations (HC-SFSR-03 and HC-SFSR-07 [formerly referred to as HC-SFSR-07 Alt]);

- Monte Cristo Lake – one location (HC-MCL); and
- SFSR upstream of Elliot Creek – one location (HC-SFSR-09).

The reference reach, HC-GC-01, is located in Glacier Creek, upstream of any obvious mining impacts. This will serve as an environmental reference, not used for comparison to the six sample locations. Sampling this reference reach at the same time as the sample locations will help isolate changes in conditions at mine-impacted reaches from the variable effects of seasonal low or high flow.

To examine seasonal differences, a subset of the sites (HC-GC-01, HC-SFSR-03, and HC-MCL) was selected to be sampled both in early summer and late summer. The early summer sample collection included all sampling described below except sediment collection for chemistry and bioassays, which only occurred during the late-summer sampling.

Aquatic habitat data, fish community surveys, benthic macroinvertebrate community samples, periphyton community samples, sediment samples for chemical analysis and toxicity testing, and surface water samples were collected using a hybridized Rapid Bioassessment Protocol (RBP; EPA 1999) and Quality Assurance Monitoring Plan for Ambient Biological Monitoring in Rivers and Streams: Benthic Macroinvertebrates and Periphyton (QAMP; Ecology 2010) approach. The RBP and QAMP both provide acceptable sampling methods for wadeable streams. Therefore, the methods most suitable for the conditions present at the MCMA site were selected. Since the QAMP and RBP are not intended for use in lakes, some procedures follow the EPA Survey of the Nation's Lakes methods (EPA 2012) as discussed later in this section to characterize the sampling reach in Monte Cristo Lake and establish a consistent baseline approach for future sampling in the lake.

The following sections describe the sampling and data collection methods. Sample collection was performed in a consistent manner at all sampling locations to ensure data are representative.

3.1 Habitat Characterization

Habitat characterization was completed on a subset of locations in early summer, and then at all seven locations in late summer. For the six stream locations, sampling procedures followed protocols outlined in Section 5 of RBPs for Use in Streams and Wadeable Rivers (EPA 1999). Due to the unique habitat of the lake (an extended pool within the SFSR), it was characterized alternately using lake protocols (July; EPA 2012) and low-gradient stream protocols (August; EPA 1999).

We evaluated substrate and instream cover, water quality, channel morphology, and riparian and bank structure, as well as a visual habitat assessment. Stream sampling reaches (100 meters long) were surveyed using resource-grade global positioning system (GPS) instruments at the upstream and downstream boundaries. We also documented proximity to human activities (i.e., trails, roads, or clear-cuts) and readily visible impacts on the stream reach. Photographs were taken at each location to document vegetation, wildlife use, and other relevant site features. Survey data for each reach were collected on field forms included in the SAP (Hart Crowser 2013a; Appendix B). Field data sheets and site photographs are presented in Appendix A. The surveys were completed after all other sample collection so as not to disturb biota or contaminate chemistry samples.

3.2 Fish Community Sampling

Fish community sampling was conducted by snorkel surveys at the seven proposed sampling locations (for both early summer and late summer sampling events) to count the species present and their size. The purpose was to assess the fish community as a way to evaluate the biological integrity of the stream reach. We obtained the necessary scientific collection permits from Washington Department of Fish and Wildlife and NOAA Fisheries/National Marine Fisheries Service to conduct the surveys, and fish sampling procedures (snorkel surveys) followed protocols outlined in Thurow (1994). The protocol for surveys involves careful, standardized field observations, species identification and abundance, and analysis using aggregated biological attributes or numbers (Mebane et al. 2003) of key species. For the lake location, we were able to snorkel all available habitat within the lake sampling reach, but we also set minnow traps to provide additional sampling.

The snorkel survey protocol calls for snorkelers to begin counting fish at the downstream limit of the sample reach and terminate at the upstream end of the reach. We followed the protocol where possible; however, we modified our approach at several reaches to adapt to local conditions. Where the current was too strong or the water too deep, surveys were conducted by floating from the upstream to the downstream end of the reach. For reaches that average 5 meters wide or less, surveys were conducted by a single snorkeler. For reaches wider than 5 meters, two snorkelers conducted the survey together. In this case, the two snorkelers began at the center line of the sampling reach and moved shoulder to shoulder, counting all fish between them and the bank. For safety, all field team members were trained in snorkeling safety precautions, and a third person (trained in cardiopulmonary resuscitation [CPR]) was located on one of the banks during all surveys. Data was collected on dive tablets and transferred to the field forms at the completion of the survey.

3.3 Benthic Macroinvertebrate Community Sampling

Macroinvertebrate populations were sampled in both early and later summer at the selected sample locations described in this document. Composite sampling sites were chosen to be of similar substrate, gradient, depth, and cover within each sampling reach.

Sampling procedures followed protocols outlined in Appendix C, Section C-1 of the QAMP Ambient Biological Monitoring in Rivers and Streams: Benthic Macroinvertebrates and Periphyton (Ecology 2010) as summarized below.

Macroinvertebrates were sampled at each stream site using the D-frame (0.3 meter x 0.3 meter, 500 micron mesh) kick-net method. One kick sample was collected at each of eight locations within the sample reach and added to form the composite sample for the site. When possible, half of the sample locations were approximately mid-channel (or up to 50 centimeters deep) and the other half were along the margins.

Macroinvertebrate collection at Monte Cristo Lake (HC-MCL-01) was conducted using a 4-inch-diameter clam gun, driven 6 inches into the sediment at eight locations along the shore. The kick net was used as a sieve to process the corer full of sediment. The organisms in the net were then processed the same way as kick stations with flowing water.

For those kick stations with flowing water, we placed the net opening into the face of the flow and positioned the net securely on the stream bottom to eliminate gaps under the frame. We collected macroinvertebrates from a 0.09-square-meter quadrat directly in front of the frame mouth. Working from the upstream edge of the quadrat backward, we carefully picked up and rubbed cobbles directly in front of the net to remove attached animals. Each cobble was inspected to be sure everything had been dislodged and then it was set aside. If a rock was lodged in the stream bottom, we rubbed it a few times concentrating on any cracks or indentations.

After all large cobbles had been removed, we used our feet to disturb the top 4 to 5 centimeters of the remaining finer substrate within the quadrat for 30 seconds. Then we pulled the net up out of the water, immersed it in the stream several times to remove fine sediment and to concentrate organisms at the end of the net. We removed any coarse rocks and sticks, checked them for clinging organisms, and placed any animals in the sample jar. We emptied the net’s contents into the sample jar and added enough ethanol so that the resulting sample consisted of 1/3 invertebrates and 2/3 ethanol by volume. Samples were collected in wide-mouth polyethylene jars and preserved in 95 percent ethanol. Samples were shipped to Rhithron Associates of Missoula, Montana, for processing.

The composite sample was analyzed for species identification and abundance, and a series of benthic index of biotic integrity (B-IBI) metrics were calculated from lab results. Another metric calculated, the Hilsenhoff biotic index (HBI), is based on taxonomic tolerance to organic pollutants. Invertebrate abundance was also calculated. Typically, in montane streams of the Pacific Northwest, invertebrate abundance of less than 500 per square meter is considered very low, 500 to 1,000 is considered low, 1,000 to 5,000 is considered moderate, and 5,000 to 10,000 is considered high (Wisseman 2005). Twelve other metrics, not part of the core B-IBI, were calculated and evaluated based on data quartiles over all sites unless other means of evaluation were available.

3.4 Periphyton Community Sampling

Similar to the macroinvertebrates, periphyton communities were monitored in early and late summer at the selected baseline sampling locations.

Sampling procedures followed protocols outlined in Appendix C, Section C-3 of the QAMP Ambient Biological Monitoring in Rivers and Streams: Benthic Macroinvertebrates and Periphyton (Ecology 2010). The procedure followed at the lake station is discussed at the end of this section.

Periphyton sampling was performed in conjunction with macroinvertebrate sampling near, but not within, the macroinvertebrate quadrats. One sample was collected at each of eight locations randomly selected within the sample reach and combined to form a composite sample for the site. Most sites were primarily coarse substrate (epilithic), so the following protocol was applied.

We carefully removed a rock from each of the eight sample locations, retaining the rock’s orientation as it occurred in the stream to avoid loss of periphyton. Selected rocks were relatively flat and were anywhere from 7.5 centimeters to 15 centimeters in diameter. When possible, the rocks were similar in size, depth, and exposure to sunlight. The rocks were placed in a single layer in a plastic tray, with the same orientation as they were in the stream. We attempted to process the samples out of direct sunlight to minimize chlorophyll degradation.

Using a 7.5-centimeter circle template, we scrubbed only the upper surface of each rock with a firm-bristled toothbrush using a circular motion. We rinsed the sampled rock surface and toothbrush bristles with a rinse bottle containing distilled water. This process was repeated for each of the eight rocks. After sample processing was complete, we measured and recorded the total rinsate volume and poured the rinsate through a funnel into a 500-milliliter (mL) Nalgene sample bottle and preserved with a 5 percent Lugol's solution in the field.

The periphyton collection at Monte Cristo Lake (HC-MCL-01) was similar to the other sites, except that periphyton was sampled by scrubbing pieces of woody debris due to the absence of rocky substrate.

Each composite sample was subsampled in the field for chlorophyll *a* analysis and taxonomic identification. The chlorophyll *a* subsample was field filtered through a 47-millimeter, 0.7-micron filter, wrapped in aluminum foil, placed in a self-sealing plastic bag and immediately put on ice. Samples were shipped to Rhithron Associates of Missoula, Montana, for processing.

3.5 Sediment Sampling

Sediment samples were collected for chemical analysis and toxicity testing (bioassay) using a stainless steel spoon. Because of the more stable nature of sediment chemistry, seasonal patterns in sediment chemistry were not anticipated; therefore, sediment samples were only collected during the late summer sampling trip. Sediment was collected from a minimum of three subsites within the sample reach, but several of the sites required more subsites to ensure an adequate sample size. Aliquots of the top 10 centimeters from each station subsite were composited to form the site sample. These aliquots were mixed thoroughly in a stainless steel bowl to produce a homogeneous sample (i.e., uniform in color, texture, and moisture content) prior to splitting between containers for toxicity testing and chemical analysis.

Samples were packaged in coolers and shipped directly to the labs after returning to the office at the end of the sampling trip. The bioassay samples were submitted to Northwestern Aquatic Sciences of Newport, Oregon, for analysis. Laboratory results and a sediment bioassay summary are provided in Appendix B. The chemistry samples were submitted to Analytical Resources, Inc. of Seattle, Washington, for analysis. Laboratory reports are provided in Appendix C. Screening criteria from the State of Washington sediment management standards (SMS; Ecology 2013) are presented in Table 3[2].

3.5.1 Sediment Bioassays

Sediment quality was evaluated based on biological criteria as established in the SMS (Ecology 2013), which serve to confirm the designation of sediment quality (Table 4). These criteria are based on both the degree of biological response (a numerical comparison) and statistical significance (a statistical

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[2] Tables not included within the text are presented at the end of the main text.

comparison). As for chemical parameters, the SMS establishes the sediment cleanup objective (SCO; response at or below which no adverse effects are expected) and the cleanup screening level (CSL; response at or below which no significant adverse effects are expected) criteria for evaluating sediment quality. The SCO is more stringent than the CSL and allows for less biological response in the test treatments.

Determination of sediment quality is based on a comparison of responses observed in the test treatments compared to those in the control treatment.

The chronic 28-day amphipod survival and growth test was conducted using *Hyalella azteca,* and the chronic 20-day midge survival and growth test was conducted using *Chironomus dilutus*. Under the new SMS rule, a test treatment fails SCO if the mean mortality in the test sediment is greater than 15 percent higher than the control and the difference is statistically significant ($p \geq 0.05$). Tests fail the CSL if the test treatment mortality is 25 percent greater than the control and the difference is statistically significant ($p \geq 0.05$).

The amphipod 28-day growth test is based on mean individual growth (MIG) rates as measured by ash-free dry weight (AFDW). A test fails SCO if the MIG in the test sediment is less than 0.75 of the control and if the difference is statistically significant ($p \geq 0.05$). The treatments fail CSL if MIG is less than 0.60 of the control and the difference is statistically significant ($p \geq 0.05$).

The midge 20-day growth test is based on MIG rates as measured by AFDW. A test fails SCO if the MIG in the test sediment is less than 0.75 of the control and if the difference is statistically significant ($p \geq 0.05$). The treatments fail CSL if MIG in the test sediment is less than 0.60 of the control and the difference is statistically significant ($p \geq 0.05$).

3.6 Surface Water Sampling

Sampling procedures followed protocols outlined in Appendix B, Section B-4 of the Quality Assurance Monitoring Plan (QAMP) Ambient Biological Monitoring in Rivers and Streams: Benthic Macroinvertebrates and Periphyton (Ecology 2010).

Surface water samples were collected during both the early summer and late summer sampling events. For each sample, we removed the lid just before sampling to prevent contamination. In order to minimize suspended solids, samples were generally collected from the upstream side of sampling locations.

For the early summer trip, we were unable to field filter samples collected for dissolved metals, so bottles were submerged in the stream to fill them and filtering was done by the lab. For the late summer trip, samples collected for dissolved metals were field filtered using a hand-operated pump with a disposable in-line, 0.45-micron filter cartridge and dedicated, disposable tubing. Samples were collected from the filter outlet directly into pre-preserved sample containers obtained from the laboratory. A minimum of 25 mL of sample water was flushed through the sampling tubing and filter before samples were collected. Samples for total metals analysis were collected using the same procedure as dissolved metals without the in-line filter.

Samples were packaged in coolers and shipped directly to the labs after returning to the office at the end of each sampling trip. The chemistry samples were submitted to Analytical Resources, Inc. of Seattle, Washington, and Brooks Rand Laboratories of Seattle, Washington, for analysis. Laboratory reports are provided in Appendix C. The proposed surface water screening criteria for both total and dissolved metals are in Table 5.

4.0 RESULTS

4.1 HC-GC-01

Due to time constraints from limited daylight during the October 2012 reconnaissance, we did not visit the reference site on that trip. Therefore, we navigated to the former CES reference location (GC-01) and identified an appropriate 100-meter sampling reach during the early summer sampling trip.

After the helicopter dropped us off at the Old Townsite on July 9, 2013, the field team hiked up the Glacier Basin Trail and used a GPS to navigate to GC-01, which was approximately 2 miles southeast of the Old Townsite (Figure 2). Snow was still present in the basin and a snow bridge (Photographs 1 and 2 in Appendix A), which posed a safety hazard for snorkeling, prevented us from reaching the exact CES sample point. We did, however, identify a reference sample reach approximately 700 feet downstream of the CES sample point and immediately downstream of the snow bridge. We sampled this site again on August 24, 2013. Photographs 1 through 3, field data sheets, and site sketches are on pages A-1 through A-24 in Appendix A.

First, we marked the upper and lower extent of the sampling reach with the Trimble GPS. Next, we completed a snorkel survey followed by surface water chemistry sampling and sediment sampling (August only) for chemistry and bioassay. Water quality measurements were collected using a Horiba multimeter. Then, we measured the length, width (average), and slope of the stream reach using a laser rangefinder and slope inclinometer. Finally, we collected macroinvertebrates and periphyton from eight locations within the reach. A summary of all detailed location information, water quality, and instream feature measurements are in Table 6.

4.1.1 Habitat Characterization

The reach habitat was predominantly a series of cascades (95 percent; Table 6) with a few small step pools (5 percent). The riparian zone had little to no vegetation in July (Photograph 1; Appendix A), and was dominated by grasses and herbaceous ground cover along the banks in August. There was no large woody debris (LWD) within the reach. We observed minimal aquatic vegetation (estimated 5 percent of the reach) in the form of algae attached to some of the larger boulders. The substrate was dominated by boulders and cobbles (Figure 3), with very little gravel and sand.

Based on the slope (10 percent) and the channel form, this reach can be classified as an A type stream (based on Rosgen 1994), which is considered high gradient. The high-gradient habitat assessment field data sheet requires rating 10 habitat parameters based on four conditional categories: optimal, suboptimal, marginal, and poor. The conditions assessed in the field for each habitat parameter are:

1. Epifaunal Substrate/Available Cover: Marginal (July and August)
2. Embeddedness: Optimal (July and August)
3. Velocity/Depth Regime: Marginal (July and August)
4. Sediment Deposition: Optimal (July and August)
5. Channel Flow Status: Marginal (July) / Suboptimal (August)
6. Channel Alteration: Optimal (July and August)
7. Frequency of Riffles (or bends): Optimal (July and August)
8. Bank Stability (each bank scored separately): Marginal (July) / Optimal (August)
9. Vegetative Protection (by bank): Poor (July) / Optimal (August)
10. Riparian Vegetative Zone Width (by bank): Poor (July) / Optimal (August)

This site scored 115 out of 200 in July 2013, and 163 out of 200 in August 2013. This seasonal score difference is largely attributed to the absence of any riparian vegetation in July due to the deep snow.

4.1.2 Fish

The snorkel survey was conducted from the downstream end of the reach to the upstream end on both trips. This reach had several wetted channels, which increased the time required to complete a thorough snorkel survey. However, no fish were observed at this site in either July or August (Table 7).

4.1.3 Macroinvertebrates

HC-GC-01 had fair biotic integrity according to B-IBI metrics, with a score of 36 in both July and August (Table 8). Invertebrate abundance at HC-GC-01 was low in July (505.6 per square meter; Table 9) and moderate in August (1,400 per square meter). The HBI rated the site as having excellent biotic integrity in both sampling events (Table 9).

Outside of the core ten B-IBI metrics, scraper and shredder richness at this site was low to moderate (Table 9). Ephemeroptera, Plecoptera, and Trichoptera (EPT) and predator richness were very low in July, and remained low in August. Scraper, shredder, EPT, and predator richness metrics are generally high in montane areas with high biological integrity. In addition, they are generally higher in upstream reaches relative to downstream. Certain taxa can be categorized by their intolerance to warm water, low dissolved oxygen, fine sediment, and fouling by filamentous algae; an increase of intolerant taxa indicates better water quality. The site had very high proportion of intolerant taxa to total taxa composition in July and a moderately high proportion in August.

4.1.4 Periphyton

Areal chlorophyll *a* biomass was below detectable limits in July, but by August had increased to 5.04 milligrams per square meter (Table 10). Overall, periphyton density at HC-GC-01 was 18,624 cells per square centimeter in July, increasing almost 20-fold to 334,093 cells per square centimeter in August. In July, diatom taxa were predominant at 80 percent, while the remaining 20 percent were non-diatom taxa in the phylum Cyanophyta. In August, the composition switched, and only 16.3

percent were diatom taxa, while the remaining 83.7 percent were non-diatom taxa in the phyla Chlorophyta and, to a lesser extent, Cyanophyta and Chrysophyta.

Community Structure

Shannon's H is an index of diversity that accounts for both total abundance and proportion of the species present; larger values indicate higher diversity. Shannon's H measure of diatom diversity was 3.575 in July, and decreased to 2.163 in August. Diatom species richness also decreased over time (27 in July, 17 in August). At the same time, the dominant diatom species shifted from *Achnathidium minutissimum* in July (24.5 percent) to *Hannea arcus* in August (52.5 percent).

Nutrients and Sediment

The pollution index for the site was 2.86 in July, and 2.93 in August, where a value of 1 indicates the most polluted conditions and 3 indicates the least polluted conditions (Table 10). Little to no (1.5 percent in July, none in August) siltation-tolerant taxa were present within the site; however, there was greater abundance in July of all motile taxa (22 percent in July, decreasing to 3.7 percent in August). Motile taxa are positively associated with habitats with frequent substrate disturbance. In July, 8.5 percent of periphyton were from a functional group that indicates nutrient rich, eutrophic waters (eutraphentic), while in August the percentage dropped to 2.83 percent (Table 10). Heterotrophic metrics also show higher abundances of periphyton that are tolerant of high organic nitrogen in July over August (High Organic N autotrophic; 52.5 percent and 18.3 percent, respectively). In July, 9 percent were tolerant to conditions involving low oxygen and decomposing organic matter (polysaprobous), while in August the percentage decreased to 4.8 percent.

Metals

Heavy metal contamination can lead to deformed or otherwise abnormal periphyton cells. No cells in either month were found to be abnormal. In July, 9 percent of the periphyton sampled were tolerant to metals; however, by August the percentage decreased to 4.5 percent.

4.1.5 Sediment Bioassays

Hyalella azteca

Mortality and growth results for HC-GC-01 test sediment did not exceed SCO or CSL criteria (Table 11) and no significant difference was observed for the test sediment relative to the control, thus passing overall.

Chironomus dilutus

There was adequate growth and survival (met SCO and CSL criteria) in the HC-GC-01 test sediment, thus passing overall (Table 11).

4.1.6 Sediment Chemistry

Arsenic in sediment samples collected from HC-GC-01 in August (74 milligrams per kilogram [mg/kg]; Table 12) exceeded SCO criteria, but did not exceed CSL.

Acid volatile sulfides and sulfide were below detection limits for sediment samples. All remaining constituents were within detectable ranges but did not exceed applicable or relevant and appropriate requirements (ARAR) limits, and sediment pH was 6.5. The analytical data quality review and laboratory reports are provided in Appendix C.

4.1.7 Surface Water Chemistry

In August, chloride and fluoride were below detection limits, while sulfate was 0.8 milligrams per liter (mg/L; Table 13). Total alkalinity was 5.8 mg/L in the form of bicarbonate.

Total Metals

In both July and August, arsenic (0.8 micrograms per liter [µg/L] and 0.78 µg/L, respectively) exceeded minimum ARAR thresholds for protection of human health for consumption of water and organisms (Table 13). There are no criteria for protection of aquatic organisms for total arsenic.

Aluminum, beryllium, cadmium, chromium, cobalt, copper, lead, nickel, selenium, silver, thallium, and vanadium were at or below detection limits in both July and August. Zinc was below the detection limits in July, but was within detectable range by August. The others were within detectable concentrations, but were below ARAR screening criteria.

Dissolved Metals

No dissolved metals exceeded ARAR criteria for protection of aquatic organisms from chronic effects (Table 13).

Aluminum, beryllium, chromium, cobalt, copper, iron, lead, nickel, selenium, thallium, and vanadium all were at or below detection limits in both July and August. Manganese and zinc were at or below detection limits in July, but were within detectable range by August. Little change was seen between sampling events for the remaining chemicals.

4.2 HC-GC-05

On the morning of August 25, 2013, we hiked up the Rainy Mine Trail that heads east from the Old Townsite campground and arrived at the reach (Figure 2). One team member conducted the snorkel survey shortly after arriving on site. At the same time, rocks were collected for periphyton and locations flagged for kick-net samples. Then, sediment was collected from several subsites and periphyton was processed while another team member collected macroinvertebrates. Finally, surface water samples were collected and habitat assessment forms completed. A summary of all detailed location information, water quality, and instream feature measurements is in Table 6. Photographs 4 through 7 and field data sheets are on pages A-25 through A-36 in Appendix A.

4.2.1 Habitat Characterization

The reach was a series of riffle/pool complexes (60 percent riffle, 40 percent pool; Table 6). Both banks have a wide band of boulders with no vegetation, indicating high flows move through this section of the stream (Photograph 4 in Appendix A). The riparian zone was dominated by western hemlock

(*Tsuga heterophylla*) and Pacific silver fir (*Abies amabilis*). There were several pieces of LWD in, across, and adjacent to the channel (Photograph 5 in Appendix A). It appears that active bank erosion is contributing to the LWD in this reach. We observed minimal aquatic vegetation (2 percent of the reach) in the form of attached algae on some of the larger boulders, further evidence that this is a dynamic and high-energy section of the stream. The substrate was dominated by boulders and cobbles, with very little gravel and sand (Figure 3).

Based on the slope (9 percent) and the channel form, this reach can be classified as an A type stream (based on Rosgen 1994), which is considered high gradient. The conditions assessed in the field for each habitat parameter are:

1. Epifaunal Substrate/Available Cover: Optimal
2. Embeddedness: Optimal
3. Velocity/Depth Regime: Optimal
4. Sediment Deposition: Optimal
5. Channel Flow Status: Marginal
6. Channel Alteration: Optimal
7. Frequency of Riffles (or bends): Optimal
8. Bank Stability (each bank scored separately): Poor (both banks)
9. Vegetative Protection (by bank): Optimal (both banks)
10. Riparian Vegetative Zone Width (by bank): Optimal (both banks)

In general, this sampling reach would be considered optimal for habitat quality. This site scored 167 out of 200 points in October 2012, and 164 out of 200 points in August 2013. This decrease was primarily due to a decrease in channel flow status and bank stability.

4.2.2 Fish

The snorkel survey was conducted from upstream to downstream. Ten fish were observed in HC-GC-05, all of which were juvenile bull trout (*Salvelinus confluentus*) between 0 and 250 millimeters (Table 7; Photograph 6 in Appendix A). In addition, a single bull trout greater than 250 millimeters was observed in a plunge pool just below the snorkel reach. A dead juvenile bull trout was found on a boulder adjacent to an isolated pool. It appeared the fish may have been stranded in a rapidly shrinking pool during the warm, sunny weather; it was somewhat desiccated. We preserved the specimen on ice and sent it to US Fish and Wildlife Service on December 10, 2013.

4.2.3 Macroinvertebrates

HC-GC-05 had good biotic integrity, with a score of 40 out of 50 over ten core metrics (Table 8). Invertebrate abundance was moderate when the site was sampled in August (2,283.3 per square meter; Table 9). The HBI rated the site as having excellent biotic integrity.

Outside of the core ten B-IBI metrics, scraper and shredder richness at this site were very high, and EPT richness was high, all indicating high biological integrity. The site had very high proportion of intolerant taxa, indicating good water quality. Collector taxa tend to increase in habitats where fine sediment or filamentous algae dominate, and chironomid taxa often dominate impacted systems. HC-GC-05 had very low abundance in either group. During the macroinvertebrate sampling, twotailed frog tadpoles and one adult (*Ascaphus truei*) were captured and released.

4.2.4 Periphyton

Areal chlorophyll *a* biomass was 1.3 milligrams per square meter in August. Overall, periphyton density at HC-GC-05 was 85,251 cells per square centimeter (Table 10). Of this, 13 percent were diatom taxa, while the remaining 87 percent were non-diatom taxa in the phylum Cyanophyta (*Phormidium* spp. and *Homeothrix* spp.).

Community Structure

Shannon's H measure of diatom diversity was 1.0, and diatom species richness was low (10). The dominant diatom species was *A. minutissimum* (85 percent of diatoms).

Nutrients and Sediment

The pollution index for the site was 2.99, with 3.00 being the least polluted conditions. No siltation taxa were present within the site, and very few (2 percent) motile taxa were present.

Metals

No cells were found to be abnormal, and very few were found to be tolerant to either metals (0.33 percent) or disturbance (0.67 percent).

4.2.5 Sediment Bioassays

Hyalella azteca

Mortality and growth results for HC-GC-05 test sediment did not exceed SCO or CSL criteria (Table 11) and no significant difference was observed for the test sediment relative to the control, thus passing overall.

Chironomus dilutus

There was adequate growth and survival (met SCO and CSL criteria) in the HC-GC-05 test sediment, thus passing overall (Table 11).

4.2.6 Sediment Chemistry

Arsenic in sediment samples collected at HC-GC-05 in August exceeded ARAR limits for SCO and CSL (133 mg/kg observed; Table 12). Acid volatile sulfides and sulfide were detected for sediment samples at 2.2 mg/kg and 3.2 mg/kg, respectively. All remaining constituents were within detectable ranges and sediment pH was 6.34.

4.2.7 Surface Water Chemistry

In August, fluoride was below detection limits, while chloride was 0.2 mg/L and sulfate was 2.0 mg/L (Table 13). Total alkalinity was 5.5 mg/L in the form of bicarbonate.

Total Metals

Arsenic (5.98 µg/L; Table 13) was the only constituent that exceeded ARAR criteria for protection of human health for consumption of water and organisms.

Aluminum, beryllium, chromium, cobalt, copper, iron, lead, nickel, selenium, silver, thallium, and vanadium all were at or below detection limits in August for total metal water samples. The remaining few constituents were within the detectable range.

Dissolved Metals

No dissolved metals exceeded ARAR criteria for protection of aquatic organisms from chronic effects (Table 13).

Aluminum, beryllium, chromium, cobalt, copper, iron, nickel, selenium, thallium, and vanadium all were at or below detection limits in August dissolved metal water samples. The remaining chemicals were all within detectable range.

4.3 HC-76-02

On the morning of August 26, 2013, we hiked up the Silver Lake trail from the Old Townsite and arrived at the reach (Figure 2). All three team members walked along the bank to the downstream end of the reach. One team member snorkeled while the other two collected rocks for periphyton and flagged those locations for kick-net sampling. Next, sediment was collected, periphyton processed, and macroinvertebrates collected. Finally, surface water samples were collected and habitat assessment forms completed. A summary of all detailed location information, water quality, and instream feature measurements is in Table 6. Photographs 8 through 11 and field data sheets for this site are on pages A-37 through A-48 in Appendix A.

4.3.1 Habitat Characterization

The stream is confined in a narrow valley with steep hillsides and a forested riparian zone (see Photographs 10 and 11 in Appendix A). The riparian vegetation was dominated by silver fir, salmonberry, and huckleberry. There was LWD across the channel and along the bank in several places (Photograph 10 in Appendix A). A notable amount of moss was present on top of boulders and along the banks (Photograph 11 in Appendix A), but no algae was observed on the submerged cobbles. The substrate was dominated by boulders, with some cobbles, gravel, and a small deposit of sand in a pool at the downstream end of the reach (Figure 3).

Based on the slope (13 percent) and the channel form, this reach can be classified as an Aa+ type stream (based on Rosgen 1994), which is considered high gradient. The conditions assessed in the field for each habitat parameter are:

1. Epifaunal Substrate/Available Cover: Optimal
2. Embeddedness: Optimal
3. Velocity/Depth Regime: Optimal
4. Sediment Deposition: Optimal
5. Channel Flow Status: Marginal
6. Channel Alteration: Optimal
7. Frequency of Riffles (or bends): Optimal
8. Bank Stability (each bank scored separately): Suboptimal/Optimal (right/left bank)
9. Vegetative Protection (by bank): Optimal (both banks)
10. Riparian Vegetative Zone Width (by bank): Optimal (both banks)

In general, this sampling reach would be considered optimal for habitat quality. This site scored 185 out of 200 points in October 2012, and 179 out of 200 points in August 2013. This decrease is primarily due to a decrease in channel flow status.

4.3.2 Fish

The snorkel survey was conducted from downstream to upstream. No fish were observed at this site in August (Table 7).

4.3.3 Macroinvertebrates

HC-76-02 had fair biotic integrity, with a score of 36 out of 50 over ten core metrics (Table 8). Invertebrate abundance was low when the site was sampled in August, with 683.3 invertebrates per square meter (Table 9). The HBI rated it as having excellent biotic integrity.

Outside of the core ten B-IBI metrics, scraper, shredder, EPT, and predator richness at this site were moderately high (Table 9), indicating higher biological integrity. The site had high proportion of intolerant taxa, an indicator of good water quality. Parasitic taxa (*Oreogeton* spp.) were also present at this site. During the macroinvertebrate sampling, a tailed frog tadpole was captured and released, and another was observed in a pool during surface water sampling.

4.3.4 Periphyton

Areal chlorophyll *a* biomass was 4.31 milligrams per square meter in August. Periphyton density at HC-76-02 was 35,521 cells per square centimeter (Table 10), of which 10 percent were diatom taxa, while the remaining 90 percent were non-diatom taxa in the phyla Chlorophyta (*Stigeoclonium* spp.) and, to a lesser extent, Cyanophyta.

Community Structure

Shannon's H measure of diatom diversity was 1.5, and diatom species richness was 16. The dominant diatom species was *A. minutissimum* (78 percent of diatoms).

Nutrients and Sediment

The pollution index for the site was 2.95. Very few siltation taxa (1 percent) were present within the site, and very few motile taxa (2.7 percent) were present.

Metals

No cells were found to be abnormal, and very few were found to be tolerant of either metals (1.3 percent) or disturbance (0.3 percent).

4.3.5 Sediment Bioassays

Hyalella azteca

Mortality and growth results for HC-76-02 test sediment did not exceed SCO or CSL criteria (Table 11) and no significant difference was observed for the test sediment relative to the control, thus passing overall.

Chironomus dilutus

Test sediment from HC-76-02 failed the SCO criteria for the 20-day mortality test (15 percent SCO; 16.25 percent observed value; Table 8), but was still well below the CSL criteria (25 percent CSL). The difference was found to be statistically significant ($p = 0.56$). HC-76-02 passed the 20-day growth test.

4.3.6 Sediment Chemistry

Arsenic in sediment samples collected from HC-76-02 in August (250 mg/kg; Table 12) exceeded ARAR limits for both SCO and CSL.

Acid volatile sulfides and sulfide were below detection limits for sediment samples. All remaining constituents were within detectable ranges and sediment pH was 6.46.

4.3.7 Surface Water Chemistry

In August, fluoride was below detection limits, while chloride was at 0.1 mg/L and sulfate was at a concentration of 1.4 mg/L (Table 13). Total alkalinity was 8.2 mg/L in the form of bicarbonate.

Total Metals

Arsenic (9.41 µg/L) exceeded the ARAR criteria for protection of human health for consumption of water and organisms.

Aluminum, beryllium, chromium, cobalt, iron, nickel, selenium, silver, thallium, and vanadium were at or below detection limits in August for total metal water samples. All other constituents were within the detectable range.

Dissolved Metals

Zinc (68 µg/L) exceeded ARAR criteria for protection of aquatic organisms from both chronic and acute effects (Table 13).

Aluminum, beryllium, chromium, cobalt, selenium, thallium, and vanadium all were at or below detection limits in August dissolved metal water samples. The remaining constituents were all within detectable ranges.

4.4 HC-SFSR-03

On the morning of July 10, 2013, the field team hiked north along the old US Forest Service road from the Old Townsite to HC- SFSR-03 (Figure 2). The sampling reach is located downstream of the Silvertip Campground and just upstream of the Hap's Hill Campground and an eroding slope of the Forest Service road (Photograph 13; Appendix A). The channel was greater than 5 meters wide with a swift flow, so two snorkelers conducted the survey floating from upstream to downstream. Then, rocks were collected for periphyton and macroinvertebrates were collected. Finally, surface water samples were collected and habitat assessment forms completed. This site was sampled again on August 23, 2013; sediment was collected on that trip in addition to all of the samples mentioned above. A summary of all detailed location information, water quality, and instream feature measurements are in Table 6. Photographs 12 through 20 and field data sheets are on pages A-49 through A-76 in Appendix A.

4.4.1 Habitat Characterization

The reach was a series of pools and riffles (50 percent each). The riparian zone was dominated by deciduous trees and shrubs: red alder (*Alnus rubra*) and Sitka willow (*Salix sitchensis*). There was LWD in the upstream portion of the reach along the left bank (Photograph 12 in Appendix A) and in the pool on the right bank in the downstream portion of the reach. There was a notable amount of aquatic vegetation (30 percent of the reach in July; 50 percent in August; Photograph 18 in Appendix A) in the form of algae attached to the submerged cobbles. The substrate was dominated by cobbles, followed by gravel and sand (Figure 3). Boulders along the margins of the wetted channel were a large component of the substrate in July (35 percent; page A-54 in Appendix A), but water levels dropped by August so the boulders were no longer considered part of the wetted substrate.

Based on the slope (3 percent) and the channel form, this reach can be classified as a B type stream (based on Rosgen 1994), which is considered high gradient. The conditions assessed in the field for each habitat parameter are listed below:

1. Epifaunal Substrate/Available Cover: Optimal
2. Embeddedness: Optimal
3. Velocity/Depth Regime: Optimal/Suboptimal (July/August 2013)
4. Sediment Deposition: Suboptimal/Marginal (July/August 2013)
5. Channel Flow Status: Marginal
6. Channel Alteration: Optimal
7. Frequency of Riffles (or bends): Optimal
8. Bank Stability (each bank scored separately): Optimal (both banks)

9. Vegetative Protection (by bank): Optimal (both banks, July 2013); Suboptimal/Optimal (Right/Left banks, August 2013)
10. Riparian Vegetative Zone Width (by bank): Optimal (both banks, July 2013); Suboptimal/Optimal (Right/Left banks, August 2013)

In general, this sampling reach would be considered optimal for habitat quality. In fact, there was a flag on the right bank in the upstream portion of the sample reach marking a bull trout redd that had been identified on October 23, 2012 (Hart Crowser 2013b; Photograph 19, Appendix A). This site scored 181 out of 200 points in October 2012, 179 out of 200 points in July 2013, and 161 out of 200 points in August 2013. This decrease may be attributed to decreased velocity/depth regime and increased sediment deposition due to seasonal changes.

4.4.2 Fish

The snorkel survey was conducted from upstream to downstream on both trips. Seven fish (four species) were observed in July 2013, and six fish (two species) observed in August (Table 7). The species seen in July were bull trout, rainbow trout (*Oncorhynchus mykiss*), cutthroat trout (*Oncorhynchus clarki*), and an unidentified salmonid species (family Salmonidae), while in August only bull trout and unidentified salmonids were observed. Bull trout were the most frequently seen species in both months (Photographs 16 and 19 in Appendix A); four individuals were observed each time. In July, the individuals were all between 51 and 200 millimeters in length; by August the individuals were larger, all between 100 and 250 millimeters. Single cutthroat trout and rainbow trout were observed in July but neither species were present in August. One unidentified salmonid individual was observed in July and two were observed in August.

4.4.3 Macroinvertebrates

HC-SFSR-03 had good biotic integrity in July, with a score of 38 out of 50 over ten core metrics. In August, the score dropped to 32 out of 50, and the rating dropped to fair (Table 8). The HBI rated the site as having excellent biotic integrity in July, but by August the rank decreased to very good integrity (Table 9). Invertebrate abundance was moderate when the site was sampled in July (1,944.4 per square meter), but increased to high levels when sampled again in August (5,572.9 per square meter).

The site had a high proportion of intolerant taxa in July (42.9 percent) and moderately high proportion in August (33.8 percent; Table 9). These are indicators of good water quality. Parasites (*Oreogeton* spp.) were present within the site, and relative abundances of chironomid and collector taxa were both very high. During the macroinvertebrate sampling in July, a tailed frog tadpole (Photograph 17 in Appendix A) was captured and released.

4.4.4 Periphyton

Areal chlorophyll *a* biomass was 2.99 milligrams per square meter in July. By August, the biomass had increased to 4.43 milligrams per square meter. Overall, periphyton density at HC-SFSR-03 was 767,261 cells per square centimeter in July, decreasing to 235,017 cells per square centimeter in August (Table 10). Two percent belonged to diatom taxa in July, while the remaining 98 percent were non-diatom taxa in the phylum Cyanophyta (mainly *Phormidium* spp.), as well as Chlorophyta to a lesser extent. In August, 6.3 percent belonged to diatom taxa, while the remaining 93.7 percent were non-diatom taxa in the phylum Cyanophyta (mainly *Phormidium* spp.).

Community Structure

Shannon's H measure of diatom diversity was 2.0 in July, and decreased to 1.6 in August. Diatom species richness also decreased over time (26 in July, 14 in August). At the same time, the dominance of the diatom species *A. minutissimum* increased from 59.3 percent in July to 73.8 percent in August).

Nutrients and Sediment

In July, 2.8 percent were tolerant of low-oxygen conditions and decomposing organic matter (polysaprobic; Table 10), which increased to 8 percent in August. The pollution index for the site was 2.96 in July, but decreased slightly to 2.87 in August. Little to no siltation taxa (0.3 percent in July, none in August) were present within the site, and very few motile taxa (1 percent in July, 0.7 percent in August) were present.

Metals

No cells in either month were found to be abnormal. In July, only 3.7 percent were found to be tolerant to metals; however, the percentage increased to 12.7 percent by August. Similarly, the presence of disturbance taxa increased between July and August sampling (0 to 1.5 percent, respectively).

4.4.5 Sediment Bioassays

Hyalella azteca

Mortality and growth results for HC-SFSR-03 test sediment did not exceed SCO or CSL criteria (Table 11) and no significant difference was observed for the test sediment relative to the control, thus passing overall.

Chironomus dilutus

There was adequate growth and survival (met SCO and CSL criteria) in the HC-SFSR-03 test sediment, thus passing overall.

4.4.6 Sediment Chemistry

Arsenic in sediment samples taken in August from HC-SFSR-03 (219 mg/kg; Table 12) exceeded ARAR limits for SCO and CSL.

Acid volatile sulfides and sulfide were below detection limits for sediment samples. All remaining constituents were within detectable range; sediment pH was 6.42.

4.4.7 Surface Water Chemistry

In August, fluoride was below detection limits, while chloride was at a concentration of 0.2 mg/L and sulfate at 2.3 mg/L (Table 13). Total alkalinity was 6.3 mg/L in the form of bicarbonate.

Total Metals

In both July and August, arsenic (7.92 µg/L and 8.83 µg/L, respectively) exceeded the lowest ARAR for protection of human health for consumption of water and organisms.

Aluminum, beryllium, chromium, cobalt, lead, nickel, selenium, silver, thallium, and vanadium all were at or below detection limits in both July and August for total metal water samples. Manganese was below detection limits in July, but by August had increased to within detectable range. Iron was above detectable limits in July, but was below the detectable range by August. Antimony, cadmium, mercury, and zinc showed an increase in concentration between July and August.

Dissolved Metals

No dissolved metals exceeded ARAR criteria for protection of aquatic organisms from chronic effects (Table 13).

Aluminum, beryllium, chromium, cobalt, copper, iron, nickel, selenium, thallium, and vanadium all were at or below detection limits in both July and August dissolved metal water samples. Lead and manganese were at or below detection limits in July, but by August had increased to within detectable range. There was generally an increase in concentration between months in the remaining chemicals: antimony, barium, calcium, magnesium, potassium, sodium, zinc, and calcium carbonate.

4.5 HC-SFSR-07

On the morning of August 22, 2013, we drove over Barlow Pass on the Mountain Loop Highway to the bridge just northeast of the pass and arrived at the stream bank by mid-morning (Figure 4). Because the channel was greater than 5 meters wide, two team members conducted the snorkel survey. Then, rocks were collected for periphyton and macroinvertebrates were collected while the third team member collected surface water. Finally, sediment samples were collected and habitat assessment forms completed. A summary of all detailed location information, water quality, and instream feature measurements are in Table 6. Photographs 21 through 26 and field data sheets are on pages A-77 through A-90 in Appendix A.

4.5.1 Habitat Characterization

The reach consisted of a large run (70 percent of the reach) with some riffles and pools (20 and 10 percent, respectively). The riparian zone was densely forested, dominated by western hemlock, with red alder, western redcedar, and subalpine fir (Photograph 24 in Appendix A). There were a couple of pieces of LWD within the reach (Photographs 25 and 26 in Appendix A) and minimal aquatic vegetation (1 percent of the reach) was observed in the form of attached algae on some of the larger boulders. The substrate was dominated by boulders and cobbles, with some gravel (Figure 3).

Based on the slope (4 percent) and the channel form, this reach can be classified as an A type stream (based on Rosgen 1994), which is considered high gradient. The conditions assessed in the field for each habitat parameter are listed below:

1. Epifaunal Substrate/Available Cover: Suboptimal

2. Embeddedness: Optimal
3. Velocity/Depth Regime: Suboptimal
4. Sediment Deposition: Optimal
5. Channel Flow Status: Suboptimal
6. Channel Alteration: Optimal
7. Frequency of Riffles (or bends): Optimal
8. Bank Stability (each bank scored separately): Optimal (both banks)
9. Vegetative Protection (by bank): Optimal (both banks)
10. Riparian Vegetative Zone Width (by bank): Optimal (both banks)

In general, this sampling reach would be considered optimal for habitat quality. This site scored 170 out of 200 points in October 2012, and 174 out of 200 points in August 2013.

4.5.2 Fish

The snorkel survey was conducted by two snorkelers from upstream to downstream. A total of 79 fish (four species) were observed in August 2013 (Table 7). The species seen were bull trout, rainbow trout, cutthroat, and an unidentified salmonid species (Photographs 21 and 22 in Appendix A). Rainbow trout were the most frequently seen species with 70 individuals observed. Most of the rainbow trout were juveniles less than 250 millimeters, though three individuals greater than 250 millimeters were recorded. Five bull trout were observed, all of which were juveniles less than 120 millimeters. A single cutthroat trout and three unidentified salmonid individuals were also observed.

4.5.3 Macroinvertebrates

HC-SFSR-07 had excellent biotic integrity, with a score of 46 out of 50 over ten core metrics (Table 8). In addition, the HBI rated it as having excellent biotic integrity. However, invertebrate abundance was very low when the site was sampled in August (268.1 per square meter; Table 9). Outside of the core ten B-IBI metrics, scraper and shredder richness at this site were low. These metrics generally score lower in downstream reaches, but this may also be a result of the proximity of this site to the road and indicates lower biological integrity. However, the site scored high in nearly every other metric.

4.5.4 Periphyton

Areal chlorophyll *a* biomass was 2.39 milligrams per square meter in August. Overall, periphyton density at HC-SFSR-07 was 85,074 cells per square centimeter (Table 10). Of this, 52 percent were diatom taxa, while the remaining 48 percent were non-diatom taxa in the phylum Cyanophyta (mainly *Homeothrix* spp.).

Community Structure

Shannon’s H measure of diatom diversity was low (0.6), as was diatom species richness (12). The dominant diatom species was *A. minutissimum* (93.33 percent of diatoms).

Nutrients and Sediment

The pollution index for the site was 2.99. No siltation taxa were present within the site, and very few motile taxa (1 percent) were present.

Metals

No cells were found to be abnormal, and very few were found to be tolerant to metals (0.5 percent) or disturbance (1.17 percent).

4.5.5 Sediment Bioassays

Hyalella azteca

Mortality and growth results for HC-SFSR-07 test sediment did not exceed SCO or CSL criteria (Table 11) and no significant difference was observed for the test sediment relative to the control, thus passing overall.

Chironomus dilutus

There was adequate growth and survival (met SCO and CSL criteria) in the HC-SFSR-07 test sediment, thus passing overall.

4.5.6 Sediment Chemistry

Arsenic in sediment samples collected at HC-SFSR-07 in August (464 mg/kg; Table 12) exceeded ARAR limits for SCO and CSL. Silver (3.5 mg/kg) also exceeded ARAR limits for both SCO and CSL. Nickel (76 mg/kg) exceeded ARAR limits for SCO, but was below the CSL.

Acid volatile sulfides concentration was below the detection limit, but sulfide was detected (1.65 mg/kg) for sediment samples. All remaining constituents were within detectable range and sediment pH was 6.54.

4.5.7 Surface Water Chemistry

In August, fluoride was below detection limits, while chloride was at 0.3 mg/L and sulfate was at a concentration of 1.9 mg/L (Table 13). Total alkalinity was 10.4 mg/L in the form of bicarbonate.

Total Metals

Arsenic (8.93 µg/L; Table 13) exceeded ARAR criteria for protection of human health for consumption of water and organisms.

Aluminum, beryllium, chromium, cobalt, lead, nickel, selenium, thallium, and vanadium were at or below detection limits in August for total metal water samples. The remaining constituents were within the detectable range.

Dissolved Metals

No dissolved metals exceeded ARAR criteria for protection of aquatic organisms from chronic effects (Table 13).

Aluminum, beryllium, chromium, cobalt, copper, iron, lead, nickel, selenium, thallium, and vanadium all were at or below detection limits in August dissolved metal water samples. The remaining constituents were all within detectable range.

4.6 HC-MCL

We arrived at the HC-MCL location (Figure 4) on the evening of July 7, 2013, and set four minnow traps baited with salmon roe. Two traps were set near a submerged log near the road in the slack side channel, one in a narrow channel to the main stream and one on the right bank of the main stream, immediately upstream of the narrow channel. We arrived back at HC-MCL by mid-morning on July 8, 2013, and retrieved the minnow traps. Three team members conducted a snorkel survey of the slack channel and then the main stream channel. Then we collected macroinvertebrates and submerged wood for periphyton sampling. Periphyton was processed while surface water samples were collected. Finally, habitat assessment forms were completed. This site was sampled again on August 27, 2013; sediment was collected on that trip in addition to all of the samples mentioned above. A summary of all detailed location information, water quality, and instream feature measurements are in Table 6. Photographs 27 through 33 and field data sheets are on pages A-91 through A-120 in Appendix A.

4.6.1 Habitat Characterization

The reach consisted of a run at the upstream end (15 percent of the reach) and a large pool for the remainder of the reach (85 percent). As shown in Photographs 27 and 29 (Appendix A), the riparian zone was dominated by shrubs: black twinberry (*Lonicera involucrata*), vine maple, willow (probably Scouler's willow; *Salix scouleriana*), and western redcedar. There was a large amount of submerged woody debris (Photograph 28 in Appendix A) and some rooted emergent aquatic vegetation (5 percent of the reach) in the form of scouring-rush (horsetail; *Equisetum hyemale*) along the right bank. The substrate consisted largely of silt with some sand and clay (Figure 3).

Based on the slope (<1 percent) and the channel form, this reach can be classified as a DA type stream (based on Rosgen 1994), which is considered low gradient. The conditions assessed in the field for each habitat parameter are listed below:

1. Epifaunal Substrate/Available Cover: Optimal
2. Pool Substrate Characterization: Suboptimal
3. Pool Variability: Optimal
4. Sediment Deposition: Marginal
5. Channel Flow Status: Suboptimal
6. Channel Alteration: Optimal
7. Channel Sinuosity: Marginal
8. Bank Stability (each bank scored separately): Suboptimal/Optimal (right/left banks)
9. Vegetative Protection (by bank): Optimal (both banks)
10. Riparian Vegetative Zone Width (by bank): Optimal (both banks)

In general, this sampling reach would be considered marginal for habitat quality. This site scored 121 out of 200 points in October 2012, and 153 out of 200 points in August 2013. Lake physical habitat characterization forms (from EPA 2012) were completed for each bank in July, so there are no scores from the low-gradient habitat assessment for that sampling trip. It was determined after the July trip that HC-MCL did not meet the criteria for a lake, so the low-gradient stream forms were used in August and will be used in subsequent monitoring years.

4.6.2 Fish

The snorkel survey was conducted by two to three people from upstream to downstream on both trips. A total of three fish (rainbow trout and unidentified salmonid) were observed in July 2013, while 67 fish (bull trout, rainbow trout, and unidentified salmonid) were observed in August (Table 7). Bull trout were the most frequently seen species in August; 57 adults were observed migrating upstream to spawn (Photograph 31 in Appendix A). In July, two juvenile rainbow trout in the 80 to 100 millimeter size class were observed. Nine rainbow trout were recorded in August, all of which were juveniles less than 150 millimeters. In July, a single unidentified salmon was captured in a minnow trap, while in August, a single unidentified salmonid individual was observed on the snorkel survey.

4.6.3 Macroinvertebrates

HC-MCL had poor biotic integrity in July, with a score of 22 out of 50 over ten core metrics. In August, the score remained at 22 out of 50 (Table 8). Invertebrate abundance was extremely low when the site was sampled in July (185 per square meter), and remained very low when sampled again in August (323.8 per square meter; Table 9). In July, the HBI rated the site as having fair biotic integrity. By August, the rating had improved to good.

This site performed poorly in the other metrics that were not part of the core B-IBI. Scraper, shredder, EPT, and predator richness at this site were extremely low relative to other sites in both sampling events (Table 9). No intolerant taxa were present in either July or August. The proportion of collector taxa was very high, and proportion of chironomid taxa was also high.

In July, a large number of casemaker caddisflies (order Tricoptera; 50 and 75 individuals) were observed in the two minnow traps deployed in the slack channel. Additionally, they were observed on the horsetail during the snorkel survey in July. Only 5 to 10 caddisflies were observed in the slack channel minnow traps in August.

4.6.4 Periphyton

During the snorkel survey, thick mats of algae or cyanobacteria were observed in the large slack channel adjacent to HC-MCL (Photograph 30 in Appendix A). Areal chlorophyll *a* biomass was 0.35 milligrams per square meter in July. By August, the value had increased to 1.46 milligrams per square meter. Overall, periphyton density at HC-MCL was 8,832 cells per square centimeter in July, increasing to 111,659 cells per square centimeter by August (Table 10). In July, only 30 percent were diatom taxa, while the remaining 70 percent were non-diatom taxa in the phylum Cyanophyta (mainly *Homeothrix* spp.). By August, diatom taxa comprised 46 percent of the periphyton community, while the remaining

54 percent were non-diatom taxa in the phyla Cyanophyta (mainly *Phormidium* spp.) and to a lesser extent Chlorophyta.

Community Structure

Shannon's H measure of diatom diversity was 2.9 in July, and decreased to 1.7 in August. Diatom species richness remained roughly the same between sampling events (35 in July, 31 in August). At the same time, the dominance of the diatom species *A. minutissimum* increased from 55.7 percent in July to 77.3 percent in August.

Nutrients and Sediment

The pollution index for the site was 2.89 in July, and increased to 2.956 in August. Few siltation taxa were present within the site, but a decrease was seen between July and August (2.2 percent and 0.7 percent respectively). Similarly, the abundance of all motile taxa decreased from 10.5 percent in July to 4.2 percent in August).

Metals

No abnormal cells were found in either month. In July 7.3 percent were found to be tolerant to metals but the percentage decreased to 3.5 percent by August.

4.6.5 Sediment Bioassays

Hyalella azteca

Mortality and growth results for HC-MCL test sediment did not exceed SCO or CSL criteria (Table 11) and no significant difference was observed for the test sediment relative to the control, thus passing overall.

Chironomus dilutus

Test sediment from HC-MCL passed the mortality test, but failed to meet the SCO criteria for the 20-day growth test (0.75 SCO; 0.72 observed value); it was also well below the CSL growth criteria (0.6 CSL). The difference was found to be statistically significant (p = 0.057).

4.6.6 Sediment Chemistry

Several chemicals in sediment samples taken in August from HC-MCL exceeded ARAR criteria. Arsenic (743 mg/kg; Table 12) and silver (3.4 mg/kg) exceeded ARAR limits for both SCO and CSL. Cadmium (2.3 mg/kg) and nickel (80 mg/kg) exceeded ARAR limits for SCO, but were below the CSL.

Acid volatile sulfides and sulfide were detected for sediment samples at 3.26 mg/kg and 4 mg/kg, respectively. All remaining constituents were within detectable range but did not exceed any screening criteria; sediment pH was 5.84.

4.6.7 Surface Water Chemistry

In August, fluoride was below detection limits, while chloride was at a concentration of 0.3 mg/L and sulfate measured 2.1 mg/L (Table 13). Total alkalinity was 11.3 mg/L in the form of bicarbonate.

Total Metals

In both July and August, arsenic (11.8 µg/L in July and 30.4 µg/L in August; Table 13) exceeded ARAR criteria for protection of human health for consumption of water and organisms.

Aluminum, beryllium, chromium, cobalt, nickel, selenium, thallium, and vanadium all were at or below detection limits in both July and August for total metal water samples. Nickel, thallium, zinc and calcium carbonate all were below detection limits in July, but had increased to within detectable ranges by August. Aluminum was above detectable limits in July (40 µg/L), but below the detectable range by August. All other constituents were within the detectable range but did not exceed any screening criteria.

Dissolved Metals

No dissolved metals exceeded ARAR criteria for protection of aquatic organisms from chronic effects (Table 13).

Aluminum, beryllium, chromium, cobalt, nickel, selenium, thallium, and vanadium all were at or below detection limits in both July and August dissolved metal water samples. Iron, lead, zinc, and calcium carbonate were at or below detection limits in July but by August had increased to within detectable range. Copper was above the detection limit in July (0.5 µg/L), but had decreased below the detectable range by August. There was a general increase in concentration between the two sampling events for the remaining constituents.

4.7 HC-SFSR-09

On the morning of August 28, 2013, we drove to HC-SFSR-09, downstream of Monte Cristo Lake and upstream of the confluence with Elliot Creek (Figure 4). The channel was wider than five meters and flow was elevated due to heavy rain the previous night, so two people conducted the snorkel survey from downstream to upstream. Then, rocks were collected for periphyton sampling and locations were flagged for kick-net samples. Then, sediment was collected while macroinvertebrates were collected and periphyton was processed. Finally, surface water samples were collected and habitat assessment forms completed. A summary of all detailed location information, water quality, and instream feature measurements are in Table 6. Photographs 34 through 37 and field data sheets are on pages A-121 through A-131 in Appendix A.

4.7.1 Habitat Characterization

The reach consisted of riffles (40 percent of the reach) and several large pools (60 percent). As shown in Photographs 34 and 35 (Appendix A), the left bank showed signs of significant erosion. The riparian zone was dominated by deciduous trees and shrubs: black cottonwood (*Populus trichocarpa*), red alder, vine maple, and red cedar. There was no LWD visible within the reach and minimal aquatic vegetation (3 percent of the reach; Photograph 37 in Appendix A) in the form of attached algae on some of the larger boulders. The substrate was dominated by boulders and cobbles, but gravel and sand were present as well (Figure 3).

Based on the slope (6 percent) and the channel form, this reach can be classified as an A type stream (based on Rosgen 1994), which is considered high gradient. The conditions assessed in the field for each habitat parameter are listed below:

1. Epifaunal Substrate/Available Cover: Optimal
2. Embeddedness: Optimal
3. Velocity/Depth Regime: Optimal
4. Sediment Deposition: Suboptimal
5. Channel Flow Status: Marginal
6. Channel Alteration: Optimal
7. Frequency of Riffles (or bends): Optimal
8. Bank Stability (each bank scored separately): Optimal/Marginal (right/left banks)
9. Vegetative Protection (by bank): Optimal (both banks)
10. Riparian Vegetative Zone Width (by bank): Optimal (both banks)

In general, this sampling reach would be considered suboptimal for habitat quality. This site scored 151 out of 200 points in October 2012, and 168 out of 200 points in August 2013. The increased score may be primarily due to improvements in riffle frequency, epifaunal substrate, and velocity/depth regime.

4.7.2 Fish

The snorkel survey was conducted by two snorkelers from downstream to upstream due to high water velocity. A total of 23 fish (rainbow trout and unidentified salmonid) were observed in August 2013 (Table 7). Rainbow trout was the most frequently seen species; 22 individuals were observed. All of the rainbow trout were juveniles less than 200 millimeters. A single unidentified salmonid was observed that was less than 50 millimeters. Water at this site was very turbid and fast moving due to heavy rains over the previous 24 hours, which severely restricted observer visibility. Water clarity improved during the time we were sampling the site and a bull trout (size not documented) was observed swimming upstream through the reach at approximately noon.

4.7.3 Macroinvertebrates

HC-SFSR-09 had excellent biotic integrity, with a score of 46 out of 50 over ten core metrics (Table 8). The HBI rated it as having excellent biotic integrity (Table 9). Invertebrate abundance was low (541.7 per square meter) when the site was sampled in August. Outside of the ten core B-IBI metrics, scraper and shredder richness at this site were low relative to other sites, and parasites (*Oreogeton* spp.) were present. However, the site performed fair to moderately well in most other metrics.

4.7.4 Periphyton

During the snorkel survey, thick mats of algae or cyanobacteria were observed in pools at this site. Areal chlorophyll *a* biomass was 2.15 milligrams per square meter in August. Overall periphyton density at HC-SFSR-09 was 43,201 cells per square centimeter. Of this, 21.7 percent were diatom taxa, while the remaining 78.3 percent were non-diatom taxa in the phyla Chlorophyta (*Stigeoclonium* spp.) and Cyanophyta (*Phormidium* spp.) (Table 10).

Community Structure

Shannon's H measure of diatom diversity was 1.7, and diatom species richness was 25. The dominant diatom species was *A. minutissimum* (76.7 percent of diatoms).

Nutrients and Sediment

Among diatoms, 6.7 percent were from a functional group that indicates nutrient rich, eutrophic water (eutraphentic). Additionally, 9.2 percent of diatoms were tolerant of low-oxygen conditions and decomposing organic matter (polysaprobous). The pollution index for the site was 2.85. Very few siltation taxa (0.3 percent) were present within the site, and very few motile taxa (0.8 percent) were present.

Metals

Very few cells were found to be abnormal (0.2 percent), and 10.83 percent were found to be tolerant to metals.

4.7.5 Sediment Bioassays

Hyalella azteca

Mortality and growth results for HC-SFSR-09 test sediment did not exceed SCO or CSL criteria (Table 11) and no significant difference was observed for the test sediment relative to the control, thus passing overall.

Chironomus dilutus

There was adequate growth and survival (met SCO and CSL criteria) in the HC-SFSR-09 test sediment, thus passing overall.

4.7.6 Sediment Chemistry

Arsenic in sediment samples collected in August from HC-SFSR-09 (92 mg/kg; Table 12) exceeded ARAR limits for SCO, but was still below the CSL. Nickel also exceeded the ARAR limits for SCO (42 mg/kg), but was below the CSL.

Acid volatile sulfides and sulfide were below detection limits for sediment samples. All remaining constituents were within detectable range and sediment pH was 6.68.

4.7.7 Surface Water Chemistry

In August, fluoride was below detection limits, while chloride was at 0.3 mg/L and sulfate was at a concentration of 2.1 mg/L (Table 13). Total alkalinity was 11.3 mg/L in the form of bicarbonate.

Total Metals

Arsenic (26.3 µg/L; Table 13) exceeded ARAR criteria for protection of human health for consumption of water and organisms.

Beryllium, chromium, cobalt, nickel, selenium, and thallium were at or below detection limits for total metal water samples. All other constituents were within the detectable range.

Dissolved Metals

No dissolved metals exceeded ARAR criteria for protection of aquatic organisms from chronic effects (Table 13).

Aluminum, beryllium, chromium, cobalt, copper, nickel, selenium, thallium, and vanadium all were at or below detection limits in dissolved metal water samples. The remaining constituents were all within detectable range.

5.0 DISCUSSION

5.1 HC-GC-01

Glacier Falls was suspected to be a migration barrier for fish and no fish were seen at HC-GC-01 during snorkel surveys in either July or August. The benthic biological integrity appeared to be moderately impaired at HC-GC-01; however, the lower B-IBI density scores and low periphyton density may be largely influenced by the physical habitat. Extremely cold water temperatures (2.2 degrees Celsius in July, 5.5 degrees Celsius in August), lingering snow, and evidence of frequent disturbance (i.e., scars from rockslides were apparent in the surrounding valley) may make this site naturally poor habitat for benthic macroinvertebrates and periphyton. In fact, motile periphyton taxa are indicators of unstable substrate and the proportion of these was especially high in July. It is interesting to note that in July, HC-GC-01 also had relatively high abundances of periphyton tolerant to heavy metals, acid runoff, and inorganic nitrogen. Given the absence of known mines upstream of this reach, the source of any contamination would likely be naturally occurring and entering the stream in the form of landslides and snowmelt.

Toxicity test results passed SMS criteria for all four endpoints (28-day mortality and growth for *H. azteca* and 20-day mortality and growth for *C. dilutus*), indicating either lack of bioavailability or non-toxic levels of heavy metals. Sediment chemistry only exceeded SCO criteria for arsenic, though it met CSL criteria and occurred in the lowest concentration across all sites (Figure 5). Sediment was relatively scarce at this site; the substrate was dominated by boulders and cobbles. This site appears to be fairly dynamic, so sediment likely moves through the system quickly with very little settling. Surface water at HC-GC-01 exceeded lowest ARAR criteria for total arsenic in both July and August, but did not exceed any dissolved metals criteria for protection of aquatic organisms.

5.2 HC-GC-05

Juvenile bull trout were common at HC-GC-05, and the macroinvertebrate metrics indicated the site had good biological integrity. In addition, the site had extremely low density of periphyton taxa that were tolerant to metals, acid runoff, or nutrient load. Also, sediment toxicity test results passed for all four endpoints. The biotic results are somewhat surprising, given that HC-GC-05 is in close proximity and downstream of Mystery Mine and Justice Mine, both of which have documented adit drainage. Sediment chemistry exceeded both SCO and CSL criteria for arsenic. The site also exceeded surface water ARAR criteria for total and dissolved arsenic, as well as dissolved lead.

After talking to Chad Larson (Ecology Environmental Assessment Program; January 16, 2014), we understand the use of periphyton as a predictive tool for habitat quality is still in preliminary development. Therefore, it is unclear what, if any, conclusions we can draw from the relationship between periphyton results and chemistry. Even more puzzling is the dissonance between B-IBI metrics and chemistry. HC-GC-05 had the highest abundance of intolerant benthic taxa, and very few tolerant benthic taxa. The substrate is dominated by boulders and large cobbles, so it may be that the scarcity of sediment at this site limits benthic invertebrate and periphyton exposure to chemicals.

5.3 HC-76-02

No fish were seen in HC-76-02 during snorkel surveys, which may be due to the steep, narrow channel and lack of velocity refuge. This site was only sampled in August and may support fish during other times of the year. This site appears to have moderately impaired benthic biological integrity, but similar to HC-GC-01, the lower B-IBI density scores and low periphyton density may be influenced by the physical habitat. The high gradient of HC-76-02, combined with its steep and narrow valley walls, may generate high velocity flows during periods of high discharge that effectively scour macroinvertebrates and periphyton from the reach. The overwhelming dominance of *A. minutissimum* among the periphyton suggests severe disturbance at HC-76-02, as this taxa often colonizes a recently disturbed site to the exclusion of other taxa (EPA 1999). Very few periphyton taxa were found to be tolerant of heavy metal contamination or acid runoff at HC-76-02.

Toxicity testing at HC-76-02 passed three of the four endpoints, but failed to meet the 20-day mortality SCO criteria for chironomids. However, the result did meet the CSL and was not statistically significant ($p \leq 0.05$). Sediment lowest ARAR criteria were also exceeded for arsenic, though sediment was quite scarce; the substrate was overwhelmingly dominated by boulders (Figure 3). Surface water lowest ARAR exceedances were recorded for arsenic (total metals), as well as zinc (dissolved metals).

5.4 HC-SFSR-03

Several species of salmonids were observed during snorkel surveys in both July and August, including juvenile bull trout. This site was found to have moderately impaired biological integrity, though this seems to shift seasonally to be more impaired in late summer. It had the highest density of benthic macroinvertebrates, but it appeared to be dominated by only three taxa: *Orthocladius* (a chironomid), *Epeorus*, and *Neophylax* by August. The August sample also had one of the highest proportion of collector taxa (second only to HC-MCL), which may be influenced by the filamentous algae seen throughout the site at that time.

This site had obvious human disturbance; a road was visible just downstream of the reach with some stream bank erosion, and metal from an old railroad track is visible jutting out of the bank at the end of the reach. In August, HC-SFSR-03 had the highest density of periphyton that were tolerant of heavy metal contamination of all the sites examined, suggesting this site may be impacted by mining activity. Similar to HC-76-02, *A. minutissimum* was the dominant periphtyon, occurring at levels that suggest moderate disturbance. It is also worth noting that this site had a relatively high percentage of polysaprobic taxa in August, suggesting that the site may have been impacted by organic nutrient load to some degree.

Sediment was more readily available at this site compared with most others, built up behind riffles and observed in the interstitial space in the gravel-cobble substrate. Sediment from HC-SFSR-03 passed all four toxicity test endpoints. However, sediment exceeded lowest ARAR criteria for arsenic. Surface water lowest ARAR exceedances were recorded only for total arsenic.

5.5 HC-SFSR-07

HC-SFSR-07 had excellent benthic biological integrity for macroinvertebrates, and several species of fish were abundant during the August survey (Table 7). However, periphyton results show some indicators of disturbance. The dominance of *A. minutissimum* suggests severe disturbance at this site. Furthermore, HC-SFSR-07 had the lowest diatom diversity of all the sites sampled. The rarity of taxa tolerant to heavy metals and acid runoff suggests that any disturbance at this site is likely due to natural scour during high flows.

Toxicity tests passed for all four endpoints, a positive indicator of sediment quality. For sediment chemistry, lowest ARAR criteria were exceeded for arsenic and silver, though the scarcity of sediment at this site may limit chemical exposure to benthic biota and periphyton; the substrate is dominated by boulders and large cobbles (Figure 3). Surface water exceeded lowest ARAR criteria for total arsenic, but the abundant population of resident juvenile fish may indicate relatively high water quality.

5.6 HC-MCL

Fish were nearly absent at HC-MCL during snorkel surveys in July, though several were observed during August, including approximately 60 adult bull trout migrating through the area before spawning (Table 7). While the site was highly used by fish in late summer, HC-MCL was the most biologically impaired site in terms of benthic macroinvertebrate and periphyton communities. It was also the most physically unique, as it was a low-gradient, lower velocity reach with fine sediment substrate (Figure 3). This physical habitat difference is reflected in its relatively high percent composition of oligochaetes, collector taxa, and motile periphyton, and low scraper, shredder, and clinger richness. The habitat and substrate at HC-MCL are so different from a typical montane stream that the macroinvertebrate results may underestimate the biotic integrity of this site. However, the extremely low benthic macroinvertebrate density is troubling, as is the scarcity or absence of EPT taxa, long-lived taxa, and intolerant invertebrate taxa. The dominance of *A. minutissimum* among the periphyton is significant, as this species is an indicator of disturbance. For example, according to Barbour et al. (EPA 1999) this taxon is frequently dominant in streams subjected to acid mine drainage. The dominance of this taxon may be an indicator of moderate to severe disturbance. In addition, the moderate abundance of periphyton taxa tolerant to metals (especially in July) suggests that heavy metal or acidic runoff from mining activities may have impacted this site.

HC-MCL failed the 20-day chironomid growth bioassay for SCO criteria, but the results met the CSL criteria and were not statistically significant.

Chemical analysis of the sediment from HC-MCL showed it was the most acidic (pH 5.84) of all the sites, and also had the highest concentration of arsenic, which exceeded both the SCO and CSL criteria. Silver exceeded the SCO and CSL, and nickel exceeded SCO criteria. In general, sediment at HC-MCL had a high load of heavy metals relative to other sites (Table 12). The site was characterized by slow, deep pools with a soft sediment substrate; sediment from upstream appeared to settle here and historical records indicate the lake may have been as deep as 30 feet in the early 1900s. Therefore, heavy metals may enter the food chain at this site through benthic biota. Surface water from HC-MCL had the highest concentrations and exceeded lowest ARAR criteria for total arsenic of all sites sampled. However, HC-MCL did not exceed the lowest ARAR criteria for protection of aquatic organisms from chronic effects for any of the dissolved metals.

5.7 HC-SFSR-09

Although visibility was low due to heavy rain, many rainbow trout were observed at HC-SFSR-09. This site also had excellent benthic biological integrity in regards to the B-IBI. However, like HC-SFSR-07, the periphyton results showed some indicators of disturbance. The dominance of *A. minutissimum* may suggest severe disturbance at this site. There was a relatively high abundance of periphyton taxa tolerant to heavy metals, as well as polysaprobic and eutrophic conditions. These results suggest that HC-SFSR-09 may have been impacted by mining activity and nutrient load.

Bioassay results indicate no adverse effects for any of the four endpoints. For sediment chemistry, arsenic and nickel exceeded SCO criteria, but were below the CSL criteria. Surface water lowest ARAR criteria were exceeded for total arsenic (Table 13). The upstream end of the site has a large, slow moving pool with a soft sediment substrate; then it flows over a series of fast-moving, boulder dominated riffles and cascades into a smaller lower pool. Similar to HC-MCL, the increased availability of soft sediment to biota in the pools may increase the risk of heavy metals entering the food chain.

6.0 CONCLUSIONS

Metals concentrations in sediment generally increased with distance downstream (Figure 5). This relationship is intuitive; as flow velocities decrease, suspended sediment settles out. When flow velocities increase, stream beds are scoured and become sediment-deprived. With the exception of HC-MCL and a small portion of HC-SFSR-09, sites were dominated by boulders and large cobbles, which were colonized by periphyton and benthic invertebrates; sediment was in rare, isolated pockets.

As a result, sites with less sediment generally had better biotic integrity than sites with more sediment, though physical factors such as flow, channel type, and disturbance interacted to make that relationship much more complex.

Biotic metrics seemed most sensitive to sediment contamination and less so to water column contamination. Fish were observed in most of the reaches expected to support fish, an indication they were able to successfully inhabit and feed in these sampling reaches. There is currently no standard assessment for periphyton similar to the B-IBI, and often there were conflicting results for various indicators within a site.

And while all sites exceeded SCO criteria for arsenic and most exceeded CSL criteria, the availability of the sediment to biota must be considered. The toxicity test result for five of the seven locations indicated no adverse effects were expected (e.g., met SCO) for all four endpoints. Two of the sites failed one endpoint each at the SCO, but the results were not statistically significant and they met the CSL, indicating no significant adverse effects were expected. Therefore, bioassay results may indicate a lack of bioavailability or non-toxic concentrations of heavy metals within the sediment.

The dual purpose of this report is to describe the physical habitat, biotic communities, and sediment and water quality for sampling reaches that may be impacted by historical discharge of mine tailings and adit water, and to establish baseline conditions prior to the planned mine waste removal action by the USDA Forest Service. The reference location (HC-GC-01) was designed as an environmental reference, not for comparison to the six sample locations. This reach will be sampled at the same time as the sample locations to help isolate changes in conditions at mine-impacted reaches from the variable effects of seasonal low or high flow. These data were collected to establish baseline conditions prior to the removal action and were not intended for comparisons with sites outside of this study. Because this is the first year of data collection, no time series data were presented and there were no changes or impacts to report. Subsequent monitoring reports will address any changes to physical habitat, biotic communities, and water and sediment quality.

7.0 USE OF THIS REPORT

Work for this project was performed, and this report prepared, in accordance with generally accepted professional practices for the nature and conditions of the work completed in the same or similar localities at the time the work was performed. It is intended for the exclusive use of the Washington State Department of Ecology for specific application to the referenced site. This report is not meant to represent a legal opinion. No other warranty, express or implied, is made.

The information in this report is intended to be used to determine whether the site has released or has a potential to release hazardous substances to the environment at concentrations above Model Toxics Control Act human health or ecological screening levels.

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TABLES

Table 3 – Potential Chemical-Specific ARARs and Proposed Screening Criteria for Sediment

Constituents of Concern (mg/kg)	Lowest Potential Sediment ARAR (a)	State of Washington Sediment Management Standards (b)		Sediment Quality Assessment Guidelines (c)	
		SCO (a)	CSL (a)	TEL	PEL
Aluminum (Al)	--	--	--	--	--
Antimony (Sb)	--	--	--	--	--
Arsenic (As)	14	14	120	5.9	17
Barium (Ba)	--	--	--	--	--
Beryllium (Be)	--	--	--	--	--
Cadmium (Cd)	2.1	2.1	5.4	0.596	3.53
Calcium (Ca)	--	--	--	--	--
Chromium (Cr)	72	72	88	37.3	90
Cobalt (Co)	--	--	--	--	--
Copper (Cu)	400	400	1,200	35.7	197
Iron (Fe)	--	--	--	--	--
Lead (Pb)	360	360	>1,300	35	91.3
Magnesium (Mg)	--	--	--	--	--
Manganese (Mn)	--	--	--	--	--
Mercury (Hg, inorganic)	0.66	0.66	0.8	0.174	0.486
Nickel (Ni)	26	26	110	18	36
Potassium (K)	--	--	--	--	--
Selenium (Se)	11	11	>20	--	--
Silver (Ag)	0.57	0.57	1.7	--	--
Sodium (Na)	--	--	--	--	--
Thallium (Th)	--	--	--	--	--
Vanadium (Va)	--	--	--	--	--
Zinc (Zn)	3,200	3,200	>4,200	123	315

Notes:

(a) Shaded cells identify lowest potential chemical-specific Applicable or Relevant and Appropriate Requirement (ARAR)

(b) Sediment Cleanup Objectives (SCO) and Cleanup Screening Levels (CSLs) as listed for WAC 173-204-563 in Ecology Sediment Management Standards (SMS; 2013). SCO represents a screening level for no adverse effects to the benthic community. CSL represents a screening level where minor adverse effects level are assumed and above which cleanup may be required

(c) From MacDonald et al. 2000; values are not ARARs and are provided for comparison purposes only

-- Not established or not applicable

Table 4 – Quality Assurance and Adverse Effects Levels for Biological Tests

Biological Test/Endpoint	**Performance Standard**	**Sediment Cleanup Objective (SCO)**	**Cleanup Screening Level (CSL)**
	Control		
Hyalella azteca			
10-day mortality	$M_C < 20\%$	$M_T - M_C > 15\%$ [a]	$M_T - M_C > 25\%$
28-day mortality	$M_C < 20\%$	$M_T - M_C > 10\%$	$M_T - M_C > 25\%$
28-day growth	$MIG_C \geq 0.15$ mg/individual	$(MIG_C - MIG_T) / MIG_C > 0.25$	$(MIG_C - MIG_T) / MIG_C > 0.40$
Chironomus dilutus			
10-day mortality	$M_C < 30\%$	$M_T - M_C > 20\%$	$M_T - M_C > 30\%$
10-day growth	$MIG_C \geq 0.48$ mg/individual	$MIG_T / MIG_C < 0.8$	$MIG_T / MIG_C < 0.7$
20-day mortality	$M_C < 32\%$	$M_T - M_C > 15\%$	$M_T - M_C > 25\%$
20-day growth	$MIG_C \geq 0.60$ mg/individual	$(MIG_C - MIG_T) / MIG_C > 0.25$	$(MIG_C - MIG_T) / MIG_C > 0.40$

Notes:

Criteria are from Chapter 70.105D RCW, WAC 173-204-563 Table VII, effective September 1, 2013

An exceedance of the SCO and CSL requires statistical significance at $p < 0.05$. Bioassay procedures will consider use of a control (instead of a reference sample). Comparison of test sediments to control is shown for SCO and CSL since it is rare to find appropriate reference sites

(a) For example, the observed effect is required to be both statistically significant ($p \leq 0.05$) and greater than 15% mortality above the control to be considered a positive indication of toxicity (hit)

M = mortality

C = control

R = reference

T = test

F = final

MIG = mean individual growth at time final

mg = milligrams

Table 5 – Potential Chemical-Specific ARARs and Proposed Screening Criteria for Surface Water

Constituents of Concern	Lowest Potential Surface Water ARAR (a)	State of Washington				Federal							
		Water Quality Standards for Surface Waters (b)		MTCA Method B Cleanup Levels [WAC 173-340-730] (c)		National Recommended Water Quality Criteria [Section 304 of the Clean Water Act] (d)				National Toxics Rule Criteria [40 CFR 131.36(b)(1)] (e)			
		Protection of Aquatic Organisms		Protection of Human Health		Protection of Aquatic Organisms		Protection of Human Health		Protection of Aquatic Organisms		Protection of Human Health	
		Acute	Chronic	Method B, Carcinogen	Method B, Non-Carcinogen	Acute	Chronic	Consumption of Water and Organism	Consumption of Organism Only	Acute	Chronic	Consumption of Water and Organism	Consumption of Organism Only
				Consumption of Organism Only									
Total Metals in µg/L													
Aluminum (Al)	--	--	--	--	--	--	--	--	--	--	--	--	--
Antimony (Sb)	5.6	--	--	--	1,040	--	--	5.6	640	--	--	14	4,300
Arsenic (As)	0.018	--	--	0.098	17.7	--	--	0.018	0.14	--	--	0.018	0.14
Barium (Ba)	1,000	--	--	--	--	--	--	1,000	--	--	--	--	--
Beryllium (Be)	273	--	--	--	273	--	--	--	--	--	--	--	--
Boron (B)	--	--	--	--	--	--	--	--	--	--	--	--	--
Cadmium (Cd)	41	--	--	--	40.5	--	--	--	--	--	--	--	--
Chromium (total) (Cr)	--	--	--	--	--	--	--	--	--	--	--	--	--
Chromium(III) (Cr)	57	180	57	--	243,000	--	--	--	--	--	57	--	--
Chromium(VI) (Cr)	486	--	--	--	486	--	--	--	--	--	--	--	--
Copper (Cu)	2,880	--	--	--	2,880	--	--	--	--	--	--	--	--
Iron (Fe)	300	--	--	--	--	--	--	300	--	--	--	--	--
Lead (Pb)	--	--	--	--	--	--	--	--	--	--	--	--	--
Manganese (Mn)	50	--	--	--	--	--	--	50	100	--	--	--	--
Mercury (Hg)	0.012	--	0.012	--	--	--	0.77	--	0.3	--	0.77	0.14	0.15
Molybdenum (Mo)	--	--	--	--	--	--	--	--	--	--	--	--	--
Nickel (Ni)	610	--	--	--	1,100	--	--	610	4,600	--	--	610	4,600
Selenium (Se)	5	20	5	--	2,700	--	5	170	4,200	--	5	--	--
Silver (Ag)	25,900	--	--	--	25,900	--	--	--	--	--	--	--	--
Thallium (Th)	0.24	--	--	--	--	--	--	0.24	0.47	--	--	1.7	6.3
Tin (Sn)	--	--	--	--	--	--	--	--	--	--	--	--	--
Vanadium (Va)	--	--	--	--	--	--	--	--	--	--	--	--	--
Zinc (Zn)	7,400	--	--	--	16,500	--	--	7,400	26,000	--	--	--	--
Dissolved Metals in µg/L													
Aluminum (Al)	87	--	--	--	--	750	87	--	--	--	--	--	--
Antimony (Sb)	--	--	--	--	--	--	--	--	--	--	--	--	--
Arsenic (As)	150	360	190	--	--	340	150	--	--	340	150	--	--
Barium (Ba)	--	--	--	--	--	--	--	--	--	--	--	--	--
Beryllium (Be)	--	--	--	--	--	--	--	--	--	--	--	--	--
Boron (B)	--	--	--	--	--	--	--	--	--	--	--	--	--
Cadmium (Cd)	0.094	0.82	0.37	--	--	0.5	0.094	--	--	0.82	0.37	--	--
Chromium (total) (Cr)	--	--	--	--	--	--	--	--	--	--	--	--	--
Chromium(III) (Cr)	24	--	--	--	--	180	24	--	--	180	--	--	--
Chromium(VI) (Cr)	10	15	10	--	--	16	11	--	--	16	11	--	--
Copper (Cu)	2.7	4.6	3.5	--	--	3.6	2.7	--	--	4.6	3.5	--	--
Iron (Fe)	1,000	--	--	--	--	--	1,000	--	--	--	--	--	--
Lead (Pb)	0.54	14.0	0.54	--	--	13.9	0.54	--	--	14.0	0.54	--	--
Manganese (Mn)	--	--	--	--	--	--	--	--	--	--	--	--	--
Mercury (Hg)	0.54	2.1	--	--	--	1.4	--	--	--	0.54	--	--	--
Molybdenum (Mo)	--	--	--	--	--	--	--	--	--	--	--	--	--
Nickel (Ni)	16	440	49.0	--	--	145	16	--	--	440	49	--	--
Selenium (Se)	--	--	--	--	--	--	--	--	--	--	--	--	--
Silver (Ag)	0.32	0.32	--	--	--	0.32	--	--	--	0.32	--	--	--
Thallium (Th)	--	--	--	--	--	--	--	--	--	--	--	--	--
Tin (Sn)	--	--	--	--	--	--	--	--	--	--	--	--	--
Vanadium (Va)	--	--	--	--	--	--	--	--	--	--	--	--	--
Zinc (Zn)	32	35	32	--	--	36	36	--	--	35	32	--	--

Notes:
Underlined values require hardness correction specific to the sample data. Hardness-dependent criteria were calculated using a hardness of 25 mg/L because all site values measured less than 25 mg/L
(a) Shaded cells identify lowest potential chemical-specific Applicable or Relevant and Appropriate Requirement (ARAR)
(b) Chapter 173-201A WAC. Water Quality Standards for Surface Waters of the State of Washington (Last update November 20, 2006)
(c) Chapter 173-340-730 WAC. MTCA Method B surface water cleanup levels. For carcinogenic constituents, the value presented is the lower of the non-carcinogenic and carcinogenic level calculated using Equations 730-1 and 730-2 and information from CLARC 3.1, unless otherwise noted
(d) Water quality criteria published under Section 304 of the Clean Water Act. EPA, National Recommended Water Quality Criteria, 2006
(e) National Toxics Rule. 40 CFR 131.36(b)(1)
-- Not established or not applicable
mg/L = milligrams per liter

Table 6 – Detailed Sampling Reach Measurements

	Sample Location and Date									
	HC-GC-01		HC-GC-05	HC-76-02	HC-SFSR-03		HC-SFSR-07	HC-MCL		HC-SFSR-09
	7/9/2013	8/24/2013	8/25/2013	8/26/2013	7/10/2013	8/23/2013	8/22/2013	7/8/2013	8/27/2013	8/28/2013
Latitude	965587.41	965587.41	968203.77	967597.08	972886.66	972886.66	986404.49	993608.94	993608.94	994803.36
Longitude	1430086.32	1430086.32	1423450.64	1422123.50	1415089.68	1415089.68	1411411.62	1412947.30	1412947.30	1414520.91
Altitude (feet)	4,482	4,482	2,873	2,931	2,448	2,448	2,172	1,954	1,954	1,800
Slope (degree)	10	10	9	13	3	3	4	0	0	6
Rivermile	0.24	0.24	2	1.2	3.9	3.9	7.4	9.1	9.1	9.7
Instream Features										
Length (m)	100	100	100	100	103	--	100	105	100	100
Width (m)	10	5.79	6.7	3.5	16.5	10.67	10	45.7	26.82	9.906
Area (m^2)	1000	579	670	350	1699.5	--	1000	4798.5	2682	990.6
Depth (m)	0.3	0.25	0.5	0.6	0.46	--	0.15	2	--	1
Velocity (m/sec)	0.7	0.73	0.76	0.6	0.63	0.37	0.9	--	0.11	0.76
LWD (m^2)	0	1	30	19	101	36	5	152.4	60	0
LWD density (m^2/km^2)	0.00	1.73	44.78	54.29	59.43	--	5.00	31.76	22.37	0.00
High water (m)	1						0.5	0.3	1	3
Stream Morphology										
Riffle (%)	0	100	60	50	50	70	20	0	0	40
Run (%)	0	0	0	0	0	0	70	80	15	0
Pool (%)	5	0	40	50	50	30	10	20	85	60
Cascade (%)	95	0	0	0	0	0	0	0	0	0
Water Quality [a]										
Temperature (degrees C)	2.33	5.5 [b]	9.8 [b]	8.3 [b]	7.48	10.4	13.3 [b]	10.14	14.7 [b]	13.6 [b]
Specific Conductance (µS/cm)	0.01	21 [b]	26 / 14 [c]	0.029 / 0.017 [c]	0.011	0.029 / 0.016 [c]	0.04 [b]	0.016	0.043 / 0.025 [c]	0.043 [b]
Dissolved Oxygen (mg/L)	15.54	10.71 [b]	10.96 [b]	10.93 [b]	15.49	10.59	10.4 [b]	18.83	9.85 [b]	10.69 [b]
pH	6.31	5.65 / 7.4 [c]	5.55 / 7.4 [c]	6.7 / 7.42 [c]	5.91	5.55 / 6.64 [c]	7.4 [b]	5.88	5.57 / 7.2 [c]	6 [b]
Turbidity (NTU)	1.5	--	--	--	0	<5	--	2.4	--	--

Notes:

(a) Water quality measured with Horiba U-50 unless otherwise noted

(b) Water quality measured with Horiba U-22 only

(c) Water quality measured with Horiba U-22 / Hach

m = meter

m^2 = square meter

m/sec = meters per second

m^2/km^2 = square meter per square kilometer

C = Celcius

µS/cm = microsiemens per centimeter

NTU = nephelometic turbitidy unit

Table 7 – Fish Observed in Snorkel Surveys

		Sample Location and Date									
		HC-GC-01		HC-GC-05	HC-76-02	HC-SFSR-03		HC-SFSR-07	HC-MCL		HC-SFSR-09
Species	**Size Class**	**7/9/2013**	**8/24/2013**	**8/25/2013**	**8/26/2013**	**7/10/2013**	**8/23/2013**	**8/22/2013**	**7/8/2013**	**8/27/2013**	**8/28/2013**
Bull trout	0-50 mm			2							
	51-80 mm					1		2			
	80-100 mm					2		2			
	100-120 mm			1			2	1			
	120-150 mm			4			1				
	150-200 mm			1		1					
	200-250 mm			2			1				
	>250 mm									57	
Cutthroat trout	51-80 mm							1			
	150-200 mm					1					
Rainbow trout	0-50 mm							12		1	
	51-80 mm										3
	80-100 mm							12	2	2	1
	100-120 mm							12		4	2
	120-150 mm							16		2	8
	150-200 mm					1		9			8
	200-250 mm							6			
	>250 mm							3			
Unid. salmonid	0-50 mm					1					1
	51-80 mm							3		1	
	80-100 mm								1		
	100-120 mm						2				
Grand Total		0	0	10	0	7	6	79	3	67	23

Notes:
mm = millimeters

Table 8 – Benthic Index of Biotic Integrity (B-IBI) Metrics

	Sample Location and Date																			
	HC-GC-01				HC-GC-05		HC-76-02		HC-SFSR-03				HC-SFSR-07		HC-MCL				HC-SFSR-09	
	7/9/2013		8/24/2013		8/25/2013		8/26/2013		7/10/2013		8/23/2013		8/22/2013		7/8/2013		8/27/2013		8/28/2013	
	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score
Tolerant Percent	0.0	5	0.0	5	0.9	5	0.0	5	0.2	5	0.2	5	0.0	5	0.0	5	0.0	5	5.1	5
Predator Percent	17.0	3	9.8	1	8.0	1	18.1	3	11.0	3	3.8	1	29.4	5	33.3	5	28.6	5	34.4	5
Dominance Percent	61.26	3	37.78	5	65.03	3	54.38	3	45.53	5	62.59	3	37.63	5	33.33	5	38.10	5	40.56	5
Total Taxa	28	3	31	3	41	5	33	3	31	3	28	3	34	3	11	1	13	1	40	3
Total Ephemeroptera	5	3	5	3	6	3	4	1	6	3	6	3	9	5	1	1	0	1	9	5
Total Plecoptera	4	3	7	3	10	5	8	5	5	3	6	3	7	3	0	1	0	1	6	3
Total Trichoptera	5	3	5	3	9	3	7	3	5	3	5	3	10	5	0	1	1	1	10	5
Total Longlived	5	5	7	5	12	5	10	5	6	5	4	3	6	5	0	1	1	1	11	5
Total Intolerant	7	5	6	5	9	5	6	5	8	5	7	5	9	5	0	1	0	1	13	5
Total Clinger	12	3	14	3	21	5	17	3	14	3	14	3	23	5	0	1	2	1	26	5
B-IBI Score [a]		36		36		40		36		38		32		46		22		22		46.0
PSSB Rating [a]	FAIR		FAIR		GOOD		FAIR		GOOD		FAIR		EXCELLENT		POOR		POOR		EXCELLENT	

Notes:

(a) Scored using species genus (fine) scale from Puget Sound Stream Benthos

	Total B-IBI Score
Excellent	46-50
Very good	45
Good	38-44
Fairly good	37
Fair	28-36
Fairly poor	26-27
Poor	18-25
Poor/very poor	17
Very poor	10-16

Table 9 – Additional Macroinvertebrate Metrics

		Sample Location and Date									
		HC-GC-01		HC-GC-05	HC-76-02	HC-SFSR-03		HC-SFSR-07	HC-MCL		HC-SFSR-09
		7/9/2013	8/24/2013	8/25/2013	8/26/2013	7/10/2013	8/23/2013	8/22/2013	7/8/2013	8/27/2013	8/28/2013
Total Abundance [a] (#/m^2)		505.6	1,400.0	2,283.3	683.3	1,944.4	5,572.9	268.1	185.0	323.8	541.7
EPT Richness [b]	H	14.0	17.0	25.0	19.0	16.0	17.0	26.0	1.0	1.0	25.0
Predator Richness [b]	H	7.0	9.0	9.0	12.0	10.0	8.0	16.0	5.0	4.0	19.0
Scraper Richness [b]	H	6.0	6.0	11.0	7.0	7.0	6.0	5.0	1.0	1.0	5.0
Shredder Richness [b]	H	4.0	5.0	9.0	5.0	2.0	5.0	2.0	1.0	0.0	4.0
Intolerant Taxa Percent [a]	H	51.1	28.0	54.5	47.6	42.9	33.8	36.1	0.0	0.0	33.9
Hilsenhoff Biotic Index [c] (HBI)	L	1.3	3.0	0.6	2.2	2.6	3.9	1.9	5.8	5.3	3.0
Collector Percent [b]	L	31.4	52.5	9.1	21.4	44.4	61.2	29.5	50.0	76.2	34.6
Parasite Percent [b]	L	0.0	0.0	0.2	2.2	0.5	0.0	0.0	0.0	0.0	1.0
Oligochaete Percent [b]	L	2.8	0.2	0.0	0.0	0.5	0.0	0.0	0.0	14.3	0.0
Tolerant Taxa Richness [b]	L	1.0	1.0	1.0	0.0	2.0	1.0	1.0	0.0	0.0	1.0
Baetis Tricaudatus Percent [a]	L	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.8
Simuliidae Percent [a]	L	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0
Chironomids Percent [b]	L	24.9	47.9	3.3	1.6	35.4	52.2	1.1	50.0	47.6	5.8

Notes:

(a) Rating from Wisseman 2005

(b) Rating based on quartiles determined by the complete dataset for all seven reaches

(c) Rating from Hilsenhoff 1987

H = Higher values indicate higher Biotic Integrity

L = Lower values indicate higher Biotic Integrity

#/m^2 = number per square meter

Excellent [a and c]	High [a]	Excellent [b]
Very good	Moderate	Good
Good	Low	Fair
Fair	Very Low	Poor
Fairly poor		
Poor		
Very poor		

Table 10 – Periphyton Metrics

	Sample Location and Date									
	HC-GC-01		**HC-GC-05**	**HC-76-02**	**HC-SFSF-03**		**HC-SFSR-07**	**HC-MCL**		**HC-SFSR-09**
	7/9/2013	**8/24/2013**	**8/25/2013**	**8/26/2013**	**7/10/2013**	**8/23/2013**	**8/22/2013**	**7/8/2013**	**8/27/2013**	**8/28/2013**
Combined Metrics (Diatom and Non-Diatom)										
Chlorophyll *a* (mg/m^2)	--	5.0	1.3	4.3	3.0	4.4	2.4	0.4	1.5	2.2
Community Structure										
Density (cells/cm^2)	18,624.7	334,093.1	85,251.3	35,521.4	767,262.0	235,017.2	85,074.1	8,832.3	111,659.7	43,201.7
Diatom Percent	80.0%	16.3%	13.0%	10.0%	2.0%	6.3%	52.0%	30.0%	46.0%	21.7%
Non-Diatom Percent	20.0%	83.7%	87.0%	90.0%	98.0%	93.7%	48.0%	70.0%	54.0%	78.3%
Diatom Metrics										
Community Structure										
Shannon H (log^2)	3.6	2.2	1.0	1.5	2.0	1.6	0.6	2.9	1.7	1.7
Species Richness	27	17	10	16	26	14	12	35	31	25
Dominant Taxon Percent	24.5%	52.5%	85.0%	78.0%	59.3%	73.8%	93.3%	55.7%	77.3%	76.7%
Organic Nutrients										
Pollution Index	2.86	2.93	3.00	2.95	2.96	2.87	2.99	2.89	2.96	2.85
Polysaprobous Taxa Percent	9.0%	4.8%	0.0%	3.7%	2.8%	8.0%	0.8%	4.5%	0.8%	9.2%
Nitrogen Heterotroph Taxa Percent	2.0%	1.3%	0.0%	0.7%	0.2%	0.0%	0.0%	0.5%	0.2%	0.5%
N Autotrophic - Low Organic N	24.0%	25.2%	4.3%	7.3%	7.0%	3.2%	1.2%	10.3%	7.8%	4.3%
N Autotrophic - High Organic N	52.5%	18.3%	87.0%	82.7%	62.0%	81.3%	94.8%	64.7%	80.0%	85.0%
Inorganic Nutrients										
Eutraphentic Taxa Percent	8.5%	2.8%	0.0%	1.3%	1.7%	0.0%	0.2%	2.5%	1.8%	6.7%
Sediment										
Motile Taxa Percent	22.0%	3.7%	2.0%	2.7%	1.0%	0.7%	1.0%	10.5%	4.2%	0.8%
Siltation Taxa Percent	1.5%	0.0%	0.0%	1.0%	0.3%	0.0%	0.0%	2.2%	0.7%	0.3%
Metals										
Abnormal Cells Percent	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%
Disturbance Taxa Percent	0.0%	0.0%	0.7%	0.3%	0.0%	1.5%	1.2%	2.2%	2.0%	1.3%
Metals Tolerant Taxa Percent	9.0%	4.5%	0.3%	1.3%	3.7%	12.7%	0.5%	7.3%	3.5%	10.8%

Notes:
mg/m^2 = milligrams per square meter
cells/cm^2 = cells per square centimeter

Table 11 – Freshwater Bioassay Results

Biological Test/Endpoint	HC-GC-01	HC-GC-05	HC-76-02	HC-SFSR-03	HC-SFSR-07	HC-MCL	HC-SFSR-09
Hyalella azteca							
28-day mortality [a]	0.00	-3.75	2.50	-2.50	-1.25	-2.50	-2.50
28-day growth [b]	-0.38	-0.28	-0.19	-0.41	-0.35	-0.21	-0.64
Chironomus dilutus							
20-day mortality [a]	-3.75	-3.75	16.25	11.25	5	5	8.75
20-day growth [b]	0.00	0.16	-0.05	0.10	0.14	0.28	0.00

Notes:

(a) Mortality values represent the (Mean $_{\text{Test}}$ - Mean $_{\text{Control}}$) using the mean percent mortality for the eight site replicate bioassays

(b) Growth values represent the ([Mean Growth $_{\text{Control}}$ - Mean Growth $_{\text{Test}}$] / Mean Growth $_{\text{Control}}$) using mean individual growth (mg/individual) for the eight site replicate bioassays

🟫 Failed to meet both the Sediment Cleanup Objective (SCO) and Cleanup Screening Level (CSL) criteria and is statistically significant ($p > 0.05$)

🟧 Failed to meet the Sediment Cleanup Objective (SCO), but met the Cleanup Screening Level (CSL) criteria and is statistically significant ($p > 0.05$)

⬜ Met both the Sediment Cleanup Objective (SCO) and Cleanup Screening Level (CSL) criteria

mg/individual = milligrams per individual

Table 12 – Analytical Results for Sediment Samples

		Concentration in mg/kg															
Sample ID	**Sampling Date**	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Nickel	Potassium
	SCO (Lowest ARAR)	--	--	14	--	--	2.1	--	72	--	400	--	360	--	--	0.66	26	--
	CSL	--	--	120	--	--	5.4	--	88	--	1200	--	1,300	--	--	0.8	110	--
HC-GC-01	8/24/2013	11700	6 J	***74***	101	0.2	0.3	3720	18.3	9.9	21.5	24100	14	5930	1300	0.37	16	1290
HC-GC-05	8/25/2013	14300	1.97 JT	***133*** J	81.4	0.1	1.5	4140	16.3	12.5	88.9	26200	20 J	7330	850	0.08	15	2030
HC-76-02	8/26/2013	16800	8.6 J	***250***	53	0.18 T	1.4	4630	21	12.2	35	27800	122	8060	940	0.2	14	1550
HC-SFSR-03	8/23/2013	17000	15 J	***219***	46.3	0.2	0.7	3690	24.4	11.2	77.4	29300	83	8750	614	0.05	20	1670
HC-SFSR-07	8/22/2013	18100	14 J	***464***	42.3	0.2	0.7	3820	48.3	15.4	89.2	28900	81	13300	622	0.02	***76***	1140
HC-MCL	8/27/2013	16600	27 J	***743***	53.7	0.2	***2.3***	3650	49.7	13.5	180	29600	235	13100	542	0.17	***80***	1260
HC-SFSR-09	8/28/2013	17100	3.06 J	***92***	50.6	0.2	0.5	5340	43.9	11.2	46.8	27400	27	11400	491	0.018 T	***42***	950

Notes:

Italic	Exceeds the lowest potential ARAR Sediment Cleanup Objective (SCO), but not the Cleanup Screening Levels (CSL), listed in Table 10
Bold italic	Exceeds both the SCO and CSL listed in Table 10
J	Estimated value
T	Detection between the method detection limit (MDL) and method reporting limit (MRL)
JT	Estimated value between MDL and MRL
U	Not detected at the MRL indicated

Table 12 – Analytical Results for Sediment Samples

Concentration in mg/kg

Sample ID	**Sampling Date**	Silver	Sodium	Thallium	Vanadium	Zinc	Acid Volatile Sulfides	pH	Preserved Total Solids	Sulfide	Total Organic Carbon	Total Solids
	SCO (Lowest ARAR)	0.57	--	--	--	3200						
	CSL	1.7	--	--	--	4,200						
HC-GC-01	8/24/2013	0.245 T	570	0.24 T	45.2	90	1.23 U	6.5	75.58	1.31 UJ	0.161	79.77
HC-GC-05	8/25/2013	0.275 T	730	0.164 T	60.4	282 J	2.2	6.34	81.3	3.2 J	0.302	75.64
HC-76-02	8/26/2013	0.43 T	790	0.125 T	53	272	1.18 U	6.46	78.59	1.25 U	0.517	80.93
HC-SFSR-03	8/23/2013	0.5	580	0.133 T	54.6	197	1.26 U	6.42	81.36	1.21 UJ	0.481	75.99
HC-SFSR-07	8/22/2013	***3.5***	510	0.115 T	47.2	174	1.25 U	6.54	78.28	1.65 J	0.282	76.23
HC-MCL	8/27/2013	***3.4***	400	0.144 T	49.6	431	3.26	5.84	69.7	4	1.05	65.4
HC-SFSR-09	8/28/2013	0.06 T	360	0.059 T	53	117	1.2 U	6.68	78.31	1.22 U	0.323	81.17

Notes:

Italic	Exceeds the lowest potential ARAR Sediment Cleanup Objective (SCO), but not the Cleanup Screening Levels (CSL), listed in Table 10
Bold italic	Exceeds both the SCO and CSL listed in Table 10
J	Estimated value
T	Detection between the method detection limit (MDL) and method reporting limit (MRL)
JT	Estimated value between MDL and MRL
U	Not detected at the MRL indicated

Table 13 – Analytical Results for Surface Water Samples

Concentration in µg/L

Sample ID	Sampling Date	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium [f]	Cobalt	Copper	Iron (b)	Lead	Magnesium	Manganese (	Mercury	Nickel (b)	Potassium
Total Metals			(b)	(b)	(b)	(d)	(d)		(e)		(d)	(b)			(b)	(e)	(b)	
	Lowest ARAR	--	5.6	0.018	1000	273	41	--	57	--	2880	300	--	--	50	0.012	610	--
HC-GC-01-A	7/9/2013	20 U	1	***0.8***	7.2	0.2 U	0.021 U	2130	0.5 U	0.2 U	0.5 U	30	0.1 U	320	0.8	0.0009	0.5 U	100
HC-GC-01	8/24/2013	20 U	1.2	***0.78***	6.1	0.2 U	0.02 U	2040	0.5 U	0.2 U	0.5 U	20 U	0.1 U	320	6.6	0.0008	0.5 U	90
HC-GC-05	8/25/2013	20 U	1.3	***5.98***	5.4	0.2 U	0.036	2410	0.5 U	0.2 U	0.5 U	20 U	0.1 U	330	3.3	0.0006	0.5 U	140
HC-76-02	8/26/2013	20 U	1.8	***9.41***	1.4	0.2 U	0.016 T	2920	0.5 U	0.2 U	0.5	20 U	0.4	270	11.6	0.0003 T	0.5 U	110
HC-SFSR-03-A	7/10/2013	20 U	1.4	***7.92***	2.8	0.2 U	0.05	2260	0.5 U	0.2 U	0.7	20	0.1 U	240	0.5 U	0.0003 T	0.5 U	140
HC-SFSR-03	8/23/2013	20 U	2.4	***8.83***	2.9	0.2 U	0.081	2560	0.5 U	0.2 U	0.6	20 U	0.1 U	260	13.8	0.0009	0.5 U	180
HC-SFSR-07	8/22/2013	20 UJ	3.5 J	***8.93***	2.9 J	0.2 UJ	0.038	3710 J	0.5 UJ	0.2 UJ	1 J	20 J	0.1 UJ	500 J	12.8 J	0.0003 T	0.5 UJ	200 J
HC-MCL-MAIN-A	7/8/2013	40	1.8	***11.8***	2.8	0.2 U	0.04	3100	0.5 U	0.2 U	0.7	100	0.2	390	7.2	0.0006	0.5 U	160
HC-MCL	8/27/2013	20 U	4.3	***30.4***	3.2	0.2 U	0.049	3860	0.5 U	0.2 U	1.2	240	0.5	570	30.9	0.0005	0.5 U	210
HC-SFSR-09	8/28/2013	30	4	***26.3***	3.5	0.2 U	0.051	4030	0.5 U	0.2 U	1.3	220	0.7	610	19.1	0.001	0.5 U	230
Dissolved Metals		(a)		(a)			(a)		(e)		(a)	(a)	(e)			(c)	(e)	
	Lowest ARAR	87	--	150	--	--	0.094	--	10	--	2.7	1000	0.54	--	--	0.54	16	--
HC-GC-01-B	7/9/2013	20 U	0.9	0.73	6.8	0.2 U	0.021 U	1980	0.5 U	0.2 U	0.5 U	30 U	0.1 U	300	0.5 U	0.0005	0.5 U	100
HC-GC-01D	8/24/2013	20 U	1.2	0.7	6	0.2 U	0.02 U	2120	0.5 U	0.2 U	1.6 U	20 U	0.1 U	320	9.2	0.0033	0.5 U	100
HC-GC-05D	8/25/2013	20 U	1.2	5.96	5.3	0.2 U	0.033	2370	0.5 U	0.2 U	0.5 U	20 U	0.3	330	2.8	0.0014	0.5 U	140
HC-76-02D	8/26/2013	20 U	1.7	8.88	1.4	0.2 U	0.015 T	3810	0.5 U	0.2 U	2.4	20	0.1	290	17.8	0.0015	1.4	120
HC-SFSR-03-B	7/10/2013	20 U	1.3	7.6	2.6	0.2 U	0.053	2110	0.5 U	0.2 U	0.5 U	30 U	0.1 U	220	0.5 U	0.0002 T	0.5 U	140
HC-SFSR-03D	8/23/2013	20 U	2.5	8.94	3	0.2 U	0.085	2740	0.5 U	0.2 U	2 U	20 U	0.1	270	15.2	0.0003 T	0.5 U	190
HC-SFSR-07D	8/22/2013	20 U	3.4	9	2.9	0.2 U	0.041	3520	0.5 U	0.2 U	0.7 U	20 U	0.1 U	510	14.1	0.0027	0.5 U	190
HC-MCL-MAIN-B	7/8/2013	20 U	1.6	11.3 J	2.2	0.2 U	0.034 J	2710	0.5 U	0.2 U	0.5	60 U	0.1 U	340	5.8	0.0003 JT	0.5 U	140
HC-MCLD	8/27/2013	20 U	4.3	26.3	3.3	0.2 U	0.048	4050	0.5 U	0.2 U	0.5 U	190	0.1	590	34.2	0.0002 T	0.5 U	210
HC-SFSR-09D	8/28/2013	20 U	3.8	19	3.4	0.2 U	0.042	4070	0.5 U	0.2 U	1.2 U	100	0.2	620	24.2	0.0004	0.5 U	230

Notes:

Bold italic	Exceeds the lowest potential Applicable or Relevant and Appropriate Requirement (ARAR) listed in Table 12
J	Estimated value
T	Detection between the method detection limit (MDL) and method reporting limit (MRL)
JT	Estimated value between MDL and MRL
U	Not detected at the MRL indicated
a	Clean Water Act, section 304 Chronic (dissolved except for mercury chronic & chromium III)
b	Clean Water Act, section 304 Human Health consumption of water & organisms (total)
c	National Toxics Rule (40 CFR 131) - Acute
d	MTCA Method B Human Health (total)
e	WAC 173-201 - dissolved (hardness dependent metals calculated for hardness = 25)
f	Chromium was analyzed as Total Chromium (III + VI). Lowest ARAR values are reported as the lesser ARAR of the two analytes

µg/L = micrograms per liter
mg/L = milligrams per liter

Table 13 – Analytical Results for Surface Water Samples

		Concentration in µg/L						Concentration in mg/L							
Sample ID	**Sampling Date**	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc	Hardness as CaCO3	Chloride	Fluoride	Sulfate	Alkalinity as Bicarbonate	Alkalinity as Carbonate	Alkalinity as Hydroxide	Alkalinity, Total
Total Metals		(e)	(d)		(b)		(b)								
	Lowest ARAR	5	25900	--	0.24	--	7400	--				--	--	--	--
HC-GC-01-A	7/9/2013	0.5 U	0.021 U	220	0.2 U	0.2 U	4 U	6.6 U							
HC-GC-01	8/24/2013	0.5 U	0.02 U	200	0.2 U	0.2 U	5	6.4				5.8	1 U	1 U	5.8
HC-GC-05	8/25/2013	0.5 U	0.02 U	360	0.2 U	0.2 U	6	7.4				5.5	1 U	1 U	5.5
HC-76-02	8/26/2013	0.5 U	0.02 U	500	0.2 U	0.2 U	8	8.4				8.2	1 U	1 U	8.2
HC-SFSR-03-A	7/10/2013	0.5 U	0.021 U	420	0.2 U	0.2 U	5	6.6							
HC-SFSR-03	8/23/2013	0.5 U	0.02 U	530	0.2 U	0.2 U	11	7.5				6.3	1 U	1 U	6.3
HC-SFSR-07	8/22/2013	0.5 UJ	0.011 T	640 J	0.2 UJ	0.2 UJ	20 J	11				10.4	1 U	1 U	10.4
HC-MCL-MAIN-A	7/8/2013	0.5 U	0.007 T	510	0.2 U	0.2 U	4 U	9.4 U							
HC-MCL	8/27/2013	0.5 U	0.018 T	710	0.2 U	0.2 U	5	12				11.3	1 U	1 U	11.3
HC-SFSR-09	8/28/2013	0.5 U	0.017 T	710	0.2 U	0.2	5	13				11.3	1 U	1 U	11.3
Dissolved Metals			(a)				(e)								
	Lowest ARAR	--	0.32	--	--	--	32	--	--	--	--				
HC-GC-01-B	7/9/2013	0.5 U	0.021 U	210	0.2 U	0.2 U	4 U	6.2 U							
HC-GC-01D	8/24/2013	0.5 U	0.02 U	220 U	0.2 U	0.2 U	16	6.6 J	0.1 U	0.1 U	0.8				
HC-GC-05D	8/25/2013	0.5 U	0.02 U	390	0.2 U	0.2 U	11	7.3	0.2	0.1 U	2				
HC-76-02D	8/26/2013	0.5 U	0.02 U	540	0.2 U	0.2 U	***68***	11	0.1	0.1 U	1.4				
HC-SFSR-03-B	7/10/2013	0.5 U	0.021 U	400	0.2 U	0.2 U	5	6.2							
HC-SFSR-03D	8/23/2013	0.5 U	0.02 U	540	0.2 U	0.2 U	18	7.9	0.2	0.1 U	2.3				
HC-SFSR-07D	8/22/2013	0.5 U	0.006 T	640	0.2 U	0.2 U	7	11	0.3	0.1 U	1.9				
HC-MCL-MAIN-B	7/8/2013	0.5 U	0.009 JT	450	0.2 U	0.2 U	4 U	8.2 U							
HC-MCLD	8/27/2013	0.5 U	0.022	740	0.2 U	0.2 U	5	13	0.3	0.1 U	2.1				
HC-SFSR-09D	8/28/2013	0.5 U	0.007 T	750	0.2 U	0.2 U	5	13	0.3	0.1 U	2.1				

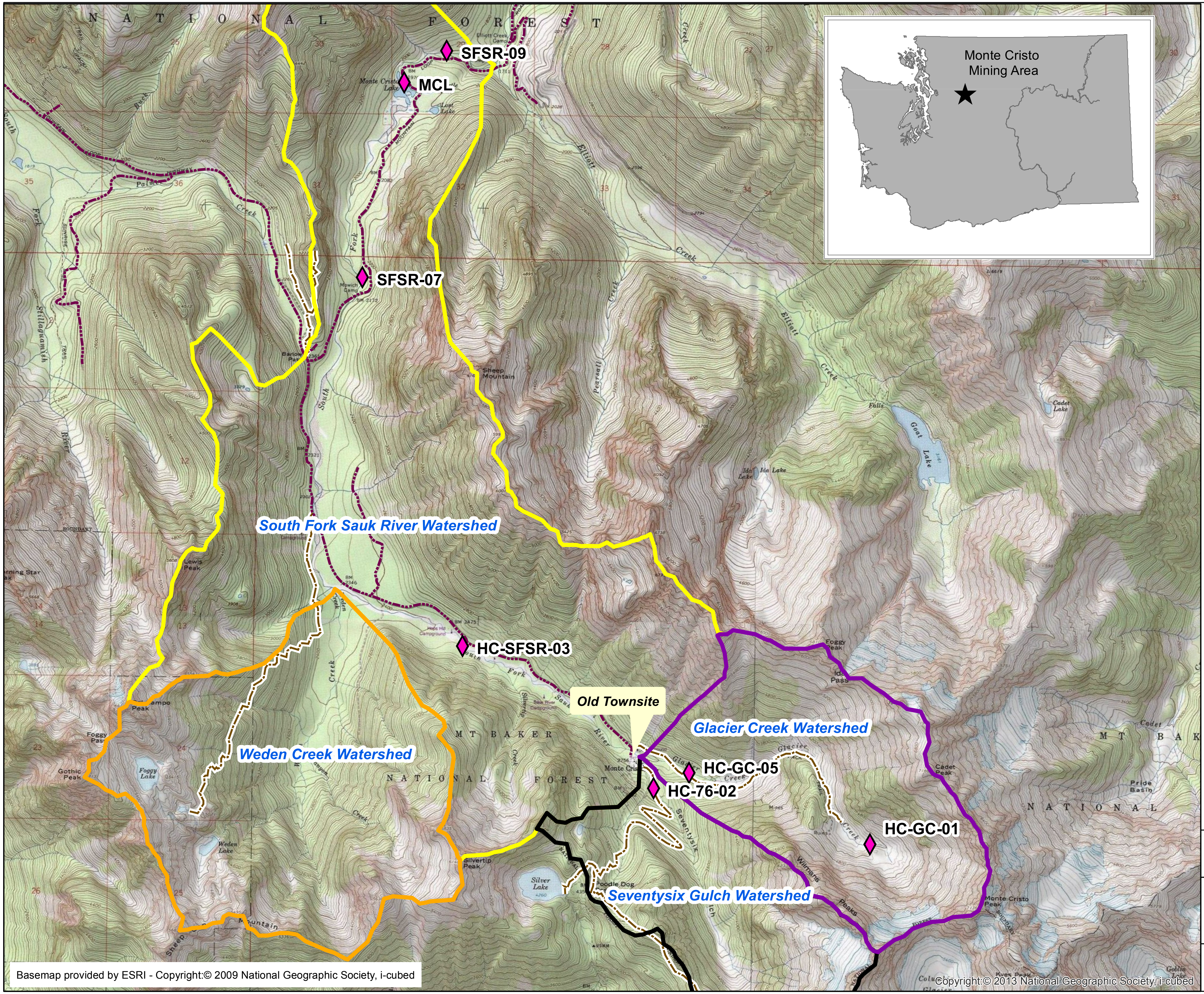
Notes:

Bold italic	Exceeds the lowest potential Applicable or Relevant and Appropriate Requirement (ARAR) listed in Table 12
J	Estimated value
T	Detection between the method detection limit (MDL) and method reporting limit (RL)
JT	Estimated value between MDL and MRL
U	Not detected at the MRL indicated
a	Clean Water Act, section 304 Chronic (dissolved except for mercury chronic & chromium III)
b	Clean Water Act, section 304 Human Health consumption of water & organisms (total)
c	National Toxics Rule (40 CFR 131) - Acute
d	MTCA Method B Human Health (total)
e	WAC 173-201 - dissolved (hardness dependent metals calculated for hardness = 25)
f	Chromium was analyzed as Total Chromium (III + VI). Lowest ARAR values are reported as the lesser ARAR of the two analytes

µg/L = micrograms per liter

mg/L = milligrams per liter

FIGURES



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HC 2013 Sample Stations

◆ Upstream end of reach

Features

Roads

Trails

Watersheds

South Fork Sauk River Watershed

Weden Creek Watershed

Seventysix Gulch Watershed

Glacier Creek Watershed

N

1 inch = 3,500 feet

0 0.5 1 Miles

NAD 1983 HARN StatePlane Washington South FIPS 4602 Feet

Monte Cristo Mining Area Aquatic Baseline Monitoring
Monte Cristo, Washington

Vicinity Map

17800-35 3/15

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Figure

1

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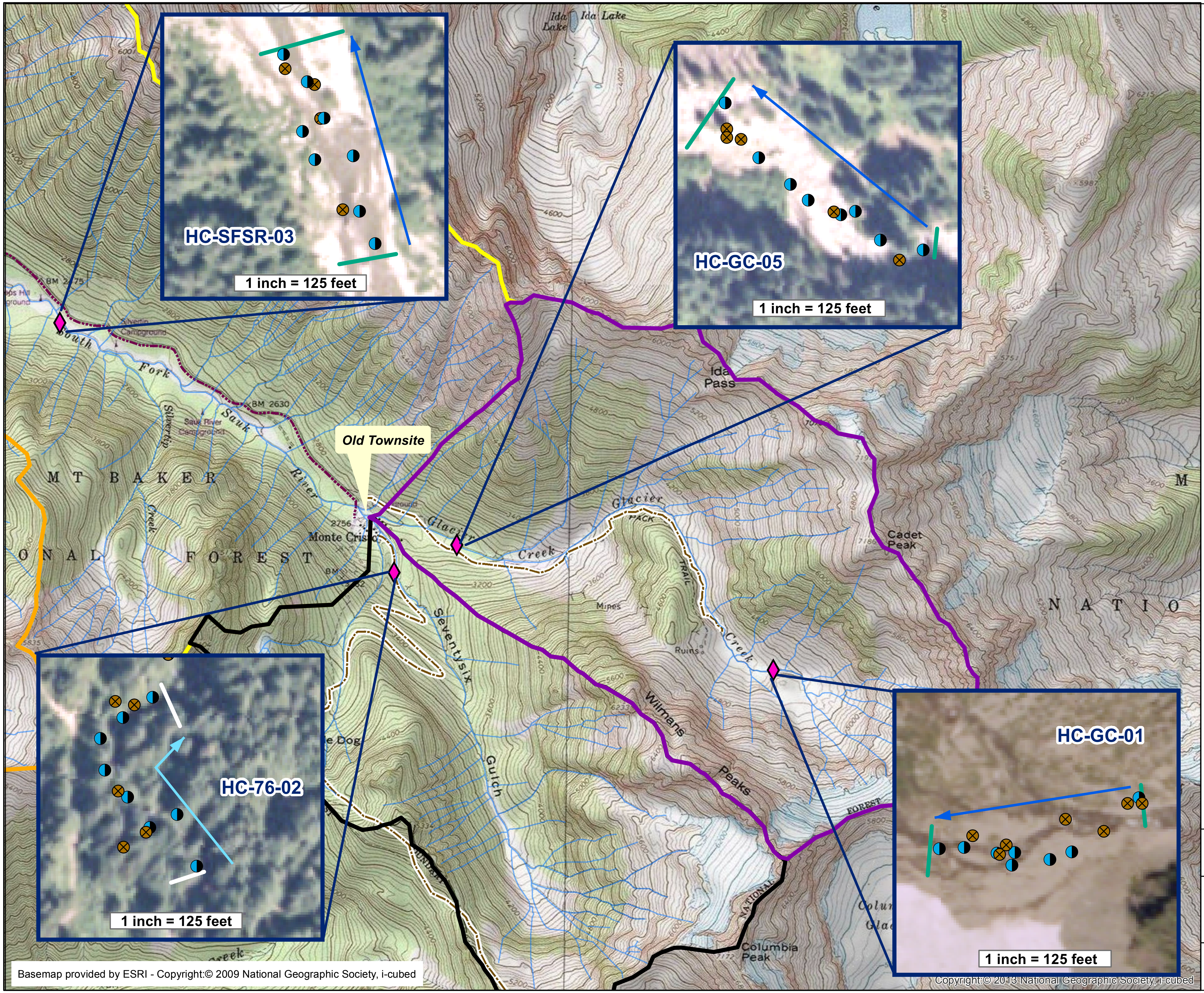

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HC 2013 Sample Stations

♦ Upstream end of reach

Sample Collection Points

◐ Benthic macroinvertebrates / periphyton

⊗ Sediment for chemistry and bioassay

— Sampling reach boundaries

Features

-··- Roads

-·- Trails

— Streams

Watersheds

South Fork Sauk River Watershed

Weden Creek Watershed

Seventysix Gulch Watershed

Glacier Creek Watershed

N

1 inch = 2,000 feet

0 0.2 0.4 0.6 Miles

NAD 1983 HARN StatePlane Washington South FIPS 4602 Feet

Monte Cristo Mining Area Aquatic Baseline Monitoring
Monte Cristo, Washington

Upstream Aquatic Stations

17800-35 3/15

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Figure
2

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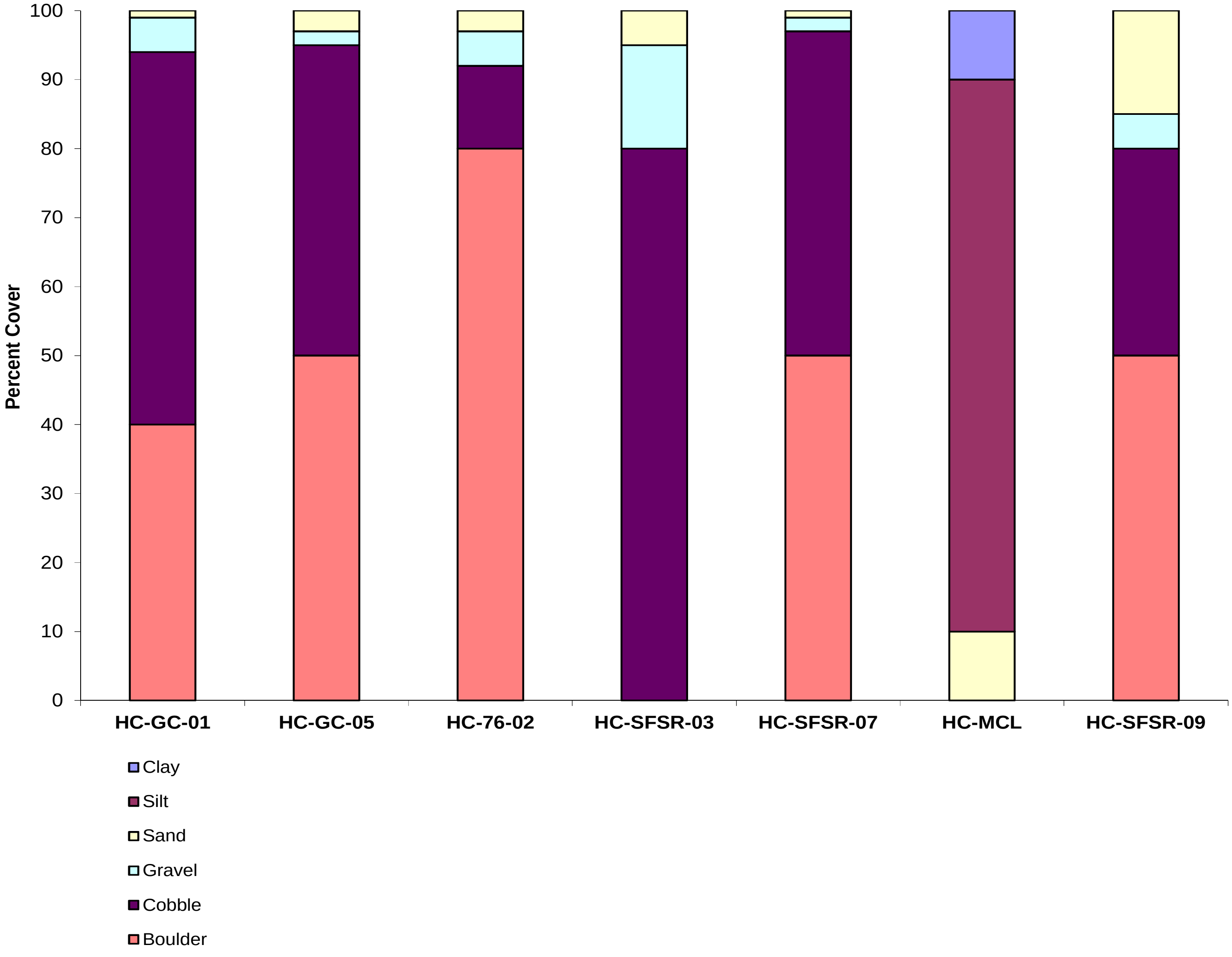

Monte Cristo Mining Area Aquatic Baseline
Monitoring
Monte Cristo, Washington

Substrate Composition by Sampling Reach

17800-35
3/15

Figure
3

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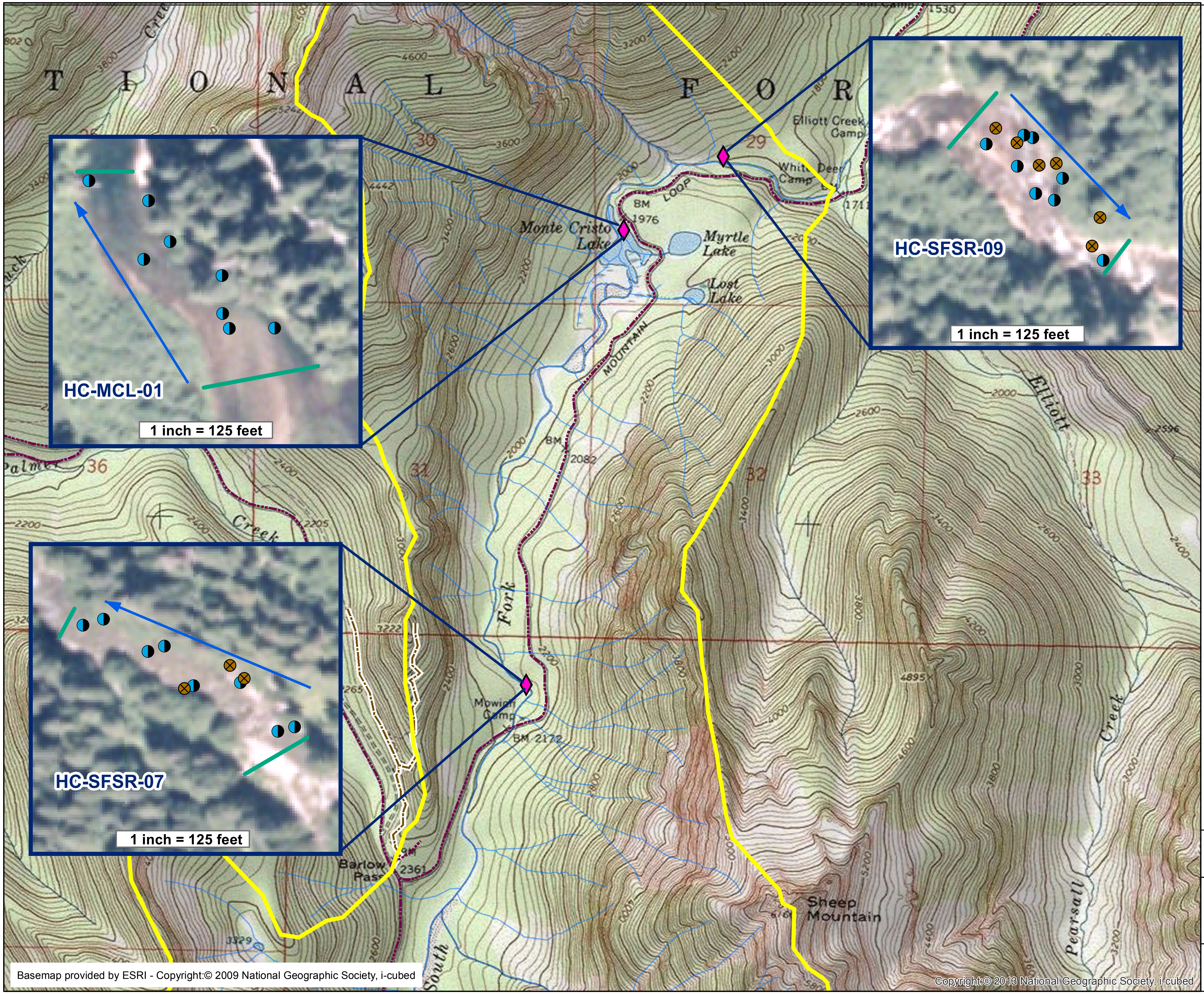


HC 2013 Sampling Stations

♦ Upstream end

Sample Collection Points

◐ Benthic macroinvertebrates / periphyton

⊗ Sediment for chemistry and bioassay

— Sampling reach boundaries

Features

-·-·- Roads

-·-·- Trails

— Streams

Watersheds

🟨 South Fork Sauk River Watershed

🟧 Weden Creek Watershed

⬛ Seventysix Gulch Watershed

🟪 Glacier Creek Watershed

N

1 inch = 1,500 feet

0 0.2 0.4 0.6 Miles

NAD 1983 HARN StatePlane Washington South FIPS 4602 Feet

Monte Cristo Mining Area Aquatic Baseline Monitoring
Monte Cristo, Washington

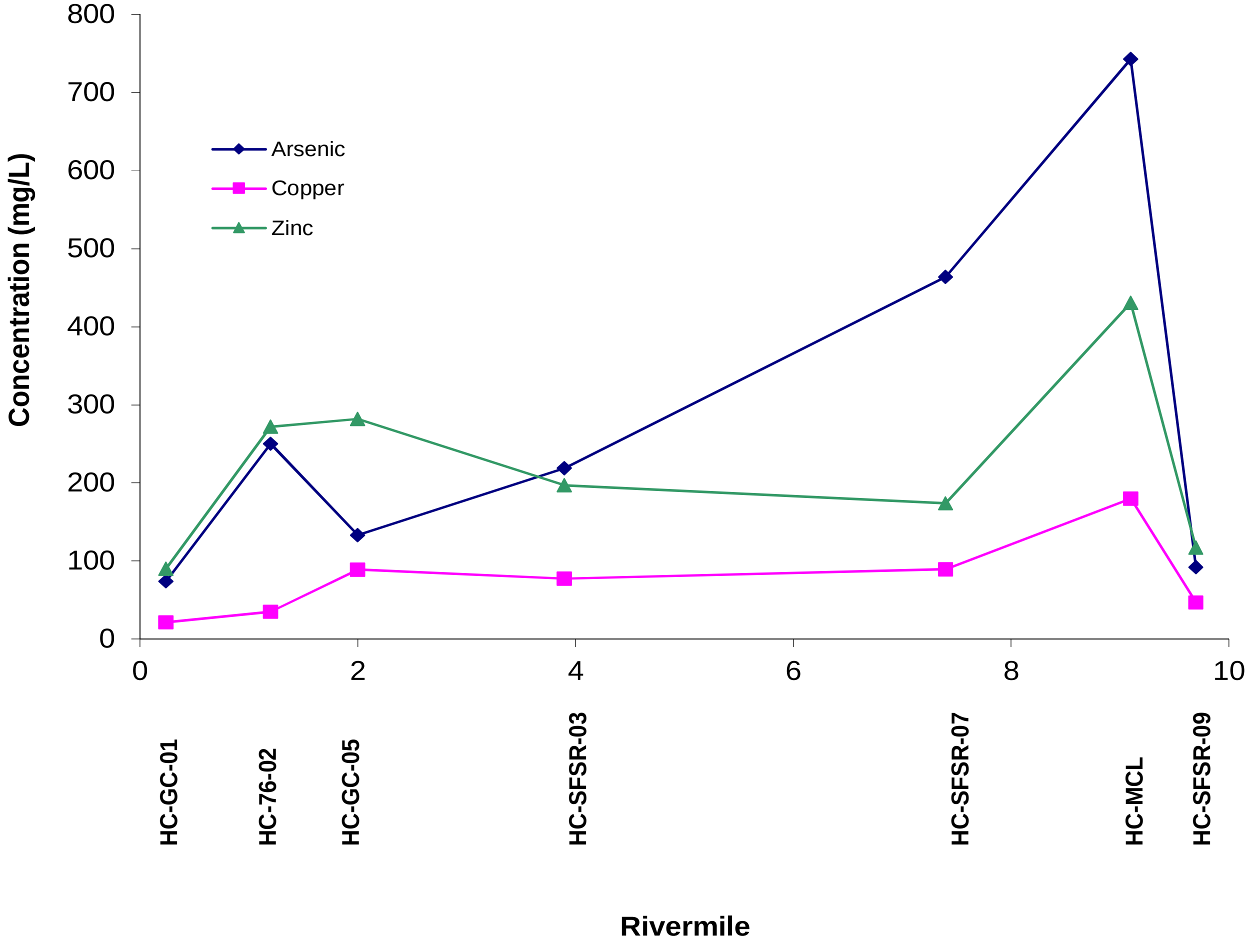
Downstream Aquatic Stations

17800-35 3/15

HARTCROWSER

Figure
4

R:\GIS\PROJECTS\17800_Ecology\35_MCMA\mxds\AquaticReport\FINAL\Figure 4_wo_diss.mxd



Monte Cristo Mining Area Aquatic Baseline Monitoring
Monte Cristo, Washington

Arsenic, Copper, and Zinc Concentrations in Sediment

17800-35 3/15

HARTCROWSER

Figure
5

MAH 03/31/15 1780035_Monte Cristo Ph3 Terrestrial Evaluation\Deliverables\Reports\Aquatic Baseline Conditions Report\Final\3 Figures\Figure5_sediment.xlsx

APPENDIX A
Field Forms and Site Photographs

Contents

Glacier Creek

HC-GC-01

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double-sided printing.

Glacier Creek
HC-GC-01
JULY

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double-sided printing.

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME Glacier Creek	LOCATION
STATION # HC-GC-01 RIVERMILE _____	STREAM CLASS Slope 10%
LAT _____ LONG _____	RIVER BASIN
STORET #	AGENCY Ecology
INVESTIGATORS MAH BAS,	
FORM COMPLETED BY MAH	DATE 7/9/13 TIME 1300 AM [✓ PM]

REASONFOR SURVEY

WEATHER CONDITIONS

Now		Past 24 hours
☐	storm (heavy rain)	☐
☐	rain (steady rain)	☐
☐	showers (intermittent)	☐
___%☐	%cloud cover	☐ ___%
☒	clear/sunny	☒

Has there been a heavy rain in the last 7 days?
☐ Yes ☐ No

Air Temperature 73 °C

Other _____

SITE LOCATION/MAP

#100-6772
looking US from Bug 2

6773
photo of Bugs 4 from RR

6774
L. DS from Bugs 4

6775
L. US from Bug 4

6776 B6

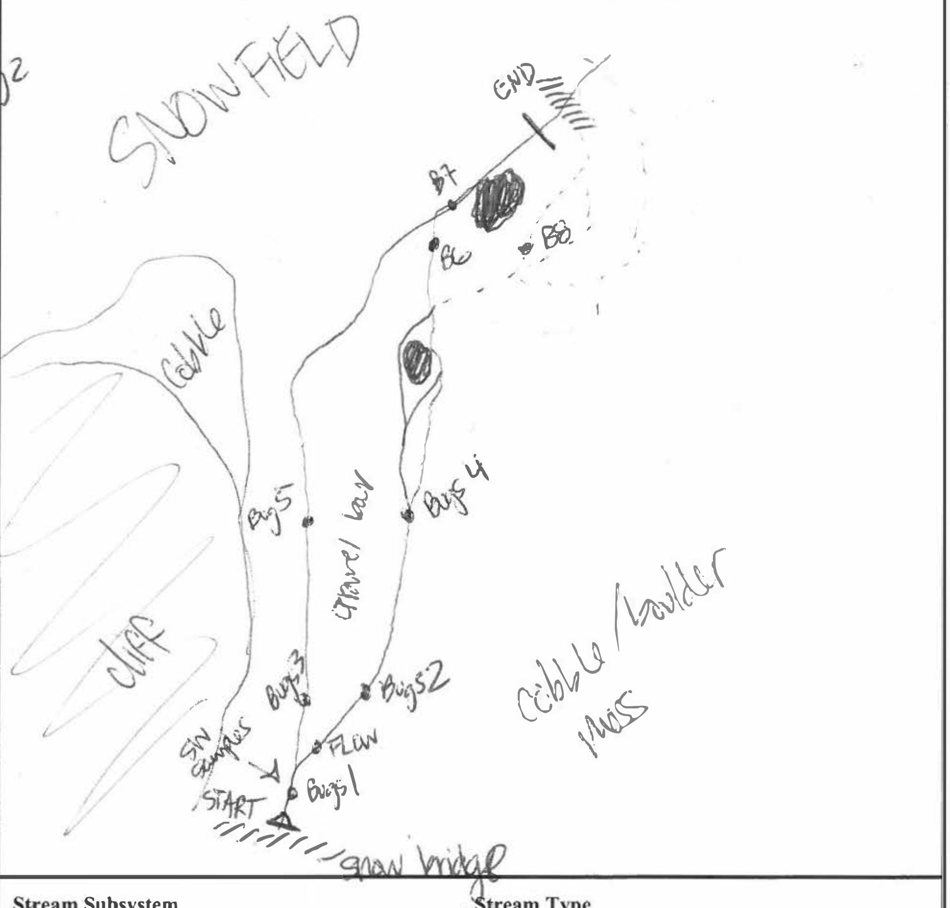
6777
L. US from B6

6778
L. DS @ DS end

6779
L. US from DS end

6780

Draw a map of the site and indicate the areas sampled (or attach a photograph)



STREAM CHARACTERIZATION

Stream Subsystem
☒ Perennial ☐ Intermittent ☐ Tidal

Stream Origin
☐ Glacial
☒ Non-glacial montane
☐ Swamp and bog
☐ Spring-fed
☐ Mixture of origins
☐ Other _____

Stream Type
☒ Coldwater ☐ Warmwater

Catchment Area _____ km^2

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET
(BACK)

WATERSHED FEATURES

Predominant Surrounding Landuse
☐ Forest ☐ Commercial
☐ Field/Pasture ☐ Industrial
☐ Agricultural ☒ Other Talus basin
☐ Residential

Local Watershed NPS Pollution
☐ No evidence ☐ Some potential sources
☒ Obvious sources

Local Watershed Erosion landslides
☐ None ☒ Moderate ☐ Heavy

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present
☐ Trees ☐ Shrubs ☐ Grasses ☑ Herbaceous

dominant species present lots of pics

INSTREAM FEATURES

Estimated Reach Length 100 m
Estimated Stream Width 10 m
Sampling Reach Area ______ m²
Area in km² (m²x1000) ______ km²
Estimated Stream Depth 1 ft ~~m~~
Surface Velocity (at thalweg) ~~3 m/sec~~ 2.30 ft/sec

Canopy Cover none
☐ Partly open ☐ Partly shaded ☐ Shaded

High Water Mark 1 m

Proportion of Reach Represented by Stream Morphology Types
☐ Riffle ____ % ☐ Run ____ %
☑ Pool 5 % step cascade 95%

Channelized ☐ Yes ☐ No
Dam Present ☐ Yes ☑ No

LARGE WOODY DEBRIS

LWD 0 m²
Density of LWD 0 m²/km² (LWD/ reach area)

AQUATIC VEGETATION

Indicate the dominant type and record the dominant species present NONE
☐ Rooted emergent ☐ Rooted submergent ☐ Rooted floating ☐ Free floating
☐ Floating Algae ☐ Attached Algae

dominant species present ______

Portion of the reach with aquatic vegetation 0 %

WATER QUALITY

Temperature 2.33 °C
Specific Conductance 0.010 mS/cm
Dissolved Oxygen 14.54 mg/L
pH 6.31
Turbidity 1.5
WQ Instrument Used Horiba

Water Odors
☒ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other ______

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs ☐ Flecks
☒ None ☐ Other ______

Turbidity (if not measured)
☐ Clear ☐ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other ______

SEDIMENT/ SUBSTRATE

Odors
☒ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other ______

Oils
☒ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits
☐ Sludge ☐ Sawdust ☐ Paper fiber ☒ Sand min.
☐ Relict shells ☐ Other ______

Looking at stones which are not deeply embedded, are the undersides black in color?
☐ Yes ☒ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**
Bedrock		
Boulder	> 256 mm (10")	50
Cobble	64-256 mm (2.5"-10")	38
Gravel	2-64 mm (0.1"-2.5")	5
Sand	0.06-2mm (gritty)	1
Silt	0.004-0.06 mm	—
Clay	<0.004 mm (slick)	—

ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	**Characteristic**	**% Composition in Sampling Area**
Detritus	sticks, wood, coarse plant materials (CPOM)	2
Muck-Mud	black, very fine organic (FPOM)	0
Marl	grey, shell fragments	0

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME Glacier Creek	LOCATION
STATION # HC-GC-01 RIVERMILE ______	STREAM CLASS slope 10%
LAT ______ LONG ______	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS MAH, BAS, CMH	
FORM COMPLETED BY MAH	DATE 7/1/13 TIME 13:30 AM [✓ PM] REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 [✓ 8] 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE	[✓ 20] 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE	20 19 18 17 16	15 14 13 12 11	10 [✓ 9] 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	[✓ 20] 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 [✓ 8] 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	[✓ 20] 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of ~~Riffles~~ (or bends) Cascade	Occurrence of ~~riffles~~ relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE	[✓ 20] 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 [✓ 4] 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 [✓ 4] 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	[✓ 2] 1 [✓ 0]
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	[✓ 2] 1 [✓ 0]
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score ________

HARTCROWSER

Snorkel Survey Form

PROJECT ______

JOB NO. ______

PROJECT MANAGER ______

FIELD TEAM ______

SNORKELER(S) BAS

STATION ID HC-GC-01

DATE 7/9/13

START TIME 1255

STOP TIME 1345

WEATHER Sunny 73F

	Estimated Length							
Species	**0 to 50 mm**	**51 to 80**	**81 to 100**	**101 to 120**	**121 to 150**	**151 to 200**	**201 to 250**	**>250 mm**
Bull trout								
Cutthroat								
Rainbow								
Steelhead								
Sculpin								
Chinook								
Whitefish								
Dace								

0 = not snorkelable due to high turbidity or hiding cover

1 = high amount of hiding cover and/or poor water clarity

2 = moderate hiding cover and/or moderate water clarity

3 = little hiding cover and good water clarity

Turbidity	
Reach area (m^2)	

Comments:

No fish seen.

Reviewed by (initials):______

Date:______

BENTHIC MACROINVERTEBRATE FIELD DATA SHEET

STREAM NAME Glacier Creek	LOCATION
STATION # HC-GC-01 RIVERMILE ______	STREAM CLASS slope 10%
LAT ______ LONG ______	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS MAH, BAS, CMH	LOT NUMBER
FORM COMPLETED BY	DATE 7/9/13 TIME ______ AM PM REASON FOR SURVEY

HABITAT TYPES	**Indicate the percentage of each habitat type present** ☐ Cobble____% ☐ Snags____% ☐ Vegetated Banks____% ☐ Sand____% ☐ Submerged Macrophytes____% ☒ Other (gravel) 100 %
SAMPLE COLLECTION	**Gear used** ☒ D-frame ☐ kick-net ☐ Other ______ **How were the samples collected?** ☒ wading ☐ from bank ☐ from boat **Indicate the number of jabs/kicks taken in each habitat type.** ☐ Cobble____ ☐ Snags____ ☐ Vegetated Banks____ ☐ Sand____ ☐ Submerged Macrophytes____ ☒ Other (gravel) 8
GENERAL COMMENTS	

QUALITATIVE LISTING OF AQUATIC BIOTA
Indicate estimated abundance: 0 = Absent/Not Observed, 1 = Rare, 2 = Common, 3= Abundant, 4 = Dominant

Periphyton	[✓ 0]	1	2	3	4	Slimes	[✓ 0]	1	2	3	4
Filamentous Algae	[✓ 0]	1	2	3	4	Macroinvertebrates	0	1	[✓ 2]	3	4
Macrophytes	[✓ 0]	1	2	3	4	Fish	[✓ 0]	1	2	3	4

FIELD OBSERVATIONS OF MACROBENTHOS
Indicate estimated abundance: 0 = Absent/Not Observed, 1 = Rare (1-3 organisms), 2 = Common (3-9 organisms), 3= Abundant (>10 organisms), 4 = Dominant (>50 organisms)

Porifera	0	1	2	3	4	Anisoptera	0	1	2	3	4	Chironomidae	0	1	2	3	4
Hydrozoa	0	1	2	3	4	Zygoptera	0	1	2	3	4	Ephemeroptera	0	[✓ 1]	2	3	4
Platyhelminthes	0	1	2	3	4	Hemiptera	0	1	2	3	4	Trichoptera	0	[✓ 1]	2	3	4
Turbellaria	0	1	2	3	4	Coleoptera	0	1	2	3	4	Other	0	1	2	3	4
Hirudinea	0	1	2	3	4	Lepidoptera	0	1	2	3	4						
Oligochaeta	0	1	2	3	4	Sialidae	0	1	2	3	4						
Isopoda	0	1	2	3	4	Corydalidae	0	1	2	3	4						
Amphipoda	0	1	2	3	4	Tipulidae	0	1	2	3	4						
Decapoda	0	1	2	3	4	Empididae	0	1	2	3	4						
Gastropoda	0	1	2	3	4	Simuliidae	0	1	2	3	4						
Bivalvia	0	1	2	3	4	Tabinidae	0	1	2	3	4						
						Culcidae	0	1	2	3	4						

Worms = 1 Stonefly = 1

PERIPHYTON FIELD DATA SHEET

STREAM NAME Glacier Creek	LOCATION
STATION # HC-GC-01 RIVERMILE ____	STREAM CLASS Slope 10%
LAT ____ LONG ____	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS MAH, BAS, CMH	LOT NUMBER
FORM COMPLETED BY MAH	DATE 7/9/13 TIME 1400 AM [✓ PM]
	REASON FOR SURVEY

HABITAT TYPES	**Indicate the percentage of each habitat type present** ❑ Sand-Silt-Mud-Muck 0 % ❑ Gravel-Cobble 97 % ❑ Bedrock 0 % ❑ Small Woody Debris 1 % ❑ Large Woody Debris 0 % ❑ Plants, Roots 0 % ❑ Riffle 0 % ❑ Run 0 % ❑ Pool 2 % ❑ Canopy 0 %
SAMPLE COLLECTION	**Gear used** ❑ suction device ❑ bar clamp sample ☒ scraping ❑ Other ____ **How were the samples collected?** ❑ wading ☒ from bank ❑ from boat **If natural habitat collections, indicate the number of samples taken in each habitat type.** ❑ Sand-Silt-Mud-Muck ____ % ☒ Gravel-Cobble 100 % ❑ Bedrock ____ % ❑ Small Woody Debris ____ % ❑ Large Woody Debris ____ % ❑ Plants, Roots ____ %
GENERAL COMMENTS	

QUALITATIVE LISTING OF AQUATIC BIOTA

Indicate estimated abundance: 0 = Absent/Not Observed, 1 = Rare (<5%), 2 = Common (5% - 30%), 3= Abundant (30% - 70%), 4 = Dominant (>70%)

Periphyton	0	[✓ 1]	2	3	4	Slimes	[✓ 0]	1	2	3	4
Filamentous Algae	[✓ 0]	1	2	3	4	Macroinvertebrates	0	1	[✓ 2]	3	4
Macrophytes	[✓ 0]	1	2	3	4	Fish	[✓ 0]	1	2	3	4

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double-sided printing.

Glacier Creek
HC-GC-01
AUGUST

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double-sided printing.

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME	LOCATION GC-01	
STATION #________ RIVERMILE________	STREAM CLASS	
LAT ____________ LONG ____________	RIVER BASIN	
STORET #	AGENCY	
INVESTIGATORS		
FORM COMPLETED BY	DATE 8-24-13 TIME 1545 AM PM	REASON FOR SURVEY

WEATHER CONDITIONS	**Now**		**Past 24 hours**	**Has there been a heavy rain in the last 7 days?** ☐ Yes ☒ No
	☐	storm (heavy rain)	☐	**Air Temperature** 30 °C
	☐	rain (steady rain)	☐	
	☐	showers (intermittent)	☒	**Other**__________
	95 % ☒	%cloud cover	☐ ____%	
	☐	clear/sunny	☐	

SITE LOCATION/MAP	**Draw a map of the site and indicate the areas sampled (or attach a photograph)**

STREAM CHARACTERIZATION	**Stream Subsystem** ☐ Perennial ☐ Intermittent ☐ Tidal	**Stream Type** ☐ Coldwater ☐ Warmwater
	Stream Origin ☐ Glacial ☐ Spring-fed ☐ Non-glacial montane ☐ Mixture of origins ☐ Swamp and bog ☐ Other________	**Catchment Area**________ km²

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES

Predominant Surrounding Landuse
☐ Forest ☐ Commercial
☐ Field/Pasture ☐ Industrial
☐ Agricultural ☒ Other talus
☐ Residential

Local Watershed NPS Pollution
☒ No evidence ☐ Some potential sources
☐ Obvious sources

Local Watershed Erosion
☒ None ☐ Moderate ☐ Heavy

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present
☐ Trees ☐ Shrubs ☒ Grasses ☒ Herbaceous

dominant species present ________

INSTREAM FEATURES

Estimated Reach Length 100 m
Estimated Stream Width 19 ft
Sampling Reach Area ____ m²
Area in km² (m²x1000) ____ km²
Estimated Stream Depth 10"
Surface Velocity (at thalweg) ____ m/sec 20 ft / 8.32 sec

Canopy Cover all open
☐ Partly open ☐ Partly shaded ☐ Shaded

High Water Mark ____ m

Proportion of Reach Represented by Stream Morphology Types
☒ Riffle 100 % ☐ Run ____ %
☐ Pool ____ %

Channelized ☐ Yes ☒ No

Dam Present ☐ Yes ☒ No

LARGE WOODY DEBRIS

LWD 1 m²
Density of LWD ____ m²/km² (LWD/ reach area)

AQUATIC VEGETATION

Indicate the dominant type and record the dominant species present
☐ Rooted emergent ☐ Rooted submergent ☐ Rooted floating ☐ Free floating
☐ Floating Algae ☒ Attached Algae

dominant species present ________

Portion of the reach with aquatic vegetation ____ %

WATER QUALITY

Temperature 5.5 °C
Specific Conductance 21
Dissolved Oxygen 10.71
pH 5.65 Jason's 7.4
Turbidity not working
WQ Instrument Used Horiba U-22

Water Odors
☒ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other ____

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs ☐ Flecks
☒ None ☐ Other ____

Turbidity (if not measured)
☒ Clear ☐ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other ____

SEDIMENT/ SUBSTRATE

Odors
☒ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other ____

Oils
☒ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits
☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand
☐ Relict shells ☐ Other ____

Looking at stones which are not deeply embedded, are the undersides black in color?
☐ Yes ☒ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**
Bedrock		0
Boulder	> 256 mm (10")	40
Cobble	64-256 mm (2.5"-10")	54
Gravel	2-64 mm (0.1"-2.5")	5
Sand	0.06-2mm (gritty)	1
Silt	0.004-0.06 mm	
Clay	< 0.004 mm (slick)	

ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	**Characteristic**	**% Composition in Sampling Area**
Detritus	sticks, wood, coarse plant materials (CPOM)	2
Muck-Mud	black, very fine organic (FPOM)	0
Marl	grey, shell fragments	0

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME	LOCATION Ut HC-GC-01
STATION #________ RIVERMILE_________	STREAM CLASS
LAT ____________ LONG ____________	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS	
FORM COMPLETED BY MAH	DATE 8-24-13 TIME 1545 AM PM
	REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 [✓ 6]	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE	[✓ 20] 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 [✓ 6]	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	[✓ 20] 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 [✓ 11]	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	[✓ 20] 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE	[✓ 20] 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank [✓ 10] 9	~~8~~ 7 6	5 4 ~~3~~	2 1 0
SCORE ___ (RB)	Right Bank [✓ 10] 9	~~8~~ 7 6	5 4 ~~3~~	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0

Total Score __________

HARTCROWSER

Snorkel Survey Form

PROJECT

JOB NO.

PROJECT MANAGER

FIELD TEAM

SNORKELER(S) BAS

STATION ID ~~G~~ HC-GTC-01

DATE 8-24-13

START TIME 1145

STOP TIME 1230

WEATHER light showers

Species	Estimated Length							
	0 to 50 mm	51 to 80	81 to 100	101 to 120	121 to 150	151 to 200	201 to 250	>250 mm
Bull trout								
Cutthroat								
Rainbow								
Steelhead								
Sculpin								
Chinook								
Whitefish								
Dace								

0 = not snorkelable due to high turbidity or hiding cover
1 = high amount of hiding cover and/or poor water clarity
2 = moderate hiding cover and/or moderate water clarity
3 = little hiding cover and good water clarity

Turbidity	
Reach area (m^2)	

Comments:

NO FISH!

Reviewed by (initials):______
Date:____________

BENTHIC MACROINVERTEBRATE FIELD DATA SHEET

STREAM NAME	LOCATION HC-17C-01	
STATION #________ RIVERMILE________	STREAM CLASS	
LAT ____________ LONG ____________	RIVER BASIN	
STORET #	AGENCY	
INVESTIGATORS		LOT NUMBER
FORM COMPLETED BY	DATE 8 24-13 TIME 1545 AM PM	REASON FOR SURVEY

HABITAT TYPES	**Indicate the percentage of each habitat type present** ☒ Cobble 54 % ☐ Snags____% ☐ Vegetated Banks____% ☐ Sand 1 % ☐ Submerged Macrophytes____% ☐ Other ( )____%
SAMPLE COLLECTION	**Gear used** ☒ D-frame ☐ kick-net ☐ Other ____________ **How were the samples collected?** ☒ wading ☐ from bank ☐ from boat **Indicate the number of jabs/kicks taken in each habitat type.** ☒ Cobble 8 ☐ Snags____ ☐ Vegetated Banks____ ☐ Sand____ ☐ Submerged Macrophytes____ ☐ Other ( )____
GENERAL COMMENTS	

QUALITATIVE LISTING OF AQUATIC BIOTA
Indicate estimated abundance: 0 = Absent/Not Observed, 1 = Rare, 2 = Common, 3= Abundant, 4 = Dominant

Periphyton	0 1 2 [✓ 3] 4	Slimes	0 1 2 [✓ 3] 4
Filamentous Algae	0 [✓ 1] 2 3 4	Macroinvertebrates	0 1 [✓ 2] 3 4
Macrophytes	[✓ 0] 1 2 3 4	Fish	[✓ 0] 1 2 3 4

FIELD OBSERVATIONS OF MACROBENTHOS
Indicate estimated abundance: 0 = Absent/Not Observed, 1 = Rare (1-3 organisms), 2 = Common (3-9 organisms), 3= Abundant (>10 organisms), 4 = Dominant (>50 organisms)

Porifera	0	1	2	3	4	Anisoptera	0	1	2	3	4	Chironomidae	0	1	2	3	4
Hydrozoa	0	1	2	3	4	Zygoptera	0	1	2	3	4	Ephemeroptera	0	1	2	3	4
Platyhelminthes	0	1	2	3	4	Hemiptera	0	1	2	3	4	Trichoptera	0	1	2	3	4
Turbellaria	0	1	2	3	4	Coleoptera	0	1	2	3	4	Other	0	1	2	3	4
Hirudinea	0	1	2	3	4	Lepidoptera	0	1	2	3	4						
Oligochaeta	0	1	2	3	4	Sialidae	0	1	2	3	4						
Isopoda	0	1	2	3	4	Corydalidae	0	1	2	3	4						
Amphipoda	0	1	2	3	4	Tipulidae	0	1	2	3	4						
Decapoda	0	1	2	3	4	Empididae	0	1	2	3	4						
Gastropoda	0	1	2	3	4	Simuliidae	0	1	2	3	4						
Bivalvia	0	1	2	3	4	Tabinidae	0	1	2	3	4						
						Culcidae	0	1	2	3	4						

PERIPHYTON FIELD DATA SHEET

STREAM NAME	LOCATION HC-GC-C1
STATION #________ RIVERMILE________	STREAM CLASS
LAT ____________ LONG ____________	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS	LOT NUMBER
FORM COMPLETED BY	DATE 8-24-13 TIME 1545 AM PM REASON FOR SURVEY

HABITAT TYPES

Indicate the percentage of each habitat type present
☒ Sand-Silt-Mud-Muck 1 % ☒ Gravel-Cobble 59 % ☐ Bedrock____%
☐ Small Woody Debris____% ☐ Large Woody Debris____% ☐ Plants, Roots____%
☐ Riffle____% ☐ Run____% ☐ Pool____%
☐ Canopy____%

SAMPLE COLLECTION

Gear used ☐ suction device ☐ bar clamp sample ☐ scraping ☐ Other ______________

How were the samples collected? ☐ wading ☐ from bank ☐ from boat

If natural habitat collections, indicate the number of samples taken in each habitat type.
☐ Sand-Silt-Mud-Muck____% ☐ Gravel-Cobble____% ☐ Bedrock____%
☐ Small Woody Debris____% ☐ Large Woody Debris____% ☐ Plants, Roots____%

GENERAL COMMENTS

QUALITATIVE LISTING OF AQUATIC BIOTA

Indicate estimated abundance: **0 = Absent/Not Observed, 1 = Rare (<5%), 2 = Common (5% - 30%), 3= Abundant (30% - 70%), 4 = Dominant (>70%)**

Periphyton	0 1 2 [✓ 3] 4	Slimes	0 1 2 [✓ 3] 4
Filamentous Algae	0 [✓ 1] 2 3 4	Macroinvertebrates	0 1 [✓ 2] 3 4
Macrophytes	[✓ 0] 1 2 3 4	Fish	[✓ 0] 1 2 3 4

HARTCROWSER

Chemistry Sampling Form

PROJECT MCMA

JOB NO.

PROJECT MANAGER M. Harvey

FIELD TEAM MAH, BAS, JMS

STATION ID HC-GC-01

DATE/TIME SAMPLED 3/21/13 14:30

STREAM DEPTH Avg 10 in max 3'

STREAM VELOCITY

SAMPLE DEPTH Integrated

WQ instrument Horiba

Operator jms

Lat

Long

	Calibrated		Start Time	End Time
T (deg C)	Y	N	5.5	
DO (mg/L)	Y	N	10.71	
pH	Y	N	5.65 Hach 7.4	
Cond (uS/cm)	Y	N	21	
Turb. (NTU)	Y	N	0.0 blanking	

Water quality comments:
(color, odor, sheen)

Sample ID (ex. HC13-SW-SFSR09)	Bottle type	# of Containers	Analyses	Preservative	Filter
HC-GC-01D	FLPE	1	Hg	N	Y
HC-GC-01	HDPE	1	Anions	N	Y
HC-GC-01D	HDPE	1	Metals (Ag, Cd, As)	N	Y
HC-GC-01D	HDPE	1	metals	Y	Y
HC-GC-01	HDPE	1	metals	Y	N
HC-GC-01	HDPE	1	Alk	N	N
HC-GC-01	HDPE	1	metals (As, Cd, Ag)	N	N
HC-GC-01	FLPE	1	Hg	N	N

Total number of bottles 8

Duplicate Sample ID –

Field Blank ID –

Rinsate Sample ID –

Sediment # of locations for composite

	%Gravel
	%Sand
	%Fines

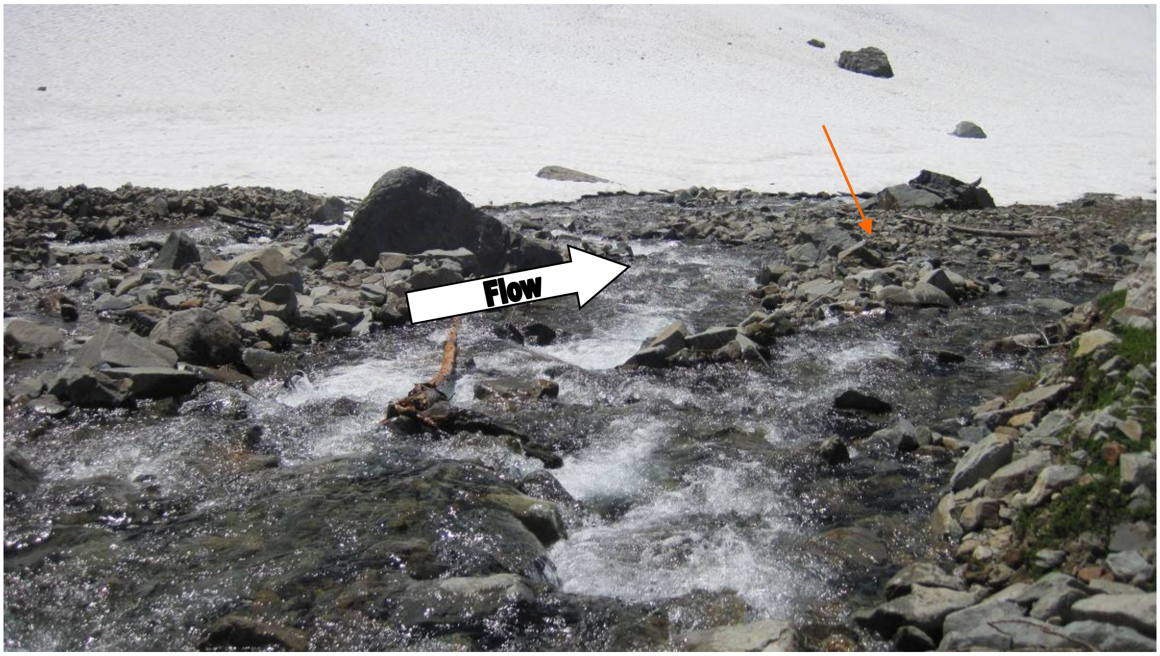
Comments:

dis. Hg
diss. Anions
diss. As Cd, Ag
diss. ~~total~~ metals
total metals
alkalinity zero headspace
total As, Cd, Hg
total ~~diss~~ Hg

Reviewed by (initials):
Date:

Photograph 1 – July 9, 2013. View upstream to start of reach (orange arrow) from southern braid of stream.

Photograph 2 – July 9, 2013. View upstream to start of reach (orange arrow) from northern braid of stream.



Photograph 3 – July 9, 2013. View downstream to end of reach (orange arrow).

Glacier Creek

HC-GC-05

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double-sided printing.

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME HC-GC-05	LOCATION
STATION #______ RIVERMILE______	STREAM CLASS
LAT ______ LONG ______	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS MAH, BAS JHS	

FORM COMPLETED BY BAS	DATE 8/25/13 TIME ~~[illegible]~~ 12:30 AM [✓ PM]	REASON FOR SURVEY

WEATHER CONDITIONS

Now		Past 24 hours
☐	storm (heavy rain)	☐
☐	rain (steady rain)	☐
☐	showers (intermittent)	☒
30 % ☒	%cloud cover	☒ ~~[illegible]~~ 95 %
☒	clear/sunny	☐

Has there been a heavy rain in the last 7 days?
☒ Yes ☐ No

Air Temperature____ °C

Other__________________

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)

STREAM CHARACTERIZATION

Stream Subsystem
☒ Perennial ☐ Intermittent ☐ Tidal

Stream Origin
☒ Glacial
☐ Non-glacial montane
☐ Swamp and bog
☐ Spring-fed
☐ Mixture of origins
☐ Other______

Stream Type
☒ Coldwater ☐ Warmwater

Catchment Area______ km²

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES

Predominant Surrounding Landuse
☒ Forest ☐ Commercial
☐ Field/Pasture ☐ Industrial
☐ Agricultural ☐ Other ______
☐ Residential

Local Watershed NPS Pollution
☒ No evidence ☐ Some potential sources
☐ Obvious sources

Local Watershed Erosion
☒ None ☐ Moderate [illegible]

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present
☒ Trees - evgreen ☐ Shrubs ☐ Grasses ☐ Herbaceous
dominant species present Hemlock, Silver Fir

INSTREAM FEATURES

Estimated Reach Length 100 m
Estimated Stream Width 22 Ft ~~m~~
Sampling Reach Area ______ m²
Area in km² (m²x1000) ______ km²
Estimated Stream Depth 0.5 m
Surface Velocity (at thalweg) ______ m/sec 13.105 / 10 m

Canopy Cover
☒ Partly open ☐ Partly shaded ☐ Shaded
High Water Mark 3.5 m
Proportion of Reach Represented by Stream Morphology Types
☒ Riffle 60 % ☐ Run ______ %
☒ Pool 40 %
Channelized ☐ Yes ☒ No
Dam Present ☒ Yes ☐ No - Natural

LARGE WOODY DEBRIS

LWD 30 m²
Density of LWD ______ m²/km² (LWD/ reach area)

AQUATIC VEGETATION

Indicate the dominant type and record the dominant species present
☐ Rooted emergent ☐ Rooted submergent ☐ Rooted floating ☐ Free floating
☐ Floating Algae ☒ Attached Algae
dominant species present ______
Portion of the reach with aquatic vegetation 2 %

WATER QUALITY

Temperature 9.8 °C
Specific Conductance Horiba: 26 µS/cm Hach: 14 µS/cm
Dissolved Oxygen 10.96
pH Horiba: 5.55 Hach: 7.4
Turbidity 0.0
WQ Instrument Used Horiba / Hach

Water Odors
☒ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other ______

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs ☐ Flecks
☒ None ☐ Other ______

Turbidity (if not measured)
☒ Clear ☐ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other ______

SEDIMENT/ SUBSTRATE

Odors
☐ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☒ None
☐ Other ______

Oils
☒ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits
☐ Sludge ☐ Sawdust ☐ Paper fiber ☒ Sand
☐ Relict shells ☐ Other ______

Looking at stones which are not deeply embedded, are the undersides black in color?
☐ Yes ☒ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**	**Substrate Type**	**Characteristic**	**% Composition in Sampling Area**
Bedrock			Detritus	sticks, wood, coarse plant materials (CPOM)	10
Boulder	> 256 mm (10")	50			
Cobble	64-256 mm (2.5"-10")	45	Muck-Mud	black, very fine organic (FPOM)	0
Gravel	2-64 mm (0.1"-2.5")	2			
Sand	0.06-2mm (gritty)	3	Marl	grey, shell fragments	0
Silt	0.004-0.06 mm				
Clay	< 0.004 mm (slick)				

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME Glacier Creek

LOCATION HC-GC-05

STATION #________ RIVERMILE________

STREAM CLASS

LAT ____________ LONG ____________

RIVER BASIN Skagit

STORET #

AGENCY

INVESTIGATORS MAH, BAS, JMS

FORM COMPLETED BY

DATE 8/25/13
TIME 1347 AM PM

REASON FOR SURVEY

	Habitat Parameter	Condition Category			
		Optimal	**Suboptimal**	**Marginal**	**Poor**
Parameters to be evaluated in sampling reach	**1. Epifaunal Substrate/ Available Cover**	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	SCORE	[✓ 20] 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
	SCORE	[✓ 20] 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
	SCORE	20 19 18 17 [✓ 16]	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
	SCORE	[✓ 20] 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
	SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 [✓ 6]	5 4 3 2 1 0

Rapid Bioassessment Protocols For Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish, Second Edition - Form 2

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

	Habitat Parameter	Condition Category			
		Optimal	Suboptimal	Marginal	Poor
Parameters to be evaluated broader than sampling reach	**6. Channel Alteration**	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
	SCORE	[✓ 20] 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
	SCORE	[✓ 20] 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
	SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 [✓ 1] 0
	SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 [✓ 1] 0
	9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	SCORE ___ (LB)	Left Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0
	SCORE ___ (RB)	Right Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0
	10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
	SCORE ___ (LB)	Left Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0
	SCORE ___ (RB)	Right Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0

Total Score __________

HARTCROWSER

Snorkel Survey Form

PROJECT MCMA
JOB NO. 17800-35
PROJECT MANAGER MAH
FIELD TEAM
SNORKELER(S) BAS

STATION ID HC-GC-05
DATE 8-25-13
START TIME 1020
STOP TIME 1130
WEATHER sunny, high 60's

lake /

	Estimated Length							
Species	**0 to 50 mm**	**51 to 80**	**81 to 100**	**101 to 120**	**121 to 150**	**151 to 200**	**201 to 250**	**>250 mm**
Bull trout ?	||			|	||||	|	||	
Cutthroat								
Rainbow								
Steelhead								
Sculpin								
Chinook								
Whitefish								
Dace								

0 = not snorkelable due to high turbidity or hiding cover
1 = high amount of hiding cover and/or poor water clarity
2 = moderate hiding cover and/or moderate water clarity
3 = little hiding cover and good water clarity

Turbidity
Reach area (m^2)

Comments: ~~lake?~~ BAS 1/16/14

1 >250 mm bull trout in plunge pool immediately below reach

Reviewed by (initials):______
Date:__________

BENTHIC MACROINVERTEBRATE FIELD DATA SHEET

STREAM NAME Glacier Creek	LOCATION HC - GC - 05
STATION #________ RIVERMILE________	STREAM CLASS
LAT __________ LONG __________	RIVER BASIN Skagit
STORET #	AGENCY

INVESTIGATORS LAH, BAS, JMS	LOT NUMBER
FORM COMPLETED BY	DATE 8/25/13 TIME 12:30 AM PM	REASON FOR SURVEY

HABITAT TYPES

Indicate the percentage of each habitat type present
☒ Cobble 80 % ☒ Snags 15 % ☐ Vegetated Banks____% ☒ Sand 3 %
☐ Submerged Macrophytes____% ☒ Other (gravel) 2 %

SAMPLE COLLECTION

Gear used ☒ D-frame ☐ kick-net ☐ Other ____________

How were the samples collected? ☒ wading ☐ from bank ☐ from boat

Indicate the number of jabs/kicks taken in each habitat type.
☒ Cobble 8 ☐ Snags____ ☐ Vegetated Banks____ ☐ Sand____
☐ Submerged Macrophytes____ ☐ Other ( )____

GENERAL COMMENTS

2 tailed frog tadpoles, 1 adult, wide variety of species

QUALITATIVE LISTING OF AQUATIC BIOTA

Indicate estimated abundance: 0 = Absent/Not Observed, 1 = Rare, 2 = Common, 3= Abundant, 4 = Dominant

Periphyton	0	1	[✓ 2]	3	4	Slimes	[✓ 0]	1	2	3	4
Filamentous Algae	0	[✓ 1]	2	3	4	Macroinvertebrates	0	1	2	[✓ 3]	4
Macrophytes	[✓ 0]	1	2	3	4	Fish	0	1	[✓ 2]	3	4

FIELD OBSERVATIONS OF MACROBENTHOS

Indicate estimated abundance: 0 = Absent/Not Observed, 1 = Rare (1-3 organisms), 2 = Common (3-9 organisms), 3= Abundant (>10 organisms), 4 = Dominant (>50 organisms)

Porifera	0	1	2	3	4	Anisoptera	0	1	2	3	4	Chironomidae	0	1	2	3	4
Hydrozoa	0	1	2	3	4	Zygoptera	0	1	2	3	4	Ephemeroptera	0	1	2	3	4
Platyhelminthes	0	1	2	3	4	Hemiptera	0	1	2	3	4	Trichoptera	0	1	2	3	4
Turbellaria	0	1	2	3	4	Coleoptera	0	1	2	3	4	Other	0	1	2	3	4
Hirudinea	0	1	2	3	4	Lepidoptera	0	1	2	3	4						
Oligochaeta	0	1	2	3	4	Sialidae	0	1	2	3	4						
Isopoda	0	1	2	3	4	Corydalidae	0	1	2	3	4						
Amphipoda	0	1	2	3	4	Tipulidae	0	1	2	3	4						
Decapoda	0	1	2	3	4	Empididae	0	1	2	3	4						
Gastropoda	0	1	2	3	4	Simuliidae	0	1	2	3	4						
Bivalvia	0	1	2	3	4	Tabinidae	0	1	2	3	4						
						Culcidae	0	1	2	3	4						

PERIPHYTON FIELD DATA SHEET

STREAM NAME Glacier Creek	LOCATION HC - GC-05	
STATION #________ RIVERMILE________	STREAM CLASS	
LAT ____________ LONG ____________	RIVER BASIN Skagit	
STORET #	AGENCY	
INVESTIGATORS MAH, BAS, JMS		LOT NUMBER
FORM COMPLETED BY	DATE 8/25/13 TIME 12:00 AM [✓ PM]	REASON FOR SURVEY

HABITAT TYPES

Indicate the percentage of each habitat type present

☒ Sand-Silt-Mud-Muck 1 % ☒ Gravel-Cobble 80 % ☐ Bedrock_____%
☐ Small Woody Debris 4 % ☐ Large Woody Debris 15 % ☐ Plants, Roots_____%
☒ Riffle 60 % ☐ Run_____% ☒ Pool 40 %
☐ Canopy 0 %

SAMPLE COLLECTION

Gear used ☐ suction device ☐ bar clamp sample ☒ scraping ☐ Other ________________

How were the samples collected? ☒ wading ☐ from bank ☐ from boat

If natural habitat collections, indicate the number of samples taken in each habitat type.

☐ Sand-Silt-Mud-Muck_____% ☐ Gravel-Cobble 100 % ☐ Bedrock_____%
☐ Small Woody Debris_____% ☐ Large Woody Debris_____% ☐ Plants, Roots_____%

GENERAL COMMENTS

20 mL, Filtered Much, Much Faster than previous samples, less difference in color in scrubbed vs. unscrubbed portions of rock. Less periphyton here?
12:47 - 13:22

QUALITATIVE LISTING OF AQUATIC BIOTA

Indicate estimated abundance: **0 = Absent/Not Observed, 1 = Rare (<5%), 2 = Common (5% - 30%), 3= Abundant (30% - 70%), 4 = Dominant (>70%)**

Periphyton	0 1 [✓ 2] 3 4	Slimes	[✓ 0] 1 2 3 4
Filamentous Algae	0 [✓ 1] 2 3 4	Macroinvertebrates	0 1 2 [✓ 3] 4
Macrophytes	[✓ 0] 1 2 3 4	Fish	0 1 [✓ 2] 3 4

Rapid Bioassessment Protocols For Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish, Second Edition - Form 1

HARTCROWSER

Chemistry Sampling Form

PROJECT MCMA

JOB NO.

PROJECT MANAGER MAH

FIELD TEAM MAH, BAS, JMS

WQ instrument Horiba

Operator MAH

STATION ID HC-GC-05

DATE/TIME SAMPLED 8/25/13 - 1425

STREAM DEPTH 0.5m

STREAM VELOCITY

SAMPLE DEPTH integrated

Lat

Long

	Calibrated	Start Time	End Time
T (deg C)	Y N		
DO (mg/L)	Y N		
pH	Y N		
Cond (uS/cm)	Y N		
Turb. (NTU)	Y N		

Water quality comments:
(color, odor, sheen)

Sample ID (ex. HC13-SW-SFSR09)	Bottle type	# of Containers	Analyses	Preservative	Filter
HC-GC-05D	FLPE	1	Hg	N	Y
HC-GC-05	HDPE	1	Anions	N	Y
HC-GC-05D	HDPE	1	Metals	N	Y
HC-GC-05D	HDPE	1	Metals	Y	Y
HC-GC-05	HDPE	1	Metals	Y	N
HC-GC-05	HDPE	1	Alk	N	N
HC-GC-05	HDPE	1	Metals	N	N
HC-GC-05	FLPE	1	Hg	N	N

Total number of bottles 8

Duplicate Sample ID -

Field Blank ID -

Rinsate Sample ID -

Sediment # of locations for composite

	%Gravel
	%Sand
	%Fines

Comments:

Reviewed by (initials):______
Date:______

Photograph 4 – August 25, 2013. View downstream from mid-reach.

Photograph 5 – August 25, 2013. View upstream from start of reach.

Photograph 6 – August 8, 2013. Juvenile bull trout were present within the reach.

Photograph 7 – August 8, 2013. Historical human disturbance from mining activities were evident within the reach.

Seventysix Gulch
HC-76-02

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double-sided printing.

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET
(FRONT)

STREAM NAME	LOCATION	
STATION # FC-76-02 RIVERMILE ______	STREAM CLASS	
LAT ______ LONG ______	RIVER BASIN	
STORET #	AGENCY	
INVESTIGATORS MAH, BAS, JMS		
FORM COMPLETED BY BAS	DATE 8/26/13 TIME 1200 AM [✓ PM]	REASON FOR SURVEY

WEATHER CONDITIONS	**Now**		**Past 24 hours**	**Has there been a heavy rain in the last 7 days?** ☑ Yes ☐ No
	☐	storm (heavy rain)	☐	**Air Temperature** 60 °C
	☐	rain (steady rain)	☑	
	☐	showers (intermittent)	☐	**Other** ______
	40 % ☑	%cloud cover	☑ 100 %	
	☐	clear/sunny	☐	

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)

STREAM CHARACTERIZATION

Stream Subsystem
☑ Perennial ☐ Intermittent ☐ Tidal

Stream Origin
☑ Glacial
☐ Non-glacial montane
☐ Swamp and bog
☐ Spring-fed
☐ Mixture of origins
☐ Other ______

Stream Type
☑ Coldwater ☐ Warmwater

Catchment Area ______ km²

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES

Predominant Surrounding Landuse
☒ Forest ☐ Commercial
☐ Field/Pasture ☐ Industrial
☐ Agricultural ☐ Other ______
☐ Residential

Local Watershed NPS Pollution
☒ No evidence ☐ Some potential sources
☐ Obvious sources

Local Watershed Erosion
☒ None ☐ Moderate ☐ Heavy

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present
☒ Trees ☒ Shrubs ☐ Grasses ☐ Herbaceous

dominant species present Silver fir, salmonberry, huckleberry

INSTREAM FEATURES

Estimated Reach Length 100 m
Estimated Stream Width 11.5 ~~m~~ ft
Sampling Reach Area ______ m^2
Area in km^2 (m^2x1000) ______ km^2
Estimated Stream Depth 0.6 m
Surface Velocity (at thalweg) ______ m/sec
23 ft /11.78 sec

Canopy Cover
☐ Partly open ☐ Partly shaded ☒ Shaded

High Water Mark 1 m

Proportion of Reach Represented by Stream Morphology Types
☒ Riffle 50 % ☐ Run ______ %
☒ Pool 50 %

Channelized ☐ Yes ☒ No

Dam Present ☐ Yes ☒ No

LARGE WOODY DEBRIS

LWD 19 m^2
Density of LWD ______ m^2/km^2 **(LWD/ reach area)**

AQUATIC VEGETATION

Indicate the dominant type and record the dominant species present
☐ Rooted emergent ☐ Rooted submergent ☐ Rooted floating ☐ Free floating
☐ Floating Algae ☐ Attached Algae

dominant species present ______

Portion of the reach with aquatic vegetation 0 %

WATER QUALITY

Temperature 8.3 °C
Specific Conductance 0.029 J 0.017
Dissolved Oxygen 10.93
pH 6.7 Jason's 7.06 bottle 7.42 stream
Turbidity 0.0 drinking
WQ Instrument Used Horiba

Water Odors
☒ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other ______

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs ☐ Flecks
☒ None ☐ Other ______

Turbidity (if not measured)
☐ Clear ☐ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other ______

SEDIMENT/ SUBSTRATE

Odors
☒ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☒ None
☐ Other ______

Oils
☒ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits
☐ Sludge ☐ Sawdust ☐ Paper fiber ☒ Sand
☐ Relict shells ☐ Other ______

Looking at stones which are not deeply embedded, are the undersides black in color?
☐ Yes ☒ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)

Substrate Type	Diameter	% Composition in Sampling Reach
Bedrock		
Boulder	> 256 mm (10")	80
Cobble	64-256 mm (2.5"-10")	12
Gravel	2-64 mm (0.1"-2.5")	5
Sand	0.06-2mm (gritty)	3
Silt	0.004-0.06 mm	
Clay	< 0.004 mm (slick)	

ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)

Substrate Type	Characteristic	% Composition in Sampling Area
Detritus	sticks, wood, coarse plant materials (CPOM)	
Muck-Mud	black, very fine organic (FPOM)	
Marl	grey, shell fragments	

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME 716 Creek	LOCATION #C- 716-07
STATION #________ RIVERMILE________	STREAM CLASS
LAT ________ LONG ________	RIVER BASIN Skagit
STORET #	AGENCY
INVESTIGATORS MAH BAS JMS	
FORM COMPLETED BY	DATE 8/26/13 TIME 1106 [✓ AM] PM REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	[✓ 20] 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE	20 19 [✓ 18] 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE	20 19 18 17 [✓ 16]	[✓ 15] 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	[✓ 20] 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 [✓ 8] 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	**Condition Category**			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	[✓ 20] 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE	[✓ 20] 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 [✓ 7] 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0

Total Score __________

HARTCROWSER

Snorkel Survey Form

PROJECT MCMA
JOB NO. 17800-35
PROJECT MANAGER MAH
FIELD TEAM JMS, BAS, MAH
SNORKELER(S) BAS

STATION ID HC-76-02
DATE 8-26-13
START TIME 0907
STOP TIME 0941
WEATHER partly sunny, 60F

	Estimated Length							
Species	**0 to 50 mm**	**51 to 80**	**81 to 100**	**101 to 120**	**121 to 150**	**151 to 200**	**201 to 250**	**>250 mm**
Bull trout								
Cutthroat								
Rainbow								
Steelhead								
Sculpin								
Chinook								
Whitefish								
Dace								

0 = not snorkelable due to high turbidity or hiding cover
1 = high amount of hiding cover and/or poor water clarity
2 = moderate hiding cover and/or moderate water clarity
3 = little hiding cover and good water clarity

Turbidity
Reach area (m^2)

Comments:

NO FISH

Reviewed by (initials):
Date:

BENTHIC MACROINVERTEBRATE FIELD DATA SHEET

S REAM NAME 76 Creek	LOCATION HC-76-02	
STATION #_____ RIVERMILE_____	STREAM CLASS	
LAT _____ LONG _____	RIVER BASIN Skagit	
STORET #	AGENCY	
INVESTIGATORS MAH BAB JTS		LOT NUMBER
FORM COMPLETED BY	DATE 8/26/13 TIME 1000 [✓ AM] PM	REASON FOR SURVEY

HABITAT TYPES	**Indicate the percentage of each habitat type present** ☑ Cobble 10 % ☑ Snags 10 % ☐ Vegetated Banks____% ☑ Sand 5 % ☐ Submerged Macrophytes____% ☐ Other (Boulder) 75 %
SAMPLE COLLECTION	**Gear used** ☒ D-frame ☐ kick-net ☐ Other _____ **How were the samples collected?** ☒ wading ☐ from bank ☐ from boat **Indicate the number of jabs/kicks taken in each habitat type.** ☑ Cobble 8 ☐ Snags____ ☐ Vegetated Banks____ ☐ Sand____ ☐ Submerged Macrophytes____ ☐ Other ( )____
GENERAL COMMENTS	tailed Frog tadpole. Inverts abundant and specious

QUALITATIVE LISTING OF AQUATIC BIOTA
Indicate estimated abundance: 0 = Absent/Not Observed, 1 = Rare, 2 = Common, 3= Abundant, 4 = Dominant

Periphyton	0	1	[✓ 2]	3	4	Slimes	[✓ 0]	1	2	3	4
Filamentous Algae	[✓ 0]	1	2	3	4	Macroinvertebrates	0	1	2	[✓ 3]	4
Macrophytes	[✓ 0]	1	2	3	4	Fish	[✓ 0]	1	2	3	4

FIELD OBSERVATIONS OF MACROBENTHOS
Indicate estimated abundance: 0 = Absent/Not Observed, 1 = Rare (1-3 organisms), 2 = Common (3-9 organisms), 3= Abundant (>10 organisms), 4 = Dominant (>50 organisms)

Porifera	0	1	2	3	4	Anisoptera	0	1	2	3	4	Chironomidae	0	1	2	3	4
Hydrozoa	0	1	2	3	4	Zygoptera	0	1	2	3	4	Ephemeroptera	0	1	2	3	4
Platyhelminthes	0	1	2	3	4	Hemiptera	0	1	2	3	4	Trichoptera	0	1	2	3	4
Turbellaria	0	1	2	3	4	Coleoptera	0	1	2	3	4	Other	0	1	2	3	4
Hirudinea	0	1	2	3	4	Lepidoptera	0	1	2	3	4						
Oligochaeta	0	1	2	3	4	Sialidae	0	1	2	3	4						
Isopoda	0	1	2	3	4	Corydalidae	0	1	2	3	4						
Amphipoda	0	1	2	3	4	Tipulidae	0	1	2	3	4						
Decapoda	0	1	2	3	4	Empididae	0	1	2	3	4						
Gastropoda	0	1	2	3	4	Simuliidae	0	1	2	3	4						
Bivalvia	0	1	2	3	4	Tabinidae	0	1	2	3	4						
						Culcidae	0	1	2	3	4						

PERIPHYTON FIELD DATA SHEET

STREAM NAME 76 Creek	LOCATION AC - 76 - 02
STATION #________ RIVERMILE________	STREAM CLASS
LAT ____________ LONG ____________	RIVER BASIN Skagit
STORET #	AGENCY
INVESTIGATORS MAH BAS JMS	LOT NUMBER
FORM COMPLETED BY	DATE 8/26/13 TIME 1000 [✓ AM] PM
	REASON FOR SURVEY

HABITAT TYPES	**Indicate the percentage of each habitat type present** 19 6 Boulder 76 ☐ Sand-Silt-Mud-Muck 2 % ☐ Gravel-Cobble [illegible] % ☐ Bedrock [illegible] % ☐ Small Woody Debris 2 % ☐ Large Woody Debris 10 % ☐ Plants, Roots_____% ☒ Riffle 50 % ☒ Run [illegible] % ☒ Pool 50 % ☐ Canopy_____%
SAMPLE COLLECTION	**Gear used** ☐ suction device ☐ bar clamp sample ☒ scraping ☐ Other __________ **How were the samples collected?** ☒ wading ☐ from bank ☐ from boat **If natural habitat collections, indicate the number of samples taken in each habitat type.** ☐ Sand-Silt-Mud-Muck_____% ☒ Gravel-Cobble [illegible] % ☐ Bedrock_____% ☐ Small Woody Debris_____% ☐ Large Woody Debris_____% ☐ Plants, Roots_____%
GENERAL COMMENTS	Not much persplyton - Low Sunlight. 10:12 - 10:17

QUALITATIVE LISTING OF AQUATIC BIOTA

Indicate estimated abundance: 0 = Absent/Not Observed, 1 = Rare (<5%), 2 = Common (5% - 30%), 3= Abundant (30% - 70%), 4 = Dominant (>70%)

Periphyton	0	1	[✓ 2]	3	4	Slimes	[✓ 0]	1	2	3	4
Filamentous Algae	[✓ 0]	1	2	3	4	Macroinvertebrates	0	[✓ 1]	2	3	4
Macrophytes	[✓ 0]	1	2	3	4	Fish	[✓ 0]	1	2	3	4

HARTCROWSER

Chemistry Sampling Form

PROJECT McMA
JOB NO.
PROJECT MANAGER MAH
FIELD TEAM MAH, BAS, JMS

STATION ID HC-76-02
DATE/TIME SAMPLED 8/26/13 - 1200 pm
STREAM DEPTH
STREAM VELOCITY
SAMPLE DEPTH integrated

WQ instrument
Operator
Lat
Long

	Calibrated	Start Time 10 45	End Time
T (deg C)	Y N		
DO (mg/L)	Y N		
pH	Y N		
Cond (uS/cm)	Y N		
Turb. (NTU)	Y N		

Water quality comments:
(color, odor, sheen)

Sample ID (ex. HC13-SW-SFSR09)	Bottle type	# of Containers	Analyses	Preservative	Filter
HC-76-02D	FLPE	1	Hg	N	Y
HC-76-02	HDPE	1	Anion	N	Y
HC-76-02D	HDPE	1	Total Metals	N	Y
HC-76-02D	HDPE	1	Metals	Y	Y
HC-76-02	HDPE	1	Metals	Y	N
HC-76-02	HDPE	1	Alk	N	N
HC-76-02	HDPE	1	Total Metals	N	N

Total number of bottles
Duplicate Sample ID
Field Blank ID
Rinsate Sample ID

Sediment # of locations for composite

	%Gravel
	%Sand
	%Fines

Comments:

C:\PROJECTS\35_MCMA\Deliverables\SAP\Appendix B - datasheets\ChemistrySamplingForms.xls

Reviewed by (initials):
Date:

Photograph 8 – August 26, 2013. Downstream end of reach.

Photograph 9 – August 26, 2013. View upstream from mid-reach.

Photograph 10 – August 26, 2013. View downstream from mid-reach

Photograph 11 – August 26, 2013. View downstream from start of reach.

South Fork Sauk River
HC-SFSR-03

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double-sided printing.

South Fork Sauk River
HC-SFSR-03
JULY

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double-sided printing.

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME	LOCATION HC-SFSR-03
STATION #________ RIVERMILE________	STREAM CLASS
LAT ____________ LONG ____________	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS BAS, MAH, CMH	
FORM COMPLETED BY MAH	DATE 1230 TIME ________ AM [✓ PM]
	REASON FOR SURVEY

WEATHER CONDITIONS

Now		Past 24 hours
☐	storm (heavy rain)	☐
☐	rain (steady rain)	☐
☐	showers (intermittent)	☐
____%☐	%cloud cover	☐____%
☒	clear/sunny	☒

Has there been a heavy rain in the last 7 days?
☐ Yes ☒ No

Air Temperature ____ 83F

Other ______________________

SITE LOCATION/MAP

6809
L. DS @ B2

6812
L. US @ B8

6813
L. DS @ DS end

6814
L. US from DS end

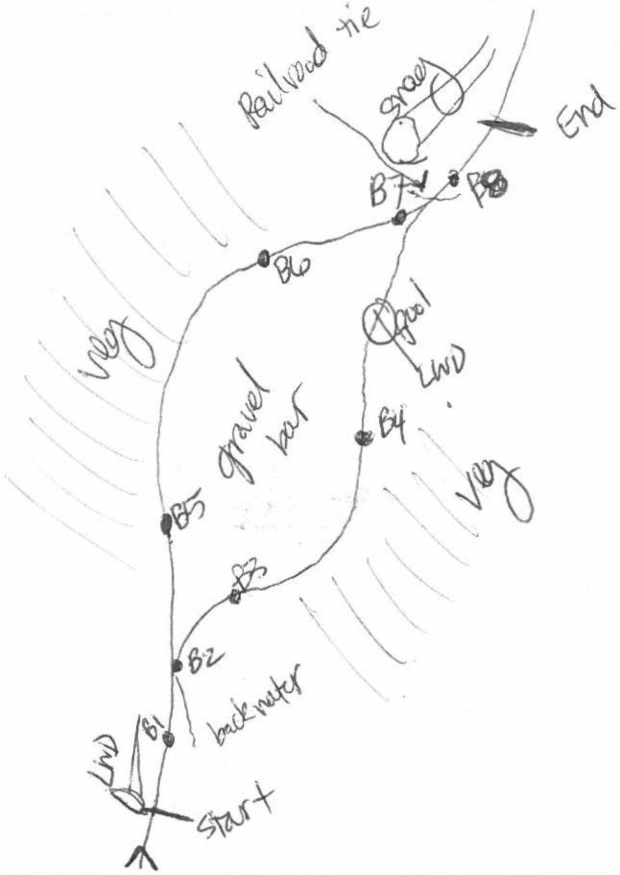
6815
L. @ RB pool from gravel bar

6816
L. DS from B2

6817
L. @ LB from B2

6818
L. US from B5

Draw a map of the site and indicate the areas sampled (or attach a photograph)



STREAM CHARACTERIZATION

Stream Subsystem
☒ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☒ Coldwater ☐ Warmwater

Stream Origin
☐ Glacial
☒ Non-glacial montane
☐ Swamp and bog
☐ Spring-fed
☐ Mixture of origins
☐ Other__________

Catchment Area__________km²

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES

Predominant Surrounding Landuse
☒ Forest ☐ Commercial
☐ Field/Pasture ☐ Industrial
☐ Agricultural ☐ Other ____________
☐ Residential

Local Watershed NPS Pollution
☒ No evidence ☐ Some potential sources
☐ Obvious sources

Local Watershed Erosion
☐ None ☒ Moderate ☐ Heavy

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present
☒ Trees ☐ Shrubs ☐ Grasses ☐ Herbaceous

dominant species present Alder

INSTREAM FEATURES

Estimated Reach Length 113 ~~m~~ y
Estimated Stream Width ~~[illegible]~~ ~~m~~ 18 y
Sampling Reach Area ______ m²
Area in km² (m²x1000) ______ km²
Estimated Stream Depth 18 ~~[illegible]~~ in"
Surface Velocity (at thalweg) 2.075 m/sec

Canopy Cover
☒ Partly open ☐ Partly shaded ☐ Shaded

High Water Mark 2 m

Proportion of Reach Represented by Stream Morphology Types
☒ Riffle 50 % ☐ Run ______ %
☒ Pool 50 %

Channelized ☐ Yes ☒ No
Dam Present ☐ Yes ☒ No

LARGE WOODY DEBRIS

LWD 332 ~~x~~ ft²
Density of LWD ______ m²/km² (LWD/ reach area)

AQUATIC VEGETATION

Indicate the dominant type and record the dominant species present
☐ Rooted emergent ☐ Rooted submergent ☐ Rooted floating ☐ Free floating
☐ Floating Algae ☒ Attached Algae

dominant species present ____________________

Portion of the reach with aquatic vegetation 30 %

WATER QUALITY

Temperature 7.48 °C
Specific Conductance 0.011
Dissolved Oxygen 15.49
pH 5.91
Turbidity 0
WQ Instrument Used Horibe

Water Odors
☒ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other ____________

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs ☐ Flecks
☒ None ☐ Other ____________

Turbidity (if not measured)
☒ Clear ☐ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other ______

SEDIMENT/ SUBSTRATE

Odors
☒ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other ____________

Oils
☒ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits NONE
☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand
☐ Relict shells ☐ Other ____________

Looking at stones which are not deeply embedded, are the undersides black in color?
☐ Yes ☒ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)

Substrate Type	Diameter	% Composition in Sampling Reach
Bedrock		0
Boulder	> 256 mm (10")	35
Cobble	64-256 mm (2.5"-10")	57
Gravel	2-64 mm (0.1"-2.5")	8
Sand	0.06-2mm (gritty)	0
Silt	0.004-0.06 mm	0
Clay	< 0.004 mm (slick)	0

ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)

Substrate Type	Characteristic	% Composition in Sampling Area
Detritus	sticks, wood, coarse plant materials (CPOM)	10
Muck-Mud	black, very fine organic (FPOM)	0
Marl	grey, shell fragments	0

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME	LOCATION HC-SFSR-03
STATION #______ RIVERMILE______	STREAM CLASS
LAT ______ LONG ______	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS BAS, MAH CMH	
FORM COMPLETED BY MAH	DATE 7/10/13 TIME 1230 AM [✓ PM] REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 [✓ 18] 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE	[✓ 20] 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime not much slow-shallow	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE	20 19 [✓ 18] 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	[✓ 15] 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	[✓ 10] 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	[✓ 20] 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE	[✓ 20] 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	[✓ 8] 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0

Total Score ________

HARTCROWSER

Snorkel Survey Form

PROJECT Monte Cristo

JOB NO. 17800-35

PROJECT MANAGER MAH

FIELD TEAM BAS MAH, CMH

SNORKELER(S) BAS, MAH

STATION ID HC-SFSR-03

DATE 7/10/13

START TIME 1125

STOP TIME 1205 - look @ pic times

WEATHER sunny, light breeze, 83F

	Estimated Length							
Species	**0 to 50 mm**	**51 to 80**	**81 to 100**	**101 to 120**	**121 to 150**	**151 to 200**	**201 to 250**	**>250 mm**
Bull trout		I	II			I		
Cutthroat						I		
Rainbow			[illegible]			I		
Steelhead								
Sculpin								
Chinook								
Whitefish								
Dace								
Unk. Trout	I							

0 = not snorkelable due to high turbidity or hiding cover
1 = high amount of hiding cover and/or poor water clarity
2 = moderate hiding cover and/or moderate water clarity
3 = little hiding cover and good water clarity

Turbidity ______

Reach area (m^2) ______

Comments:

Unk. Trout = Rainbow or Cutthroat

Reviewed by (initials): ______

Date: ______

BENTHIC MACROINVERTEBRATE FIELD DATA SHEET

STREAM NAME HC - SFSR - 03	LOCATION
STATION #________ RIVERMILE________	STREAM CLASS
LAT ____________ LONG ____________	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS MAH, BAS, CMH	LOT NUMBER
FORM COMPLETED BY	DATE 7/10/13 TIME 3:30 AM [✓ PM] REASON FOR SURVEY

HABITAT TYPES	**Indicate the percentage of each habitat type present** ☐ Cobble_____% ☐ Snags_____% ☐ Vegetated Banks_____% ☐ Sand_____% ☐ Submerged Macrophytes_____% ☐ Other ( )_____%
SAMPLE COLLECTION	**Gear used** ☒ D-frame ☐ kick-net ☐ Other ____________ **How were the samples collected?** ☒ wading ☐ from bank ☐ from boat **Indicate the number of jabs/kicks taken in each habitat type.** ☒ Cobble 100% ☐ Snags_____ ☐ Vegetated Banks_____ ☐ Sand_____ ☐ Submerged Macrophytes_____ ☐ Other ( )_____
GENERAL COMMENTS	Lot's of Macroinverts + diverse. Saw a tailed-frog tadpole

QUALITATIVE LISTING OF AQUATIC BIOTA

Indicate estimated abundance: 0 = Absent/Not Observed, 1 = Rare, 2 = Common, 3= Abundant, 4 = Dominant

Periphyton	0	[✓ 1]	2	3	4	Slimes	[✓ 0]	1	2	3	4
Filamentous Algae	0	1	[✓ 2]	3	4	Macroinvertebrates	0	1	2	[✓ 3]	4
Macrophytes	[✓ 0]	1	2	3	4	Fish	0	[✓ 1]	2	3	4

FIELD OBSERVATIONS OF MACROBENTHOS

Indicate estimated abundance: 0 = Absent/Not Observed, 1 = Rare (1-3 organisms), 2 = Common (3-9 organisms), 3= Abundant (>10 organisms), 4 = Dominant (>50 organisms)

Porifera	0	1	2	3	4	Anisoptera	0	1	2	3	4	Chironomidae	0	1	2	3	4
Hydrozoa	0	1	2	3	4	Zygoptera	0	1	2	3	4	Ephemeroptera	0	1	2	3	4
Platyhelminthes	0	1	2	3	4	Hemiptera	0	1	2	3	4	Trichoptera	0	1	2	3	4
Turbellaria	0	1	2	3	4	Coleoptera	0	1	2	3	4	Other	0	1	2	3	4
Hirudinea	0	1	2	3	4	Lepidoptera	0	1	2	3	4						
Oligochaeta	0	1	2	3	4	Sialidae	0	1	2	3	4						
Isopoda	0	1	2	3	4	Corydalidae	0	1	2	3	4						
Amphipoda	0	1	2	3	4	Tipulidae	0	1	2	3	4						
Decapoda	0	1	2	3	4	Empididae	0	1	2	3	4						
Gastropoda	0	1	2	3	4	Simuliidae	0	1	2	3	4						
Bivalvia	0	1	2	3	4	Tabinidae	0	1	2	3	4						
						Culcidae	0	1	2	3	4						

PERIPHYTON FIELD DATA SHEET

STREAM NAME HC-SFSR-03	LOCATION
STATION #________ RIVERMILE________	STREAM CLASS
LAT ____________ LONG ____________	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS BAS MAH CMH	LOT NUMBER
FORM COMPLETED BY	DATE 7/10/13 TIME 13:30 AM [✓ PM]
	REASON FOR SURVEY

HABITAT TYPES

Indicate the percentage of each habitat type present
☐ Sand-Silt-Mud-Muck_____% ☒ Gravel-Cobble 90 % ☐ Bedrock_____%
☐ Small Woody Debris_____% ☒ Large Woody Debris 10 % ☐ Plants, Roots_____%
☒ Riffle 50 % ☐ Run_____% ☒ Pool 50 %
☐ Canopy_____%

SAMPLE COLLECTION

Gear used ☐ suction device ☐ bar clamp sample ☒ scraping ☐ Other ____________________

How were the samples collected? ☒ wading ☐ from bank ☐ from boat

If natural habitat collections, indicate the number of samples taken in each habitat type.
☐ Sand-Silt-Mud-Muck_____% ☒ Gravel-Cobble 100 % ☐ Bedrock_____%
☐ Small Woody Debris_____% ☐ Large Woody Debris_____% ☐ Plants, Roots_____%

GENERAL COMMENTS

Much more attached algae in downstream portions of the reach

QUALITATIVE LISTING OF AQUATIC BIOTA

Indicate estimated abundance: **0 = Absent/Not Observed, 1 = Rare (<5%), 2 = Common (5% - 30%), 3= Abundant (30% - 70%), 4 = Dominant (>70%)**

Periphyton	0	[✓ 1]	2	3	4	Slimes	[✓ 0]	1	2	3	4
Filamentous Algae	0	1	[✓ 2]	3	4	Macroinvertebrates	0	1	2	[✓ 3]	4
Macrophytes	[✓ 0]	1	2	3	4	Fish	0	[✓ 1]	2	3	4

Rapid Bioassessment Protocols For Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish, Second Edition - Form 1

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double-sided printing.

South Fork Sauk River

HC-SFSR-03

AUGUST

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double-sided printing.

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET
(FRONT)

STREAM NAME SF Sauk	LOCATION HC-SPSR-03	
STATION # SFSR-03 RIVERMILE ________	STREAM CLASS	
LAT ____________ LONG ____________	RIVER BASIN Skagit	
STORET #	AGENCY	
INVESTIGATORS MAH, RAS, JMS		
FORM COMPLETED BY	DATE ________ TIME ________ AM PM	REASON FOR SURVEY RI

WEATHER CONDITIONS

Now		Past 24 hours
☐	storm (heavy rain)	☐
☐	rain (steady rain)	☐
☐	showers (in ermittent)	☐
90 % ☑	%cloud cover	☐ ____ %
☐	clear/sunny	☑

Has there been a heavy rain in the last 7 days?
☐ Yes ☑ No

Air Temperature _____ °C

Other ______________________________

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)

STREAM CHARACTERIZATION

Stream Subsystem
☑ Perennial ☐ Intermittent ☐ Tidal

Stream Origin
☑ Glacial
☐ Non-glacial montane
☐ Swamp and bog
☐ Spring-fed
☐ Mixture of origins
☐ Other__________

Stream Type
☑ Coldwater ☐ Warmwater

Catchment Area__________km²

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES

Predominant Surrounding Landuse
☑ Forest
☐ Field/Pasture
☐ Agricultural
☐ Residential
☐ Commercial
☐ Industrial
☐ Other ______________

Local Watershed NPS Pollution
☑ No evidence ☐ Some potential sources
☐ Obvious sources

Local Watershed Erosion
☑ None ☐ Moderate ☐ Heavy

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present
☑ Trees ☐ Shrubs ☐ Grasses ☐ Herbaceous

dominant species present alder and sitka willow

INSTREAM FEATURES

Estimated Reach Length ______m
Estimated Stream Width ______ m
Sampling Reach Area ______m²
Area in km² (m²x1000) ______km²
Estimated Stream Depth ______m
Surface Velocity (at thalweg) ______m/sec 26.82 sec | 10M

Canopy Cover
☐ Partly open ☐ Partly shaded ☐ Shaded

High Water Mark ______m

Proportion of Reach Represented by Stream Morphology Types
☐ Riffle______% ☐ Run______%
☐ Pool______%

Channelized ☐ Yes ☐ No

Dam Present ☐ Yes ☐ No

LARGE WOODY DEBRIS

LWD 36 m²
Density of LWD ______m²/km² (LWD/ reach area)

AQUATIC VEGETATION

Indicate the dominant type and record the dominant species present
☐ Rooted emergent ☐ Rooted submergent ☐ Rooted floating ☐ Free floating
☐ Floating Algae ☑ Attached Algae

dominant species present took pictures on silver

Portion of the reach with aquatic vegetation 50 %

WATER QUALITY

Temperature______ °C
Specific Conductance______
Dissolved Oxygen ______
pH ______
Turbidity ______
WQ Instrument Used ______________

Water Odors
☐ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other______________

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs ☐ Flecks
☐ None ☐ Other______________

Turbidity (if not measured)
☐ Clear ☐ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other______

SEDIMENT/ SUBSTRATE

Odors
☐ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☑ None
☐ Other______________________

Oils
☑ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits
☐ Sludge ☐ Sawdust ☐ Paper fiber ☑ Sand
☐ Relict shells ☐ Other______________

Looking at stones which are not deeply embedded, are the undersides black in color?
☐ Yes ☑ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)

Substrate Type	Diameter	% Composition in Sampling Reach
Bedrock		0
Boulder	> 256 mm (10")	0
Cobble	64-256 mm (2.5"-10")	80
Gravel	2-64 mm (0.1"-2.5")	15
Sand	0.06-2mm (gritty)	5
Silt	0.004-0.06 mm	
Clay	< 0.004 mm (slick)	

ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)

Substrate Type	Characteristic	% Composition in Sampling Area
Detritus	sticks, wood, coarse plant materials (CPOM)	5
Muck-Mud	black, very fine organic (FPOM)	0
Marl	grey, shell fragments	0

Jason Shira's (ECY) Notes
HC-SFSR-03

Water Samples

- partially filled TM (ARI) with filtered water ~100 mL

$$1000 \; \frac{\cancel{m}^2}{} \left| \frac{1km}{1000 \cancel{m}} \right| \frac{1km}{1000 \cancel{m}} = \frac{1}{1000000} \quad \frac{1}{1000}$$

8/23/13 SFSR-03

weather: 90% Clouds, 0 wind, mid 70's

snorkel: ~12:30

Water Quality: 12:50

width (ft): 35'

depth

velocity

		horiba	Hach
12:45 deploy	Temp:	10.4	
14:30	DO:	10.59	6.64
	pH:	5.55	
	EC:	29 µS/cm	~16
	Turbidity:	< 5 NTU	
		30-50	

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME SF Sauk
LOCATION HC - SFSR - 03
STATION # SFSR-03 RIVERMILE ________
STREAM CLASS
LAT ____________ LONG ____________
RIVER BASIN Skagit
STORET #
AGENCY
INVESTIGATORS HAH, BAS, JMS
FORM COMPLETED BY
DATE 8/23/13
TIME 16:47 AM PM
REASON FOR SURVEY RI

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	[✓ 20] 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE	20 19 18 17 [✓ 16]	~~15~~ 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE	20 19 18 17 16	15 14 ~~13~~ 12 [✓ 11]	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	[✓ 10] 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 [✓ 8] 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	[✓ 20] 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE	[✓ 20] 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	[✓ 8] 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	[✓ 8] 7 6	5 4 3	2 1 0

Total Score __________

HARTCROWSER

Snorkel Survey Form

PROJECT MCMA

JOB NO.

PROJECT MANAGER M. Havey

FIELD TEAM MAH, BAS, JMS

SNORKELER(S) MAH + BAS

STATION ID HC-SFSR-03

DATE 8/23/13

START TIME 1230

STOP TIME 1302

WEATHER 90% Cloud cover, mid 70s, 0 wind

	Estimated Length							
Species	**0 to 50 mm**	**51 to 80**	**81 to 100**	**101 to 120**	**121 to 150**	**151 to 200**	**201 to 250**	**>250 mm**
Bull trout	Lake?			2	1		1	
Cutthroat								
Rainbow								
Steelhead								
Sculpin								
Chinook								
Whitefish								
Dace								
unID trout				2				
				likely same species as above				

0 = not snorkelable due to high turbidity or hiding cover
1 = high amount of hiding cover and/or poor water clarity
2 = moderate hiding cover and/or moderate water clarity
3 = little hiding cover and good water clarity

Turbidity

Reach area (m^2)

Comments: unclear whether specimens are Bull trout, Brown trout, or other. Photos taken for verification. un-ID trout were seen too briefly for ID. Largest fish either extremely Bold or perhaps too lethargic to care. Smaller fish were all extremely skittish.

Suspect lake trout.

Reviewed by (initials):

Date:

BENTHIC MACROINVERTEBRATE FIELD DATA SHEET

SF Sauk

STREAMNAME ~~HC SFSR~~	LOCATION HC - SFSR - 03
STATION # SFSR 03 RIVERMILE	STREAM CLASS
LAT LONG	RIVER BASIN Skagit
STORET #	AGENCY
INVESTIGATORS MAH, BAS, JMS	LOT NUMBER
FORM COMPLETED BY	DATE 8/23/13 TIME 1500 AM PM
	REASON FOR SURVEY

HABITAT TYPES

Indicate the percentage of each habitat type present
☒ Cobble 80 % ☐ Snags 0 % ☐ Vegetated Banks 0 % ☒ Sand 5 %
☒ Submerged Macrophytes [redacted] % ☒ Other (gravel) 15 %

SAMPLE COLLECTION

Gear used ☒ D-frame ☐ kick-net ☐ Other

How were the samples collected? ☒ wading ☐ from bank ☐ from boat

Indicate the number of jabs/kicks taken in each habitat type.
☒ Cobble 8 ☐ Snags ☐ Vegetated Banks ☐ Sand
☐ Submerged Macrophytes ☐ Other ( )

GENERAL COMMENTS

Lot's of attached algae, one large worm,

QUALITATIVE LISTING OF AQUATIC BIOTA
Indicate estimated abundance: 0 = Absent/Not Observed, 1 = Rare, 2 = Common, 3= Abundant, 4 = Dominant

Periphyton	0	1	[✓ 2]	3	4	Slimes	[✓ 0]	1	2	3	4
Filamentous Algae	0	1	2	[✓ 3]	4	Macroinvertebrates	0	1	[✓ 2]	3	4
Macrophytes	[✓ 0]	1	2	3	4	Fish	0	[✓ 1]	2	3	4

FIELD OBSERVATIONS OF MACROBENTHOS
Indicate estimated abundance: 0 = Absent/Not Observed, 1 = Rare (1-3 organisms), 2 = Common (3-9 organisms), 3= Abundant (>10 organisms), 4 = Dominant (>50 organisms)

Porifera	0	1	2	3	4	Anisoptera	0	1	2	3	4	Chironomidae	0	1	2	3	4
Hydrozoa	0	1	2	3	4	Zygoptera	0	1	2	3	4	Ephemeroptera	0	1	2	3	4
Platyhelminthes	0	1	2	3	4	Hemiptera	0	1	2	3	4	Trichoptera	0	1	2	3	4
Turbellaria	0	1	2	3	4	Coleoptera	0	1	2	3	4	Other	0	1	2	3	4
Hirudinea	0	1	2	3	4	Lepidoptera	0	1	2	3	4						
Oligochaeta	0	1	2	3	4	Sialidae	0	1	2	3	4						
Isopoda	0	1	2	3	4	Corydalidae	0	1	2	3	4						
Amphipoda	0	1	2	3	4	Tipulidae	0	1	2	3	4						
Decapoda	0	1	2	3	4	Empididae	0	1	2	3	4						
Gastropoda	0	1	2	3	4	Simuliidae	0	1	2	3	4						
Bivalvia	0	1	2	3	4	Tabinidae	0	1	2	3	4						
						Culcidae	0	1	2	3	4						

PERIPHYTON FIELD DATA SHEET

STREAM NAME SF Sauk	LOCATION HC-SFSR-03	
STATION # SFSR-03 RIVERMILE ____	STREAM CLASS	
LAT ____ LONG ____	RIVER BASIN Skagit	
STORET #	AGENCY	
INVESTIGATORS MAH, BAS, JMS		LOT NUMBER
FORM COMPLETED BY	DATE 8/23/13 TIME 1500 AM PM	REASON FOR SURVEY

HABITAT TYPES

Indicate the percentage of each habitat type present

☒ Sand-Silt-Mud-Muck 5 % ☒ Gravel-Cobble 95 % ☐ Bedrock 0 %
☐ Small Woody Debris ____ % ☐ Large Woody Debris 3 % ☐ Plants, Roots 0 %
☒ Riffle 70 % ☐ Run ____ % ☒ Pool 30 %
☒ Canopy [illegible] % ~ 2%

SAMPLE COLLECTION

Gear used ☐ suction device ☐ bar clamp sample ☒ scraping ☐ Other ____

How were the samples collected? ☒ wading ☐ from bank ☐ from boat

If natural habitat collections, indicate the number of samples taken in each habitat type.

☐ Sand-Silt-Mud-Muck ____ % ☒ Gravel-Cobble 100 % ☐ Bedrock ____ %
☐ Small Woody Debris ____ % ☐ Large Woody Debris ____ % ☐ Plants, Roots ____ %

GENERAL COMMENTS

lots of attached algae, sample is quite green.

50 mL filtered, very slow to filter.

QUALITATIVE LISTING OF AQUATIC BIOTA

Indicate estimated abundance: **0 = Absent/Not Observed, 1 = Rare (<5%), 2 = Common (5% - 30%), 3= Abundant (30% - 70%), 4 = Dominant (>70%)**

Periphyton	0 1 [✓ 2] 3 4	Slimes	[✓ 0] 1 2 3 4
Filamentous Algae	0 1 2 [✓ 3] 4	Macroinvertebrates	0 1 [✓ 2] 3 4
Macrophytes	[✓ 0] 1 2 3 4	Fish	0 [✓ 1] 2 3 4

地面, 26.825/10m

HARTCROWSER

Chemistry Sampling Form

PROJECT MCMA
JOB NO.
PROJECT MANAGER M. Havey
FIELD TEAM MAH, BAS, JMS

STATION ID HC-SFSR-03
DATE/TIME SAMPLED 8/23/13
STREAM DEPTH
STREAM VELOCITY
SAMPLE DEPTH

WQ instrument
Lat
Operator
Long

	Calibrated	Start Time	End Time
T (deg C)	Y N		
DO (mg/L)	Y N		
pH	Y N		
Cond (uS/cm)	Y N		
Turb. (NTU)	Y N		

Water quality comments:
(color, odor, sheen)

Sample ID (ex. HC13-SW-SFSR09)	Bottle type	# of Containers	Analyses	Preservative	Filter
HC-SFSR-03	HDPE	1	Anions	N	Y
HC-SFSR-03	FLPE	1	Hg	N	Y
HC-SFSR-03	HDPE	1	Metals	Y	Y
HC-SFSR-03	HDPE	1	Metals (As, Cd, As)	N	Y
HC-SFSR-03	HDPE	1	Metals	Y	N
HC-SFSR-03	HDPE	1	Metals(As, Cd, As)	N	N
HC-SFSR-03	FLPE	1	Hg	N	N
HC-SFSR-03	HDPE	1	Alk	N	N

Total number of bottles 8
Duplicate Sample ID –
Field Blank ID –
Rinsate Sample ID –

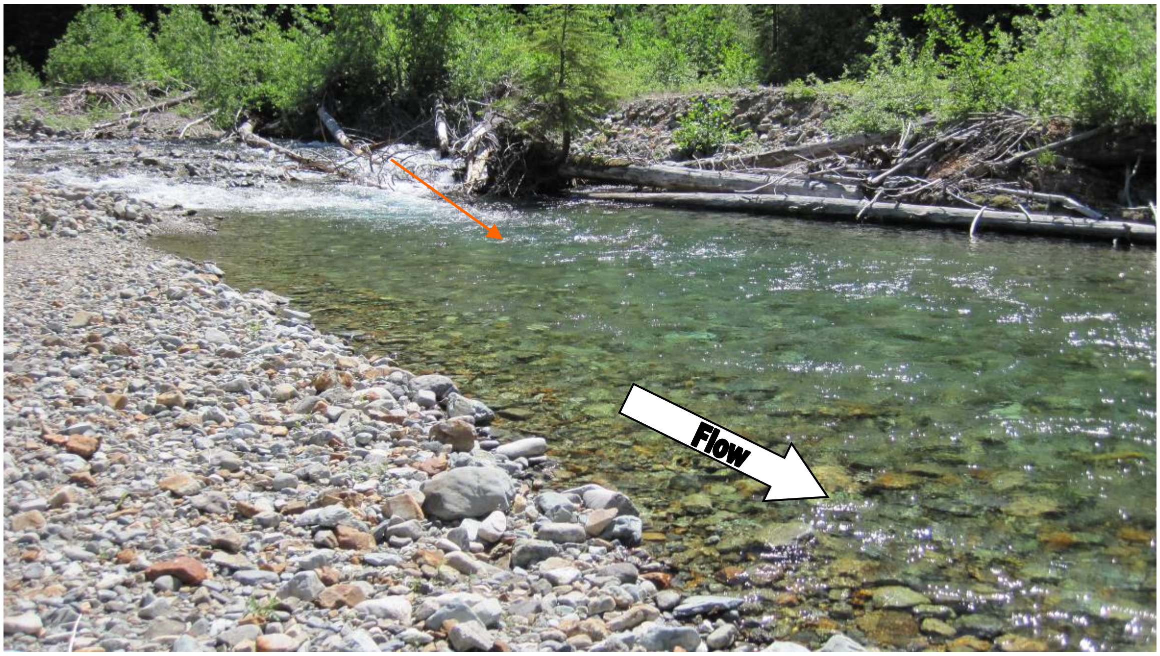
Sediment # of locations for composite

	%Gravel
	%Sand
	%Fines

Comments:

C:\PROJECTS\35_MCMA\Deliverables\SAP\Appendix B - datasheets\ChemistrySamplingForms.xls

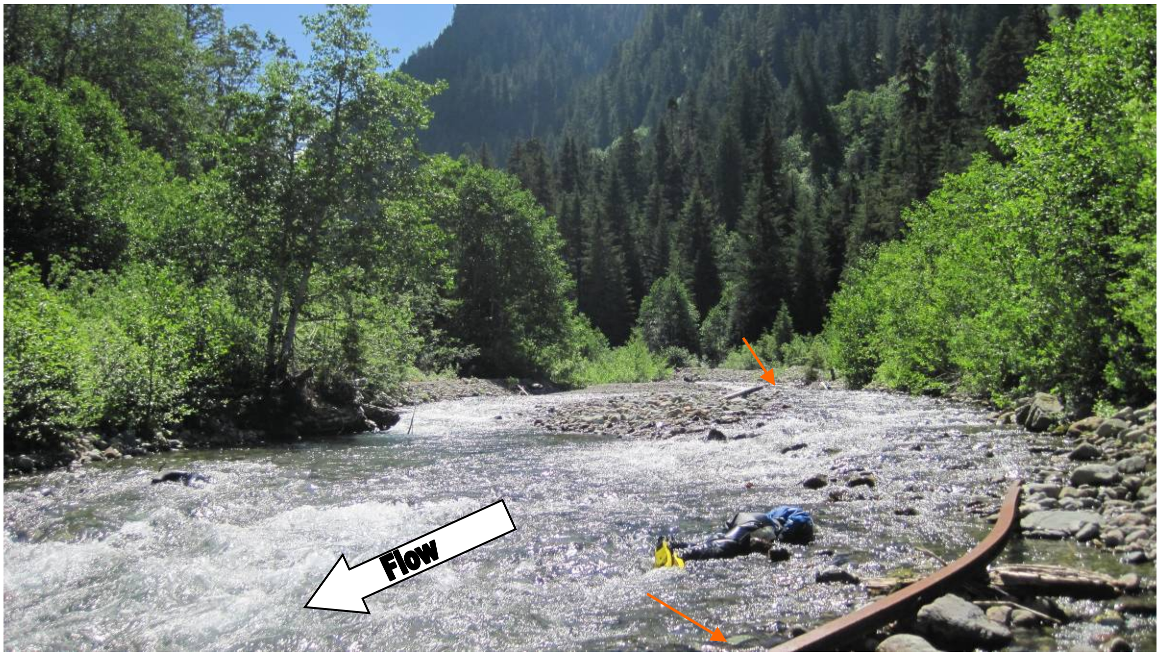
Reviewed by (initials):
Date:



Photograph 12 – July 10, 2013. Start of reach (orange arrow). Note presence of large woody debris.

Photograph 13 – July 10, 2013. View downstream towards end of reach (orange arrow) from mid-reach.

Photograph 14 – July 10, 2013. View upstream from mid-reach. Riparian vegetation can be seen on river right.



Photograph 15 – July 10, 2013. View upstream to start of reach (top orange arrow) from end of reach (bottom orange arrow).

Photograph 16 – July 10, 2013. Several species of trout were seen within the reach.

Photograph 17 – July 10, 2013. Tailed frog tadpole was observed within the reach.

Photograph 18 – August 23, 2013. Attached algae were observed within the reach.

Photograph 19 – August 23, 2013. Bull trout were observed within the reach.

Photograph 20 – August 23, 2013. Historical human disturbance from mining activities were evident within the reach.

South Fork Sauk River

HC-SFSR-07

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double-sided printing.

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET
(FRONT)

STREAM NAME SF Sauk	LOCATION S-07 Alt
STATION #________ RIVERMILE________	STREAM CLASS
LAT ____________ LONG ____________	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS	
FORM COMPLETED BY	DATE 8/22/13 TIME 11:30 [✓ AM] PM
	REASON FOR SURVEY

WEATHER CONDITIONS

Now		Past 24 hours
☐	storm (heavy rain)	☐
☐	rain (steady rain)	☐
☐	showers (intermittent)	☐
___%☐	%cloud cover	☐___%
☑	clear/sunny	☐

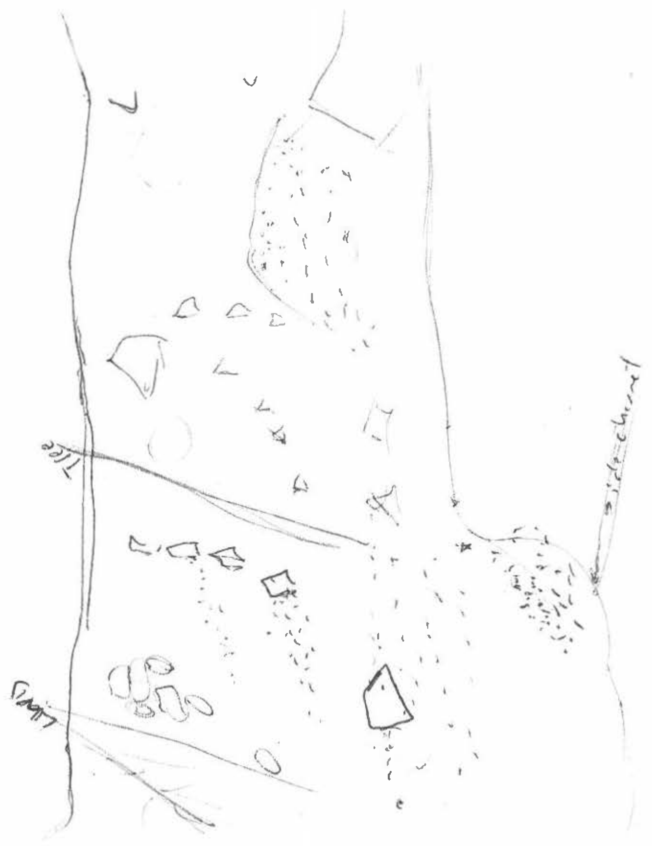
Has there been a heavy rain in the last 7 days?
☐ Yes ☑ No

Air Temperature_____ °C

Other______________________________

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)



STREAM CHARACTERIZATION

Stream Subsystem
☑ Perennial ☐ Intermittent ☐ Tidal

Stream Origin
☑ Glacial
☐ Non-glacial montane
☐ Swamp and bog
☐ Spring-fed
☐ Mixture of origins
☐ Other__________

Stream Type
☑ Coldwater ☐ Warmwater

Catchment Area__________km²

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES

Predominant Surrounding Landuse
☑ Forest ☐ Commercial
☐ Field/Pasture ☐ Industrial
☐ Agricultural ☐ Other ______
☐ Residential

Local Watershed NPS Pollution
☑ No evidence ☐ Some potential sources
☐ Obvious sources

Local Watershed Erosion
☑ None ☐ Moderate ☐ Heavy

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present
☑ Trees ☐ Shrubs ☐ Grasses ☐ Herbaceous

dominant species present western hemlock

INSTREAM FEATURES

Estimated Reach Length ~100 m
Estimated Stream Width 10 m
Sampling Reach Area 1000 m²
Area in km² (m²x1000) 1×10^{-3} km²
2.5 max
Estimated Stream Depth 0.5 avg ft
Surface Velocity (at thalweg) 0.90 m/sec

Canopy Cover
☐ Partly open ☑ Partly shaded ☐ Shaded

High Water Mark 0.5 m

Proportion of Reach Represented by Stream Morphology Types
☐ Riffle 20 % ☐ Run 70 %
☐ Pool 10 %

Channelized ☐ Yes ☑ No
Dam Present ☐ Yes ☑ No

LARGE WOODY DEBRIS

LWD 5 m²
Density of LWD 5,000 m²/km² **(LWD/ reach area)**

AQUATIC VEGETATION

Indicate the dominant type and record the dominant species present
☐ Rooted emergent ☐ Rooted submergent ☐ Rooted floating ☐ Free floating
☐ Floating Algae ☑ Attached Algae

dominant species present ______

Portion of the reach with aquatic vegetation 1 %

WATER QUALITY

Temperature 13.3 °C
Specific Conductance 0.040 mS/cm
Dissolved Oxygen 10.4
pH 7.4
Turbidity 0.0
WQ Instrument Used Horiba

Water Odors
☑ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other ______

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs ☐ Flecks
☑ None ☐ Other ______

Turbidity (if not measured)
☑ Clear ☐ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other ______

SEDIMENT/ SUBSTRATE

Odors
☐ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other ______

Oils
☐ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits
☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand
☐ Relict shells ☐ Other ______

Looking at stones which are not deeply embedded, are the undersides black in color?
☐ Yes ☐ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**
Bedrock		0
Boulder	> 256 mm (10")	50
Cobble	64-256 mm (2.5"-10")	47
Gravel	2-64 mm (0.1"-2.5")	2
Sand	0.06-2mm (gritty)	<1
Silt	0.004-0.06 mm	0
Clay	< 0.004 mm (slick)	0

ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	**Characteristic**	**% Composition in Sampling Area**
Detritus	sticks, wood, coarse plant materials (CPOM)	~~0~~ <1
Muck-Mud	black, very fine organic (FPOM)	0
Marl	grey, shell fragments	0

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME SF Sauk	LOCATION S-07 Alt
STATION # ________ RIVERMILE ________	STREAM CLASS
LAT ____________ LONG ____________	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS MAH, BAS, Jms	
FORM COMPLETED BY Jms	DATE 8/22/13 TIME 11:30 [✓ AM] PM
	REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 [✓ 14] 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE	[✓ 20] 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE	20 19 18 17 16	15 [✓ 14] 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom aff[illegible] by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 [✓ 19] 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 [✓ 12] 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 [✓ 19] 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE	20 19 [✓ 18] 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 [✓ 9]	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 [✓ 9]	8 7 6	5 4 3	2 1 0

Total Score __________

HARTCROWSER

Snorkel Survey Form

PROJECT MCMA
JOB NO. 17800-35
PROJECT MANAGER M. Havey
FIELD TEAM BAS / MAH
SNORKELER(S) BAS / MAH

STATION ID SFSR-07 ~~S-07 Alt~~
DATE 8/23/13
START TIME
STOP TIME 12:48
WEATHER sunny, warm mid 70's, no wind

	Estimated Length							
Species	0 to 50 mm	51 to 80	81 to 100	101 to 120	121 to 150	151 to 200	201 to 250	>250 mm
Bull trout								
Cutthroat		1						
Rainbow	12		16+7	9+3	9+7	5+4	4+2	1+2
Steelhead								
Sculpin								
Chinook								
Whitefish								
~~Dace~~ un-ID salmonid -BAS		(3) + ~~1~~	~~1~~	~~1~~				
Bull/Brown/	Lake?,	2	2	1				

0 = not snorkelable due to high turbidity or hiding cover
1 = high amount of hiding cover and/or poor water clarity
2 = moderate hiding cover and/or moderate water clarity
(3) = little hiding cover and good water clarity

Turbidity
Reach area (m^2)

Comments:

~~lotts~~ lots of caddis flies

Mystery Fish: either Bull/Brown/Lake trout, Photos to verify. Suspect Lake Trout.

Reviewed by (initials):______
Date:______

BENTHIC MACROINVERTEBRATE FIELD DATA SHEET

STREAM NAME SF - Sauk	LOCATION HC -SFSR-07
STATION #SFSR 07 RIVERMILE	STREAM CLASS
LAT LONG	RIVER BASIN Skagit
STORET #	AGENCY
INVESTIGATORS MAH, BAS, JMS	LOT NUMBER
FORM COMPLETED BY	DATE 8/22/13 TIME 1530 AM PM REASON FOR SURVEY

HABITAT TYPES	**Indicate the percentage of each habitat type present** ☒ Cobble 47 % ☐ Snags 0 % ☐ Vegetated Banks 0 % ☐ Sand <1 % ☐ Submerged Macrophytes 0 % ☒ Other (Boulder) 50 %
SAMPLE COLLECTION	**Gear used** ☒ D-frame ☐ kick-net ☐ Other **How were the samples collected?** ☒ wading ☐ from bank ☐ from boat **Indicate the number of jabs/kicks taken in each habitat type.** ☒ Cobble 8 ☐ Snags ☐ Vegetated Banks ☐ Sand ☐ Submerged Macrophytes ☐ Other ( )
GENERAL COMMENTS	Not much in volume, lots of caddisflies

QUALITATIVE LISTING OF AQUATIC BIOTA

Indicate estimated abundance: 0 = Absent/Not Observed, 1 = Rare, 2 = Common, 3= Abundant, 4 = Dominant

Periphyton	0 1 2 [✓ 3] 4	Slimes	[✓ 0] 1 2 3 4
Filamentous Algae	[✓ 0] 1 2 3 4	Macroinvertebrates	0 1 [✓ 2] 3 4
Macrophytes	[✓ 0] 1 2 3 4	Fish	0 1 2 [✓ 3] 4

FIELD OBSERVATIONS OF MACROBENTHOS

Indicate estimated abundance: 0 = Absent/Not Observed, 1 = Rare (1-3 organisms), 2 = Common (3-9 organisms), 3= Abundant (>10 organisms), 4 = Dominant (>50 organisms)

Porifera	0 1 2 3 4	Anisoptera	0 1 2 3 4	Chironomidae	0 1 2 3 4
Hydrozoa	0 1 2 3 4	Zygoptera	0 1 2 3 4	Ephemeroptera	0 1 2 3 4
Platyhelminthes	0 1 2 3 4	Hemiptera	0 1 2 3 4	Trichoptera	0 1 2 3 4
Turbellaria	0 1 2 3 4	Coleoptera	0 1 2 3 4	Other	0 1 2 3 4
Hirudinea	0 1 2 3 4	Lepidoptera	0 1 2 3 4		
Oligochaeta	0 1 2 3 4	Sialidae	0 1 2 3 4		
Isopoda	0 1 2 3 4	Corydalidae	0 1 2 3 4		
Amphipoda	0 1 2 3 4	Tipulidae	0 1 2 3 4		
Decapoda	0 1 2 3 4	Empididae	0 1 2 3 4		
Gastropoda	0 1 2 3 4	Simuliidae	0 1 2 3 4		
Bivalvia	0 1 2 3 4	Tabinidae	0 1 2 3 4		
		Culcidae	0 1 2 3 4		

PERIPHYTON FIELD DATA SHEET

STREAM NAME SF - Sauk
LOCATION HC - SFSR-07
STATION # SFSR07 RIVERMILE________
STREAM CLASS
LAT __________ LONG __________
RIVER BASIN Skagit
STORET #
AGENCY
INVESTIGATORS MAH, BAS, JMS
LOT NUMBER
FORM COMPLETED BY
DATE 8/22/13
TIME 1530 AM PM
REASON FOR SURVEY

HABITAT TYPES

Indicate the percentage of each habitat type present
☑ Sand-Silt-Mud-Muck <1 %
☒ Gravel-Cobble 100 %
☐ Bedrock____%
☑ Small Woody Debris <1 %
☒ Large Woody Debris <1 %
☐ Plants, Roots____%
☒ Riffle 80 %
☒ Run 10 %
☑ Pool 10 %
☑ Canopy 0 %

SAMPLE COLLECTION

Gear used ☐ suction device ☐ bar clamp sample ☑ scraping ☐ Other __________

How were the samples collected? ☑ wading ☐ from bank ☐ from boat

If natural habitat collections, indicate the number of samples taken in each habitat type.
☐ Sand-Silt-Mud-Muck____%
☒ Gravel-Cobble 100 % 8
☐ Bedrock____%
☐ Small Woody Debris____%
☐ Large Woody Debris____%
☐ Plants, Roots____%

GENERAL COMMENTS

100 mL filtered, Brown liquid, took 3 hrs to filter.

QUALITATIVE LISTING OF AQUATIC BIOTA

Indicate estimated abundance: 0 = Absent/Not Observed, 1 = Rare (<5%), 2 = Common (5% - 30%), 3= Abundant (30% - 70%), 4 = Dominant (>70%)

Periphyton	0	1	2	[✓ 3]	4	Slimes	[✓ 0]	1	2	3	4
Filamentous Algae	[✓ 0]	1	2	3	4	Macroinvertebrates	0	1	[✓ 2]	3	4
Macrophytes	[✓ 0]	1	2	3	4	Fish	0	1	~~2~~	[✓ 3]	4

HARTCROWSER

Chemistry Sampling Form

PROJECT

JOB NO.

PROJECT MANAGER M. Havey

FIELD TEAM MAH, BAS, Jms

WQ instrument Horiba

Operator jms

STATION ID S-07Alt

DATE/TIME SAMPLED 8/22/13

STREAM DEPTH 2.5 ft

STREAM VELOCITY 0.90

SAMPLE DEPTH Integrated

Lat

Long

	Calibrated	Start Time	End Time
T (deg C)	Y N		13.3
DO (mg/L)	Y N		10.4
pH	Y N		7.4
Cond (uS/cm)	Y N		40
Turb. (NTU)	Y N		0

Water quality comments:
(color, odor, sheen)

Sample ID (ex. HC13-SW-SFSR09)	Bottle type	# of Containers	Analyses	Preservative	Field Filter	
HC-SFSR-07	HDPE	1	Anions	N	Y	ARI
HC-SFSR-07	HDPE	1	metals	Y	Y	ARI
HC-SFSR-07D	HDPE	1	metals (As, Cd, Ag)	N	Y	BR
HC-SFSR-07D	FLPE	1	Hg	N	Y	BR
HC-SFSR-07D	HDPE	1	metals (As, Cd, Ag)	N	N	BR
HC-SFSR-07	FLPE	1	Hg	N	N	BR
HC-SFSR-07	HDPE	1	Alk	N	N	ARI

Total number of bottles 7

Duplicate Sample ID —

Field Blank ID —

Rinsate Sample ID —

Sediment # of locations for composite

	%Gravel
	%Sand
	%Fines

Comments: Total metals sample for ARI ~~(As, Cd, Ag)~~ metals analysis has ~100 mL of dissolved (filtered) water mixed with total fraction.

~~(Conductivity~~ Specific Conductance w/ Hach = 21.9 mS/cm

C:\PROJECTS\35_MCMA\Deliverables\SAP\Appendix B - datasheets\ChemistrySamplingForms.xls

Reviewed by (initials):______
Date:__________

Photograph 21 – August 22, 2013. Large range of salmonid species and size-classes observed within reach.

Photograph 22 – August 22, 2013. Bull trout observed within the reach.

Photograph 23 – October 23, 2012. View of the upper portion of the sampling reach from the upstream end.

Photograph 24 – October 23, 2012. View of the upper portion of the sampling reach from the midpoint boulder.

Photograph 25 – October 23, 2012. View of the lower portion of the sampling reach from the midpoint boulder.

Photograph 26 – October 23, 2012. View of the lower portion of the sampling reach from the downstream end.

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double-sided printing.

Monte Cristo Lake

HC-MCL

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double-sided printing.

Monte Cristo Lake
HC-MCL
JULY

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double-sided printing.

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME MCMA lake	LOCATION
STATION #______ RIVERMILE______	STREAM CLASS
LAT ______ LONG ______	RIVER BASIN
STOREt #	AGENCY
INVESTIGATORS	
FORM COMPLETED BY BAS	DATE 7/8/13 TIME 10:30 [✓ AM] PM
	REASON FOR SURVEY

WEATHER CONDITIONS	**Now**		**Past 24 hours**	**Has there been a heavy rain in the last 7 days?** ☐ Yes ☒ No
	☐	storm (heavy rain)	☐	**Air Temperature**____ °C ~80 F
	☐	rain (steady rain)	☐	**Other**________
	☐	showers (intermittent)	☐	
	40 %☐	%cloud cover	☐ __ %	
	☒	clear/sunny	☒	

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)

photo 100-6749

100-6748

STREAM CHARACTERIZATION

Stream Subsystem
☒ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☒ Coldwater ☐ Warmwater

Stream Origin
☐ Glacial
☒ Non-glacial montane
☐ Swamp and bog
☐ Spring-fed
☐ Mixture of origins
☐ Other______

Catchment Area______ km²

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET
(BACK)

WATERSHED FEATURES

Predominant Surrounding Landuse
☒ Forest ☐ Commercial
☐ Field/Pasture ☐ Industrial
☐ Agricultural ☐ Other ______
☐ Residential

Local Watershed NPS Pollution
☐ No evidence ☐ Some potential sources
☒ Obvious sources

Local Watershed Erosion
☐ None ☒ Moderate ☐ Heavy (landslides present nearby region)

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present
☒ Trees ☒ Shrubs ☐ Grasses ☐ Herbaceous

dominant species present Vicinity - willow, hemlock, vine maple, Fir, twinberry, Ferns (Bracken

INSTREAM FEATURES

Estimated Reach Length ~~115~~ m Y BAS 2/25/14

Estimated Stream Width 50 ~~m~~ Y

Sampling Reach Area ______ m^2

Area in km^2 (m^2x1000) ______ km^2

Estimated Stream Depth 1 - 2 m

Surface Velocity (at thalweg) ______ m/sec 0

Canopy Cover
☒ Partly open ☐ Partly shaded ☐ Shaded

High Water Mark 0.3 m

Proportion of Reach Represented by Stream Morphology Types
☐ Riffle 0 % ☐ Run 80 %
☐ Pool 20 %

Channelized ☐ Yes ☒ No

Dam Present ☐ Yes ☒ No

LARGE WOODY DEBRIS *

LWD 500 ~~m^2~~ Ft^2 BAS 2/25/14

Density of LWD ______ m^2/km^2 (LWD/ reach area)

AQUATIC VEGETATION

Indicate the dominant type and record the dominant species present
☒ Rooted emergent ☐ Rooted submergent ☐ Rooted floating ☐ Free floating
☐ Floating Algae ☐ Attached Algae

dominant species present Horsetail

Portion of the reach with aquatic vegetation <10 %

WATER QUALITY

Temperature 10.4 °C

Specific Conductance .016 milli.

Dissolved Oxygen 18.83

pH 5.08

Turbidity 2.4

WQ Instrument Used Horriba U-50

Water Odors
☒ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other ______

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs ☐ Flecks
☒ None ☐ Other ______

Turbidity (if not measured)
☐ Clear ☐ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other ______

SEDIMENT/ SUBSTRATE

Odors
☒ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other ______

Oils
☒ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits
☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand
☐ Relict shells ☐ Other ______

Looking at stones which are not deeply embedded, are the undersides black in color?
☐ Yes ☐ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**
Bedrock		0
Boulder	> 256 mm (10")	0
Cobble	64-256 mm (2.5"-10")	0
Gravel	2-64 mm (0.1"-2.5")	0
Sand	0.06-2mm (gritty)	0
Silt	0.004-0.06 mm	80% - 100%
Clay	< 0.004 mm (slick)	0

ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	**Characteristic**	**% Composition in Sampling Area**
Detritus	sticks, wood, coarse plant materials (CPOM)	~12%
Muck-Mud	black, very fine organic (FPOM)	0%
Marl	grey, shell fragments	0%

RR

Draft

PHYSICAL HABITAT CHARACTERIZATION - LAKES

Reviewed by (initial): ______

SITE ID: NCMA Lake-RR **DATE:** 7 / 8 / 2013

STATION: ● A ○ B ○ C ○ D ○ E ○ F ○ G ○ H ○ I ○ J

DEPTH AT STATION (10 m offshore) 2 . 0 ○ ft ● m

LAT ______ . ______

IF STATION WAS RELOCATED, INDICATE HERE: ○

DROPPED: ○

NEW STATION (K, L, etc.) ______

IS IT AN ISLAND? ○

UNABLE TO SAMPLE: ○

LONG ______ . ______

LITTORAL ZONE

Surface film type	● None	○ Scum	○ Algal Mat	○ Oily	○ Other

0 = Absent (0%) 1 = Sparse (<10%) 2 = Moderate (10-40%)
3 = Heavy (40-75%) 4 = Very Heavy (>75%)

BOTTOM SUBSTRATE

						Flag
Bedrock (>4000mm; larger than a car)	[✓ 0]	1	2	3	4	
Boulders (250-4000mm; basketball-car)	[✓ 0]	1	2	3	4	
Cobble (64-250mm; tennis ball-basketball)	[✓ 0]	1	2	3	4	
Gravel (2-64mm; ladybug to tennis ball size)	[✓ 0]	1	2	3	4	
Sand (0.06 - 2mm; gritty between fingers)	[✓ 0]	1	2	3	4	
Silt, Clay, or Muck (<0.06mm; not gritty)	0	1	2	3	[✓ 4]	
Approx 12? Woody Debris	0	1	[✓ 2]	3	4	
Organic (Leaf Pack, Detritus)	0	[✓ 1]	2	3	4	

Color		○ Black	● Gray	
	○ Brown	○ Red	○ Other	
Odor	● None	○ H_2S	○ Anoxic	
	○ Oil	○ Chemical	○ Other	

AQUATIC MACROPHYTES

						Flag
Submergent	[✓ 0]	1	2	3	4	
Emergent	0	[✓ 1]	2	3	4	
Floating	[✓ 0]	1	2	3	4	
Total Aquatic Macrophyte Cover	0	[✓ 1]	2	3	4	

Do macrophytes extend lakeward? ○ Yes ● No

FISH COVER

						Flag
Aquatic and Inundated Herbaceous Veg.	0	[✓ 1]	2	3	4	
Woody Debris/Snags > 0.3 m Dia.	0	[✓ 1]	2	3	4	
Woody Brush/Woody Debris <0.3 m dia. (alive or dead)	0	[✓ 1]	2	3	4	
Inundated Live Trees >0.3 m dia	[✓ 0]	1	2	3	4	
Overhanging Veg. within 1 m of Surface	0	[✓ 1]	2	3	4	
Ledges or Sharp Dropoffs	0	[✓ 1]	2	3	4	
Boulders	[✓ 0]	1	2	3	4	
Human Structures- Docks, Landings, etc	[✓ 0]	1	2	3	4	

RIPARIAN ZONE

0 = Absent (0%) 1 = Sparse (<10%) 2 = Moderate (10-40%)
3 = Heavy (40-75%) 4 = Very Heavy (>75%)

CANOPY (>5 m high)

Flag

○ Deciduous ○ Broadleaf Evergreen ○ Coniferous
● Mixed ○ None

						Flag
Big Trees (Trunk >0.3 m dBH)	0	1	[illegible]	[✓ 3]	4	
Small Trees (Trunk <0.3 m dBH)	0	1	[✓ 2]	3	4	

UNDERSTORY (0.5 TO 5m high)

Flag

○ Deciduous ○ Broadleaf Evergreen ○ Coniferous
● Mixed ○ None

						Flag
Woody Shrubs & Saplings	0	1	2	[✓ 3]	4	
Tall Herbs, Grasses, & Forbs	0	[✓ 1]	2	3	4	

GROUND COVER (<0.5 high)

						Flag
Woody Shrubs & Saplings	0	1	2	3	[✓ 4]	
Herbs, Grasses and Forbs	0	[✓ 1]	2	3	4	
Standing Water or Inundated Vegetation	[✓ 0]	1	2	3	4	
Barren, Bare Dirt or Buildings	[✓ 0]	[illegible]	2	3	4	

SHORELINE SUBSTRATE ZONE

						Flag
Bedrock (>4000mm; larger than a car)	[✓ 0]	1	2	3	4	
Boulders (250-4000mm; basketball-car size)	[✓ 0]	1	2	3	4	
Cobble (64-250mm; tennis ball-basketball size)	[✓ 0]	1	2	3	4	
Gravel (2-64 mm; ladybug-tennis ball size)	[✓ 0]	1	2	3	4	
Sand (0.06 - 2mm; gritty between fingers)	[✓ 0]	1	2	3	4	
Silt, Clay, or Muck (<0.06mm; not gritty)	0	1	2	3	[✓ 4]	
Woody Debris	0	1	[✓ 2]	3	4	
Organic (Leaf Pack, Detritus)	0	[✓ 1]	2	3	4	
Vegetation or Other	[illegible]	[✓ 1]	2	3	4	

HUMAN INFLUENCE

0 = Not Present P = Present outside plot C = Present within plot

				Flag
Buildings	[✓ 0]	P	C	
Commercial	[✓ 0]	P	C	
Park Facilities/ Man-made beach	[✓ 0]	P	C	
Docks/Boats	[✓ 0]	P	C	
Walls, dikes or revetments	[✓ 0]	P	C	
Landfill/Trash	[✓ 0]	P	C	
Roads or Railroad	0	[✓ P]	C	
Power lines	[✓ 0]	P	C	
Row Crops	[✓ 0]	P	C	
Pasture/Range/Hay Field	[✓ 0]	P	C	
Orchard	[✓ 0]	P	C	
Lawn	[✓ 0]	P	C	

Flag codes: K = No measurement or observation made. U = Suspect measurement or observation; F1, F2, etc = misc. flags assigned by field crew. Explain all flags in comment sections.

Draft

PHYSICAL HABITAT CHARACTERIZATION - LAKES (continued)

SITE ID: MCMA LkL RR   DATE: ___/___/_____

LITTORAL FISH MACROHABITAT CLASSIFICATION

Human Disturbance	○ None ● Low ○ Moderate ○ High
Cover Class	● No/Little Cover ○ Patchy Cover ○ Continuous Cover
Cover Type (mark all that apply)	○ Artificial ○ Boulders ○ Fill ● Woody ● Vegetation ○ None
Dominant Substrate	● Mud/Muck ○ Sand/Gravel ○ Cobble/Boulder ○ Bedrock

BANK FEATURES (within plot)

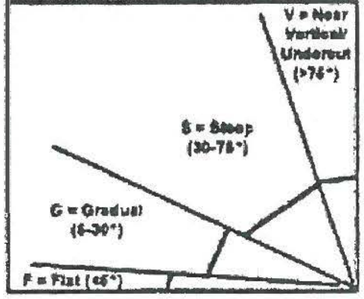
Angle (see figure below)	○ Flat <6°) ● Gradual (6-30°) ○ Steep (30-75°) ○ Near vertival/undercut (>75°)
Vertical height from waterline to high water mark:	0.3 (m)
Horizontal distance from waterline to high water mark:	less than ≤0.3 ~~1~~ (m)

INVASIVE PLANTS AND INVERTEBRATES

Littoral Plot SPECIES	Mark if observed	FLAG	Shoreline/Riparian Plot SPECIES	Mark if observed	FLAG
NONE OBSERVED	○		NONE OBSERVED	○	
Zebra or Quagga Mussel	○		Purple loosestrife	○	
Eurasian watermilfoil	○		Knotweed (Giant or Japanese)	○	
Hydrilla	○		Hairy willow herb	○	
Curly pondweed	○		Flowering rush	○	
African waterweed	○			○	
Brazilian waterweed	○			○	
European water chestnut	○			○	
Water hyacinth	○			○	
Parrot feather	○			○	
Yellow floating heart	○			○	
Giant salvinia	○			○	
	○			○	

Flag	Comments

Bank Angle Classes



Flag codes: K = No measurement or observation made; U = Suspect measurement or observation; F1, F2, etc. = misc. flags assigned by field crew. Explain all flags in comment sections.

RL

Draft

PHYSICAL HABITAT CHARACTERIZATION - LAKES

Reviewed by (initial): ______

SITE ID: MCMA Lake - RL **DATE:** 7 / 8 / 2013

STATION. ● A ○ B ○ C ○ D ○ E ○ F ○ G ○ H ○ I ○ J

DEPTH AT STATION (10 m offshore) 2.0 ○ ft ● m

LAT ______

IF STATION WAS RELOCATED, INDICATE HERE: ○

DROPPED: ○

NEW STATION (K, L, etc.) ____ IS IT AN ISLAND? ○

UNABLE TO SAMPLE: ○

LONG ______

LITTORAL ZONE

Surface film type: ● None ○ Scum ○ Algal Mat ○ Oily ○ Other

0 = Absent (0%) 1 = Sparse (<10%) 2 = Moderate (10-40%)
3 = Heavy (40-75%) 4 = Very Heavy (>75%)

BOTTOM SUBSTRATE

						Flag
Bedrock (>4000mm; larger than a car)	[✓ 0]	1	2	3	4	
Boulders (250-4000mm; basketball-car)	[✓ 0]	1	2	3	4	
Cobble (64-250mm; tennis ball-basketball)	[✓ 0]	1	2	3	4	
Gravel (2-64mm; ladybug to tennis ball size)	[✓ 0]	1	2	3	4	
Sand (0.06 - 2mm; gritty between fingers)	[✓ 0]	1	2	3	4	
Silt, Clay, or Muck (<0.06mm; not gritty)	0	1	2	3	[✓ 4]	
Woody Debris	0	[✓ 1]	2	3	4	
Organic (Leaf Pack, Detritus)	0	[✓ 1]	2	3	4	

Color: ○ Black ● Gray ○ Brown ○ Red ○ Other

Odor: ● None ○ H_2S ○ Anoxic ○ Oil ○ Chemical ○ Other

AQUATIC MACROPHYTES

						Flag
Submergent	[✓ 0]	1	2	3	4	
Emergent	0	[✓ 1]	2	3	4	
Floating	[✓ 0]	1	2	3	4	
Total Aquatic Macrophyte Cover	0	[✓ 1]	2	3	4	

Do macrophytes extend lakeward? Yes [✓ No]

FISH COVER

						Flag
Aquatic and Innundated Herbaceous Veg.	[✓ 0]	1	2	3	4	
Woody Debris/Snags > 0.3 m Dia.	[✓ 0]	1	2	3	4	
Woody Brush/Woody Debris <0.3 m dia. (alive or dead)	0	[✓ 1]	2	3	4	
Inundated Live Trees >0.3 m dia	[✓ 0]	1	2	3	4	
Overhanging Veg. within 1 m of Surface	[✓ 0]	1	2	3	4	
Ledges or Sharp Dropoffs	[✓ 0]	1	2	3	4	
Boulders	[✓ 0]	1	2	3	4	
Human Structures- Docks, Landings, etc	[✓ 0]	1	2	3	4	

RIPARIAN ZONE

0 = Absent (0%) 1 = Sparse (<10%) 2 = Moderate (10-40%)
3 = Heavy (40-75%) 4 = Very Heavy (>75%)

CANOPY (>5 m high)

Flag

○ Deciduous ○ Broadleaf Evergreen ○ Coniferous ○ Mixed ● None

Big Trees (Trunk >0.3 m dBH)	[✓ 0]	1	2	3	4	
Small Trees (Trunk <0.3 m dBH)	[✓ 0]	1	2	3	4	

UNDERSTORY (0.5 TO 5m high)

Flag

● Deciduous ○ Broadleaf Evergreen ○ Coniferous ○ Mixed ○ None

Woody Shrubs & Saplings	0	1	2	3	[✓ 4]	
Tall Herbs, Grasses, & Forbs	[✓ 0]	1	2	3	4	

GROUND COVER (<0.5 high)

						Flag
Woody Shrubs & Saplings	0	1	2	3	[✓ 4]	
Herbs, Grasses and Forbs	0	[✓ 1]	2	3	4	
Standing Water or Inundated Vegetation	[✓ 0]	1	2	3	4	
Barren, Bare Dirt or Buildings	0	[✓ 1]	2	3	4	

SHORELINE SUBSTRATE ZONE

						Flag
Bedrock (>4000mm; larger than a car)	[✓ 0]	1	2	3	4	
Boulders (250-4000mm; basketball-car size)	[✓ 0]	1	2	3	4	
Cobble (64-250mm; tennis ball-basketball size)	[✓ 0]	1	2	3	4	
Gravel (2-64 mm; ladybug-tennis ball size)	[✓ 0]	1	2	3	4	
Sand (0.06 - 2mm; gritty between fingers)	[✓ 0]	1	2	3	4	
Silt, Clay, or Muck (<0.06mm; not gritty)	0	1	2	3	[✓ 4]	
Woody Debris	0	[✓ 1]	2	3	4	
Organic (Leaf Pack, Detritus)	0	[✓ 1]	2	3	4	
Vegetation or Other	[✓ 0]	1	2	3	4	

HUMAN INFLUENCE

0 = Not Present P = Present outside plot C = Present within plot

				Flag
Buildings	[✓ 0]	P	C	
Commercial	[✓ 0]	P	C	
Park Facilities/ Man-made beach	[✓ 0]	P	C	
Docks/Boats	[✓ 0]	P	C	
Walls, dikes or revetments	[✓ 0]	P	C	
Landfill/Trash	[✓ 0]	P	C	
Roads or Railroad	[✓ 0]	P	C	
Power lines	[✓ 0]	P	C	
Row Crops	[✓ 0]	P	C	
Pasture/Range/Hay Field	[✓ 0]	P	C	
Orchard	[✓ 0]	P	C	
Lawn	[✓ 0]	P	C	

Flag codes: K = No measurement or observation made, U = Suspect measurement or observation; F1, F2, etc = misc. flags assigned by field crew. Explain all flags in comment sections.

Draft

PHYSICAL HABITAT CHARACTERIZATION - LAKES (continued)

SITE ID: MCMA Lake RR DATE: __/__/____

LITTORAL FISH MACROHABITAT CLASSIFICATION	
Human Disturbance	● None ○ Low ○ Moderate ○ High
Cover Class	● No/Little Cover ○ Patchy Cover ○ Continuous Cover
Cover Type (mark all that apply)	○ Artificial ○ Boulders ○ Fill ● Woody ● Vegetation ○ None
Dominant Substrate	● Mud/Muck ○ Sand/Gravel ○ Cobble/Boulder ○ Bedrock

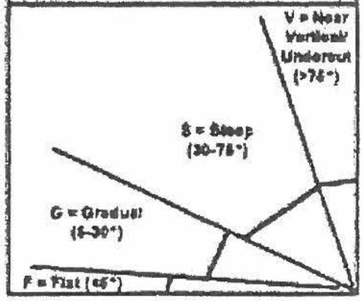
BANK FEATURES (within plot)	
Angle (see figure below)	○ Flat <5°) ● Gradual (5-30°) ○ Steep (30-75°) ○ Near vertival/undercut (>75°)
Vertical height from waterline to high water mark:	0.3 (m)
Horizontal distance from waterline to high water mark:	12.0 (m)

INVASIVE PLANTS AND INVERTEBRATES

Littoral Plot			Shoreline/Riparian Plot		
SPECIES	Mark if observed	FLAG	SPECIES	Mark if observed	FLAG
NONE OBSERVED	○		NONE OBSERVED	○	
Zebra or Quagga Mussel	○		Purple loosestrife	○	
Eurasian watermilfoil	○		Knotweed (Giant or Japanese)	○	
Hydrilla	○		Hairy willow herb	○	
Curly pondweed	○		Flowering rush	○	
African waterweed	○			○	
Brazilian waterweed	○			○	
European water chestnut	○			○	
Water hyacinth	○			○	
Parrot feather	○			○	
Yellow floating heart	○			○	
Giant salvinia	○			○	
	○			○	

Flag	Comments

Bank Angle Classes



Flag codes: K = No measurement or observation made; U = Suspect measurement or observation; F1, F2, etc. = misc. flags assigned by field crew. Explain all flags in comment sections.

HARTCROWSER

Snorkel Survey Form

PROJECT MCMA
JOB NO.
PROJECT MANAGER
FIELD TEAM
SNORKELER(S) MAH, BS

STATION ID HC - MCM- MAIN
DATE 7/8/13
START TIME Approx 10:00am
STOP TIME 10:45
WEATHER Clear + Sunny

Species	Estimated Length							
	0 to 50 mm	51 to 80	81 to 100	101 to 120	121 to 150	151 to 200	201 to 250	>250 mm
Bull trout								
Cutthroat								
Rainbow			II					
Steelhead								
Sculpin	~~III~~ BAS 1/16/14							
Chinook								
Whitefish								
Dace								
☆ unk. Salmonid			1(90mm)					

0 = not snorkelable due to high turbidity or hiding cover
1 = high amount of hiding cover and/or poor water clarity
2 = moderate hiding cover and/or moderate water clarity
3 = little hiding cover and good water clarity

Turbidity
Reach area (m^2)

Comments:

☆ Unknown Salmonid caught in minnow trap 3

Minnow Trap 4 = Nothing

Minnow Trap 1 and 2 = Lots of Caddis fly
↓
(75 and 50)

Reviewed by (initials):______
Date:______

BENTHIC MACROINVERTEBRATE FIELD DATA SHEET

STR AM NAME	LOCATION	
STATION # Mc. Hcmt- [illegible] RIVERMILE ____	STREAM CLASS	
LAT ____ LONG ____	RIV R BASIN	
STORET #	AGENCY	
INVESTIGATORS		LOT NUMBER
FORM COMPLETED BY Chris H.	DATE 7/8/13 TIME 17:00 AM PM	REASON FOR SUSPECT

HABITAT TYPES	**Indicate the percentage of each habitat type present** ☐ Cobble ____% ☐ Snags 2 % ☐ Vegetated Banks ____% ☐ Sand ____% ☐ Submerged Macrophytes 2 % ☒ Other (mud/muck) 96 %
SAMPLE COLLECTION	**Gear used** ☒ D-frame ☐ kick-net ☒ Other Clam gun **How were the samples collected?** ☐ wading ☒ from bank ☐ from boat **Indicate the number of jabs/kicks taken in each habitat type.** ☐ Cobble ☐ Snags ____ ☐ Vegetated Banks ____ ☐ Sand ☐ Submerged Macrophytes ____ ☒ Other (mud/muck) ____
GENERAL COMMENTS	

QUALITATIVE LISTING OF AQUATIC BIOTA

Indicate estimated abundance: 0 = Absent/Not Observed, 1 = Rare, 2 = Common, 3= Abundant, 4 = Dominant

Periphyton	0	[✓ 1]	2	3	4	Slimes	[✓ 0]	1	2	3	4
Filamentous Algae	[✓ 0]	1	2	3	4	Macroinvertebrates	0	[✓ 1]	2	3	4
Macrophytes	0	1	[✓ 2]	3	4	Fish	0	[✓ 1]	2	3	4

FIELD OBSERVATIONS OF MACROBENTHOS

Indicate estimated abundance: 0 = Absent/Not Observed, 1 = Rare (1-3 organisms), 2 = Common (3-9 organisms), 3= Abundant (>10 organisms), 4 = Dominant (>50 organisms)

Porifera	0	1	2	3	4	Anisoptera	0	1	2	3	4	Chironomidae	0	1	2	3	4
Hydrozoa	0	1	2	3	4	Zygoptera	0	1	2	3	4	Ephemeroptera	0	1	2	3	4
Platyhelminthes	0	1	2	3	4	Hemiptera	0	1	2	3	4	Trichoptera	0	1	[✓ 2]	3	4
Turbellaria	0	1	2	3	4	Coleoptera	0	1	2	3	4	Other	0	1	2	3	4
Hirudinea	0	1	2	3	4	Lepidoptera	0	1	2	3	4						
Oligochaeta	0	1	2	3	4	Sialidae	0	1	2	3	4						
Isopoda	0	1	2	3	4	Corydalidae	0	1	2	3	4						
Amphipoda	0	1	2	3	4	Tipulidae	0	1	2	3	4						
Decapoda	0	1	2	3	4	Empididae	0	1	2	3	4						
Gastropoda	0	1	2	3	4	Simuliidae	0	1	2	3	4						
Bivalvia	0	1	2	3	4	Tabinidae	0	1	2	3	4						
						Culcidae	0	1	2	3	4						

Rapid Bioassessment Protocols For Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish, Second Edition - Form 1

PERIPHYTON FIELD DATA SHEET

STREAM NAME	LOCATION
STATION # Mc-HcmL-m RIVERMILE ______	STREAM CLASS
LAT ______ LONG ______	RIVER BASIN
STOREET #	AGENCY
INVESTIGATORS	LOT NUMBER
FORM COMPLETED BY Chris H.	DATE 7/8/13 TIME 17:00 AM [✓ PM]
	REASON FOR SURVEY

HABITAT TYPES

Indicate the percentage of each habitat type present

☒ Sand-Silt-Mud-Muck 100 % ☐ Gravel-Cobble ____% ☐ Bedrock ____%

☐ Small Woody Debris ____% ☐ Large Woody Debris ____% ☐ Plants, Roots ____%

☐ Riffle ____% ☐ Run ____% ☐ Pool ____%

☐ Canopy ____%

SAMPLE COLLECTION

Gear used ☐ suction device ☐ bar clamp sample ☒ scraping ☐ Other ______

How were the samples collected? ☐ wading ☒ from bank ☐ from boat

If natural habitat collections, indicate the number of samples taken in each habitat type.

☒ Sand-Silt-Mud-Muck 100 % ☐ Gravel-Cobble ____% ☐ Bedrock ____%

☐ Small Woody Debris ____% ☐ Large Woody Debris ____% ☐ Plants, Roots ____%

GENERAL COMMENTS

QUALITATIVE LISTING OF AQUATIC BIOTA

Indicate estimated abundance: 0 = Absent/Not Observed, 1 = Rare (<5%), 2 = Common (5% - 30%), 3= Abundant (30% - 70%), 4 = Dominant (>70%)

Periphyton	0	[✓ 1]	2	3	4	Slimes	[✓ 0]	1	2	3	4
Filamentous Algae	[✓ 0]	1	2	3	4	Macroinvertebrates	0	[✓ 1]	2	3	4
Macrophytes	0	1	[✓ 2]	3	4	Fish	0	[✓ 1]	2	3	4

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double-sided printing.

Monte Cristo Lake
HC-MCL
AUGUST

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double-sided printing.

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME SF Sk K	LOCATION HC - MCL
STATION #________ RIVERMILE________	STREAM CLASS
LAT ____________ LONG ____________	RIVER BASIN Skagit
STORET #	AGENCY
INVESTIGATORS FAH, BAS, JMS	
FORM COMPLETED BY MAH	DATE 8-27-13 TIME 1200 AM ●
	REASON FORSURVEY

WEATHER CONDITIONS

Now		Past 24 hours
☐	storm (heavy rain)	☐
☐	rain (steady rain)	☒
☒	showers (intermittent)	☐
____%☐	%cloud cover	☐____%
☐	clear/sunny	☐

Has there been a heavy rain in the last 7 days?
☒ Yes ☐ No

Air Temperature 65 °● F

Other____________________

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)

STREAM CHARACTERIZATION

Stream Subsystem
☒ Perennial ☐ Intermittent ☐ Tidal

Stream Origin
☐ Glacial ☐ Spring-fed
☐ Non-glacial montane ☐ Mixture of origins
☐ Swamp and bog ☐ Other________

Stream Type
☒ Coldwater ☐ Warmwater

Catchment Area________km²

Rapid Bioassessment Protocols For Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish, Second Edition - Form 1

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES

Predominant Surrounding Landuse
☒ Forest ☐ Commercial
☐ Field/Pasture ☐ Industrial
☐ Agricultural ☐ Other ______
☐ Residential

Local Watershed NPS Pollution
☒ No evidence ☐ Some potential sources
☐ Obvious sources

Local Watershed Erosion
☒ None ☐ Moderate ☐ Heavy

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present
☐ Trees ☒ Shrubs ☐ Grasses ☐ Herbaceous
dominant species present black twinberry, vine maple, willow, cedar

INSTREAM FEATURES

Estimated Reach Length 100 m
Estimated Stream Width 88 ft
Sampling Reach Area ______ m²
Area in km² (m²x1000) ______ km²
Estimated Stream Depth ______ m
Surface Velocity (at thalweg) ~~______ m/sec~~ 33ft/ 91.42 sec

Canopy Cover
☒ Partly open ☐ Partly shaded ☐ Shaded
High Water Mark 1 m
Proportion of Reach Represented by Stream Morphology Types
☐ Riffle ______ % ☒ Run ~~100~~ % 15
☒ Pool 85 %
Channelized ☐ Yes ☒ No
Dam Present ☐ Yes ☒ No

LARGE WOODY DEBRIS

LWD 60 m²
Density of LWD ______ m²/km² (LWD/ reach area)

AQUATIC VEGETATION

Indicate the dominant type and record the dominant species present
☒ Rooted emergent ☐ Rooted submergent ☐ Rooted floating ☐ Free floating
☐ Floating Algae ☐ Attached Algae
dominant species present horsetail
Portion of the reach with aquatic vegetation 5 %

WATER QUALITY

Temperature 14.7 °C
Specific Conductance 0.043 ~0.0251 ~~250~~ Hach
Dissolved Oxygen 9.85
pH 5.57 7.2 - Hach
Turbidity ______
WQ Instrument Used Horiba U22

Water Odors
☒ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other ______

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs ☐ Flecks
☒ None ☐ Other ______

Turbidity (if not measured)
☐ Clear ☒ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other ______

SEDIMENT/ SUBSTRATE

Odors
☒ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other ______

Oils
☒ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits NONE
☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand
☐ Relict shells ☐ Other ______

Looking at stones which are not deeply embedded, are the undersides black in color?
☐ Yes ☒ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)

Substrate Type	Diameter	% Composition in Sampling Reach
Bedrock		0
Boulder	> 256 mm (10")	0
Cobble	64-256 mm (2.5"-10")	0
Gravel	2-64 mm (0.1"-2.5")	0
Sand	0.06-2mm (gritty)	10
Silt	0.004-0.06 mm	~~100~~ 80
Clay	< 0.004 mm (slick)	10

ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)

Substrate Type	Characteristic	% Composition in Sampling Area
Detritus	sticks, wood, coarse plant materials (CPOM)	20
Muck-Mud	black, very fine organic (FPOM)	
Marl	grey, shell fragments	0

Draft

PHYSICAL HABITAT CHARACTERIZATION - LAKES

Reviewed by (initial): ______

SITE ID: HC-MCL

DATE: 08 / 27 / 13

STATION: ○ A ○ B ○ C ○ D ○ E ○ F ○ G ○ H ○ I ○ J

DEPTH AT STATION (10 m offshore) ___ . ___ ○ ft ○ m

LAT ___ . ______

IF STATION WAS RELOCATED, INDICATE HERE: ○

DROPPED: ○

NEW STATION (K, L, etc.) ___

IS IT AN ISLAND? ○

UNABLE TO SAMPLE: ○

LONG ___ . ______

LITTORAL ZONE

Surface film type: ☒ None ○ Scum ○ Algal Mat ○ Oily ○ Other

0 = Absent (0%) 1 = Sparse (<10%) 2 = Moderate (10-40%)
3 = Heavy (40-75%) 4 = Very Heavy (>75%)

BOTTOM SUBSTRATE

						Flag
Bedrock (>4000mm; larger than a car)	[✓ 0]	1	2	3	4	
Boulders (250-4000mm; basketball-car)	[✓ 0]	1	2	3	4	
Cobble (64-250mm; tennis ball-basketball)	[✓ 0]	1	2	3	4	
Gravel (2-64mm; ladybug to tennis ball size)	[✓ 0]	1	2	3	4	
Sand (0.06 - 2mm; gritty between fingers)	0	1	[✓ 2]	3	4	
Silt, Clay, or Muck (<0.06mm; not gritty)	0	1	2	3	[✓ 4]	
Woody Debris	0	1	[✓ 2]	3	4	
Organic (Leaf Pack, Detritus)	0	[✓ 1]	~~2~~	3	4	

Color: ○ Black ○ Gray ☒ Brown ○ Red ○ Other

Odor: ☒ None ○ H_2S ○ Anoxic ○ Oil ○ Chemical ○ Other

AQUATIC MACROPHYTES

						Flag
Submergent	[✓ 0]	1	2	3	4	
Emergent	0	[✓ 1]	2	3	4	
Floating	[✓ 0]	1	2	3	4	
Total Aquatic Macrophyte Cover	0	[✓ 1]	2	3	4	

Do macrophytes extend lakeward? [✓ ○ Yes] ○ No

FISH COVER

						Flag
Aquatic and Inundated Herbaceous Veg.	[✓ 0]	1	2	3	4	
Woody Debris/Snags > 0.3 m Dia.	0	1	[✓ 2]	3	4	
Woody Brush/Woody Debris <0.3 m dia. (alive or dead)	0	1	[✓ 2]	3	4	
Inundated Live Trees >0.3 m dia	[✓ 0]	1	2	3	4	
Overhanging Veg. within 1 m of Surface	0	[✓ 1]	2	3	4	
Ledges or Sharp Dropoffs	0	[✓ 1]	2	3	4	
Boulders	[✓ 0]	1	2	3	4	
Human Structures - Docks, Landings, etc	[✓ 0]	1	2	3	4	

RIPARIAN ZONE

0 = Absent (0%) 1 = Sparse (<10%) 2 = Moderate (10-40%)
3 = Heavy (40-75%) 4 = Very Heavy (>75%)

CANOPY (>5 m high)

○ Deciduous ○ Broadleaf Evergreen [✓ ○ Coniferous] ○ Mixed ○ None

						Flag
Big Trees (Trunk >0.3 m dBH)	0	1	[✓ 2]	3	4	
Small Trees (Trunk <0.3 m dBH)	0	[✓ 1]	2	3	4	

UNDERSTORY (0.5 TO 5m high)

[✓ ○ Deciduous] ○ Broadleaf Evergreen [✓ ○ Coniferous] [✓ ○ Mixed] ○ None

						Flag
Woody Shrubs & Saplings	0	1	2	[✓ 3]	4	
Tall Herbs, Grasses, & Forbs	0	[✓ 1]	2	3	4	

GROUND COVER (<0.5 high)

						Flag
Woody Shrubs & Saplings	0	1	2	[✓ 3]	4	
Herbs, Grasses and Forbs	0	[✓ 1]	2	3	4	
Standing Water or Inundated Vegetation	[✓ 0]	1	2	3	4	
Barren, Bare Dirt or Buildings	0	1	[✓ 2]	3	4	

SHORELINE SUBSTRATE ZONE

						Flag
Bedrock (>4000mm; larger than a car)	[✓ 0]	1	2	3	4	
Boulders (250-4000mm; basketball-car size)	[✓ 0]	1	2	3	4	
Cobble (64-250mm; tennis ball-basketball size)	[✓ 0]	1	2	3	4	
Gravel (2-64 mm; ladybug-tennis ball size)	[✓ 0]	1	2	3	4	
Sand (0.06 - 2mm; gritty between fingers)	0	1	[✓ 2]	3	4	
Silt, Clay, or Muck (<0.06mm; not gritty)	0	1	2	[✓ 3]	4	
Woody Debris	0	1	[✓ 2]	3	4	
Organic (Leaf Pack, Detritus)	0	[✓ 1]	2	3	4	
Vegetation or Other	0	[✓ 1]	2	3	4	

HUMAN INFLUENCE

0 = Not Present P = Present outside plot C = Present within plot

				Flag
Buildings	[✓ 0]	P	C	
Commercial	[✓ 0]	P	C	
Park Facilities/ Man-made beach	[✓ 0]	P	C	
Docks/Boats	[✓ 0]	P	C	
Walls, dikes or revetments	[✓ 0]	P	C	
Landfill/Trash	[✓ 0]	P	C	
Roads or Railroad	0	[✓ P]	C	
Power lines	[✓ 0]	P	C	
Row Crops	[✓ 0]	P	C	
Pasture/Range/Hay Field	[✓ 0]	P	C	
Orchard	[✓ 0]	P	C	
Lawn	[✓ 0]	P	C	

Flag codes: K = No measurement or observation made. U = Suspect measurement or observation; F1, F2, etc = misc flags assigned by field crew. Explain all flags in comment sections.

PHYSICAL HABITAT CHARACTERIZATION - LAKES (continued)

Draft

SITE ID: ____________ **DATE:** ___/___/_____

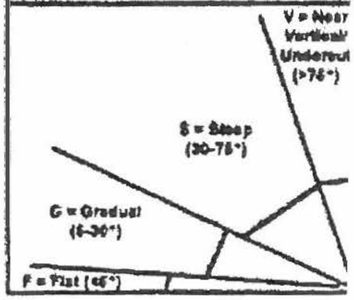
LITTORAL FISH MACROHABITAT CLASSIFICATION		**BANK FEATURES (within plot)**	
Human Disturbance	☒ None ○ Low ○ Moderate ○ High	Angle (see figure below)	○ Flat <5°) [✓ ○ Gradual (5-30°)] ○ Steep (30-75°) ○ Near vertival/undercut (>75°)
Cover Class	○ No/Little Cover ☒ Patchy Cover ○ Continuous Cover		
Cover Type (mark all that apply)	○ Artificial ○ Boulders ○ Fill ☒ Woody ○ Vegetation ○ None	Vertical height from waterline to high water mark:	1.0 (m)
Dominant Substrate	☒ Mud/Muck ○ Sand/Gravel ○ Cobble/Boulder ○ Bedrock	Horizontal distance from waterline to high water mark:	11.5 (m)

INVASIVE PLANTS AND INVERTEBRATES

Littoral Plot			Shoreline/Riparian Plot		
SPECIES	Mark if observed	FLAG	SPECIES	Mark if observed	FLAG
NONE OBSERVED	☒		NONE OBSERVED	☒	
Zebra or Quagga Mussel	○		Purple loosestrife	○	
Eurasian watermilfoil	○		Knotweed (Giant or Japanese)	○	
Hydrilla	○		Hairy willow herb	○	
Curly pondweed	○		Flowering rush	○	
African waterweed	○			○	
Brazilian waterweed	○			○	
European water chestnut	○			○	
Water hyacinth	○			○	
Parrot feather	○			○	
Yellow floating heart	○			○	
Giant salvinia	○			○	
	○			○	

Flag	Comments

Bank Angle Classes



Flag codes: K = No measurement or observation made; U = Suspect measurement or observation; F1, F2, etc. = misc. flags assigned by field crew. Explain all flags in comment sections.

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME SF Sauk	LOCATION HC - MCL
STATION #______ RIVERMILE______	STREAM CLASS
LAT ______ LONG ______	RIVER BASIN Skagit
STORET #	AGENCY
INVESTIGATORS LAH, BAS, JMS	
FORM COMPLETED BY	DATE 8-27-13 TIME 1200 AM [✓ PM] / REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 [✓ 16]	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 13 12 [✓ 11]	10 9 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 [✓ 18] 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 [✓ 8] 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	[✓ 15] 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	[✓ 20] 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 [✓ 8] 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank ~~10~~ 9	[✓ 8] 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 [✓ 9]	8 7 6	5 4 3	2 1 0

Total Score ________

HARTCROWSER

Snorkel Survey Form

PROJECT MCMA

JOB NO.

PROJECT MANAGER MAH

FIELD TEAM MAH BAS JMS

SNORKELER(S) MAH BAS

STATION ID HC- MCL

DATE 8/27/13

START TIME 9:01

STOP TIME 10:05

WEATHER Overcast showers

	Estimated Length							
Species	**0 to 50 mm**	**51 to 80**	**81 to 100**	**101 to 120**	**121 to 150**	**151 to 200**	**201 to 250**	**>250 mm**
Bull trout								57
Cutthroat								
Rainbow	1		2	4	2			
Steelhead								
Sculpin								
Chinook								
Whitefish								
Dace								
unID trout		1						

0 = not snorkelable due to high turbidity or hiding cover
1 = high amount of hiding cover and/or poor water clarity
2 = moderate hiding cover and/or moderate water clarity
3 = little hiding cover and good water clarity

Turbidity
Reach area (m^2)

Comments:

Reviewed by (initials):______
Date:__________

BENTHIC MACROINVERTEBRATE FIELD DATA SHEET

STREAM NAME SF Sauk	LOCATION HC-MCL	
STATION # ______ RIVERMILE ______	STREAM CLASS	
LAT ______ LONG ______	RIVER BASIN Skagit	
STORET #	AGENCY	
INVESTIGATORS MAH BAS JMS		LOT NUMBER
FORM COMPLETED BY MAH	DATE 8-27-13 TIME 1100 [✓ AM] PM	REASON FOR SURVEY

HABITAT TYPES	**Indicate the percentage of each habitat type present** ☐ Cobble____% ☒ Snags 15 % ☐ Vegetated Banks____% ☒ Sand 4 % ☒ Submerged Macrophytes 1 % ☒ Other (Silt) 25 %
SAMPLE COLLECTION	**Gear used** ~~☒ D-frame~~ ☐ kick-net ☒ Other Clam gun **How were the samples collected?** ☒ wading ☐ from bank ☐ from boat **Indicate the number of jabs/kicks taken in each habitat type.** ☐ Cobble____ ☐ Snags____ ☐ Vegetated Banks____ ☐ Sand____ ☐ Submerged Macrophytes____ ☒ Other (Silt) 8
GENERAL COMMENTS	Very few inverts seen, 2 jars used due to abundance of organic detritus in samples. Clam gun used. Caddis Flies commonly observed.

QUALITATIVE LISTING OF AQUATIC BIOTA

Indicate estimated abundance: 0 = Absent/Not Observed, 1 = Rare, 2 = Common, 3= Abundant, 4 = Dominant

Periphyton	0	[✓ 1]	2	3	4	Slimes	[✓ 0]	1	2	3	4
Filamentous Algae	[✓ 0]	1	2	3	4	Macroinvertebrates	0	1	[✓ 2]	3	4
Macrophytes	0	[✓ 1]	2	3	4	Fish	0	1	2	[✓ 3]	4

FIELD OBSERVATIONS OF MACROBENTHOS

Indicate estimated abundance: 0 = Absent/Not Observed, 1 = Rare (1-3 organisms), 2 = Common (3-9 organisms), 3= Abundant (>10 organisms), 4 = Dominant (>50 organisms)

Porifera	0	1	2	3	4	Anisoptera	0	1	2	3	4	Chironomidae	0	1	2	3	4
Hydrozoa	0	1	2	3	4	Zygoptera	0	1	2	3	4	Ephemeroptera	0	1	2	3	4
Platyhelminthes	0	1	2	3	4	Hemiptera	0	1	2	3	4	Trichoptera	0	1	2	3	4
Turbellaria	0	1	2	3	4	Coleoptera	0	1	2	3	4	Other	0	1	2	3	4
Hirudinea	0	1	2	3	4	Lepidoptera	0	1	2	3	4						
Oligochaeta	0	1	2	3	4	Sialidae	0	1	2	3	4						
Isopoda	0	1	2	3	4	Corydalidae	0	1	2	3	4						
Amphipoda	0	1	2	3	4	Tipulidae	0	1	2	3	4						
Decapoda	0	1	2	3	4	Empididae	0	1	2	3	4						
Gastropoda	0	1	2	3	4	Simuliidae	0	1	2	3	4						
Bivalvia	0	1	2	3	4	Tabinidae	0	1	2	3	4						
						Culcidae	0	1	2	3	4						

Rapid Bioassessment Protocols For Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish, Second Edition - Form 1

PERIPHYTON FIELD DATA SHEET

STREAM NAME SF Sauk

LOCATION HC - MCL

STATION #________ RIVERMILE________

STREAM CLASS

LAT ____________ LONG ____________

RIVER BASIN Skagit

STORET #

AGENCY 0

INVESTIGATORS MAH BAS JHS

LOT NUMBER

FORM COMPLETED BY MAH

DATE 8-27-13
TIME 1245 AM PM

REASON FOR SURVEY

HABITAT TYPES

Indicate the percentage of each habitat type present
☒ Sand-Silt-Mud-Muck ~~100~~ 80 % ☐ Gravel-Cobble____% ☐ Bedrock____%
☐ Small Woody Debris____% ☒ Large Woody Debris 20 % ☒ Plants, Roots <1 %
☐ Riffle____% ☒ Run ~~100~~ % 15 ☒ Pool 65 %
☐ Canopy____%

SAMPLE COLLECTION

Gear used ☐ suction device ☐ bar clamp sample ☒ scraping ☐ Other ____________

How were the samples collected? ☒ wading ☐ from bank ☐ from boat

If natural habitat collections, indicate the number of samples taken in each habitat type.
☒ Sand-Silt-Muck 100 % ☐ Gravel-Cobble____% ☐ Bedrock____%
☐ Small Woody Debris____% ☐ Large Woody Debris____% ☐ Plants, Roots____%

GENERAL COMMENTS

very muddy, Zone
Caddisflies very abundant

QUALITATIVE LISTING OF AQUATIC BIOTA

Indicate estimated abundance: **0 = Absent/Not Observed, 1 = Rare (<5%), 2 = Common (5% - 30%), 3= Abundant (30% - 70%), 4 = Dominant (>70%)**

Periphyton	0 [✓ 1] 2 3 4	Slimes	[✓ 0] 1 2 3 4
Filamentous Algae	[✓ 0] 1 2 3 4	Macroinvertebrates	0 1 [✓ 2] 3 4
Macrophytes	0 [✓ 1] 2 3 4	Fish	0 1 2 [✓ 3] 4

- [illegible]

HARTCROWSER

Chemistry Sampling Form

PROJECT MCMA
JOB NO. 17800-35
PROJECT MANAGER MAH
FIELD TEAM JMS, BAS, MAH

WQ instrument Horiba U-22
Operator

STATION ID HC-MCV
DATE/TIME SAMPLED 8/27/13
STREAM DEPTH
STREAM VELOCITY
SAMPLE DEPTH
Lat
Long

	Calibrated	Start Time	End Time	Water quality comments: (color, odor, sheen)
T (deg C)	Y N			
DO (mg/L)	Y N			
pH	Y N			
Cond (uS/cm)	Y N			
Turb. (NTU)	Y N			

Sample ID (ex. HC13-SW-SFSR09)	Bottle type	# of Containers	Analyses	Preservative	Filter

Total number of bottles
Duplicate Sample ID
Field Blank ID
Rinsate Sample ID

Sediment # of locations for composite

	%Gravel
	%Sand
	%Fines

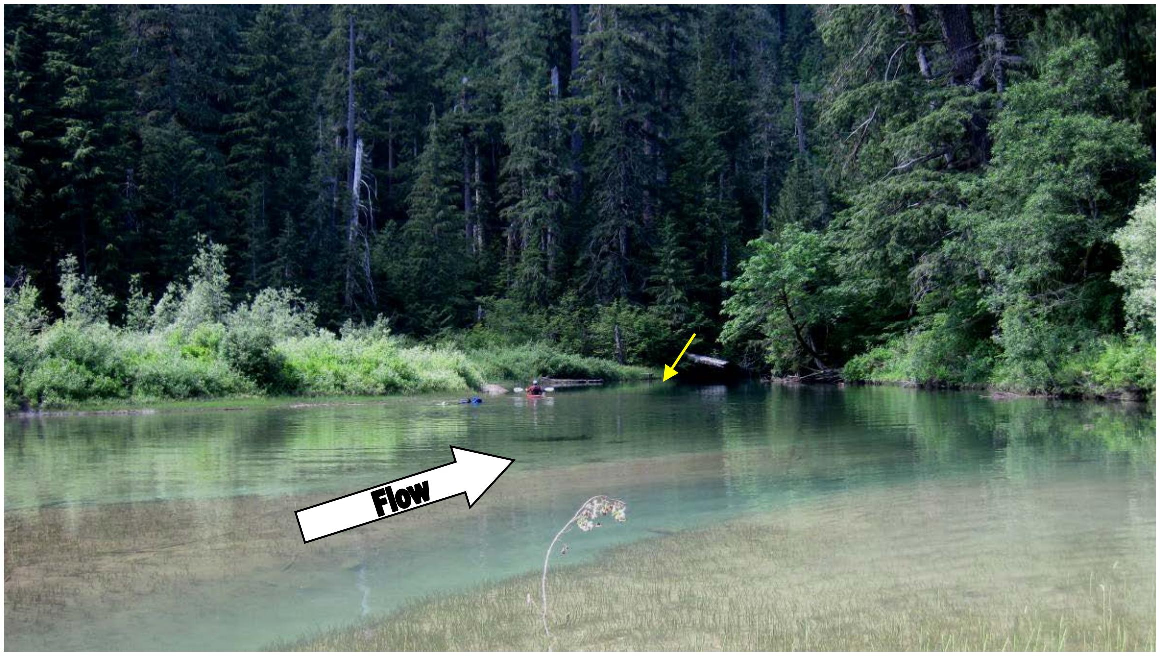
Comments:

C:\PROJECTS\35_MCMA\Deliverables\SAP\Appendix B - datasheets\ChemistrySamplingForms.xls

Reviewed by (initials):
Date:

Photograph 27 – July 8, 2013. View across top of reach to river left. Note lack of canopy.

Photograph 28 – July 8, 2013. Submerged woody debris present within the reach.



Photograph 29 – July 8, 2013. View downstream to end of reach (yellow arrow).

Photograph 30 – August 27, 2013. Algal/microbial mats producing gas bubbles. Bubbles seen frequently breaking surface of the backwater.

Photograph 31 – August 27, 2013. School of ~70 bull trout seen migrating through the main channel.

Photograph 32 – August 27, 2013. View at end of reach (yellow arrow) from downstream. Note presence of large woody debris.

Photograph 33 – July 10, 2013. Red staining prominent when viewed from above. Image shows river just upstream of MCL-backwater (seen in top right)

South Fork Sauk River
HC-SFSR-09

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double-sided printing.

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET
(FRONT)

STREAM NAME ~~HC~~ · SF Sauk	LOCATION HC · SFS2-09
STATION #________ RIVERMILE________	STREAM CLASS
LAT ____________ LONG ____________	RIVER BASIN Skagit
STORET #	AGENCY
INVESTIGATORS MAH BAS, JMS	
FORM COMPLETED BY BAS	DATE 8/28/13 TIME 11:00 [✓ AM] PM
	REASON FOR SURVEY

WEATHER CONDITIONS

Now		Past 24 hours
☐	storm (heavy ain)	☒
☐	rain (steady rain)	☒
☒	showers (intermittent)	☒
80 % ☒	%cloud cover	☒ 100 %
☐	clear/sunny	☐

Has there been a heavy rain in the last 7 days?
☒ Yes ☐ No

Air Temperature ~68 °C

Other________________________

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)

STREAM CHARACTERIZATION

Stream Subsystem
☒ Perennial ☐ Intermittent ☐ Tidal

Stream Origin
☐ Glacial
☐ Non-glacial montane
☐ Swamp and bog
☐ Spring-fed
☒ Mixture of origins
☐ Other__________

Stream Type
☒ Coldwater ☐ Warmwater

Catchment Area__________km^2

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET
(BACK)

WATERSHED FEATURES

Predominant Surrounding Landuse
☒ Forest ☐ Commercial
☐ Field/Pasture ☐ Industrial
☐ Agricultural ☐ Other ______
☐ Residential

Local Watershed NPS Pollution
☒ No evidence ☐ Some potential sources
☐ Obvious sources

Local Watershed Erosion
☒ None ☐ Moderate ☐ Heavy

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present
☒ Trees ☒ Shrubs ☐ Grasses ☐ Herbaceous
dominant species present Cottonwood, Alder, vine maple, Cedar?

INSTREAM FEATURES

Estimated Reach Length 100 m
Estimated Stream Width 32.5 ~~m~~ ft
Sampling Reach Area ______ m²
Area in km² (m²x1000) ______ km²
Estimated Stream Depth 1 m
Surface Velocity (at thalweg) ______ m/sec 13.325/33 ft

Canopy Cover
☒ Partly open ☐ Partly shaded ☐ Shaded
High Water Mark 3 m
Proportion of Reach Represented by Stream Morphology Types
☒ Riffle 40 % ☐ Run ______ %
☒ Pool 60 %
Channelized ☐ Yes ☒ No
Dam Present ☐ Yes ☒ No

LARGE WOODY DEBRIS

LWD 0 m²
Density of LWD ______ m²/km² **(LWD/ reach area)**

AQUATIC VEGETATION

Indicate the dominant type and record the dominant species present
☐ Rooted emergent ☐ Rooted submergent ☐ Rooted floating ☐ Free floating
☐ Floating Algae ☒ Attached Algae
dominant species present Matted algae, some filamentous green
Portion of the reach with aquatic vegetation 3 %

WATER QUALITY

Temperature 13.6 °C
Specific Conductance 0.043 (note: Blinking, water very turbid)
Dissolved Oxygen 10.69
pH 6.0
Turbidity 0.0
WQ Instrument Used Horiba

Water Odors
☒ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other ______

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs ☐ Flecks
☒ None ☐ Other ______

Turbidity (if not measured)
☐ Clear ☐ Slightly turbid ☒ Turbid
☐ Opaque ☐ Stained ☐ Other ______

SEDIMENT/ SUBSTRATE

Odors
☒ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other ______

Oils
☒ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits
☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand
☐ Relict shells ☐ Other ______

Looking at stones which are not deeply embedded, are the undersides black in color?
☐ Yes ☒ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**
Bedrock		
Boulder	> 256 mm (10")	50
Cobble	64-256 mm (2.5"-10")	30
Gravel	2-64 mm (0.1"-2.5")	5
Sand	0.06-2mm (gritty)	15
Silt	0.004-0.06 mm	
Clay	< 0.004 mm (slick)	

ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	**Characteristic**	**% Composition in Sampling Area**
Detritus	sticks, wood, coarse plant materials (CPOM)	3
Muck-Mud	black, very fine organic (FPOM)	
Marl	grey, shell fragments	

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME SF Sauk	LOCATION HC-SFSR-09
STATION #________ RIVERMILE_________	STREAM CLASS
LAT ___________ LONG ___________	RIVER BASIN Skagit
STORET #	AGENCY
INVESTIGATORS MAH, BAS, JHS	
FORM COMPLETED BY BAS	DATE 8/18/13 TIME 11:15 [✓ AM] PM REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 [✓ 16]	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE	20 19 [✓ 18] 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE	20 19 18 17 [✓ 16]	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	[✓ 15] 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	[✓ 10] 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	[✓ 20] 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE	[✓ 20] 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 7 ~~6~~	[✓ 5] 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 [✓ 9]	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 [✓ 9]	8 7 6	5 4 3	2 1 0

Total Score __________

HARTCROWSER

Snorkel Survey Form

PROJECT MCMA
JOB NO.
PROJECT MANAGER MAH
FIELD TEAM MAH, BAS, JMS
SNORKELER(S) MAH, BAS

STATION ID HC-SFSR-09
DATE 8/28/13
START TIME 8:50
STOP TIME 9:50
WEATHER Rainy, overcast, some sun

Species	Estimated Length							
	0 to 50 mm	51 to 80	81 to 100	101 to 120	121 to 150	151 to 200	201 to 250	>250 mm
Bull trout								
Cutthroat								
Rainbow		3	i	2	4 +4	4+4		
Steelhead								
Sculpin								
Chinook								
Whitefish								
Dace								
UNID	1							

0 = not snorkelable due to high turbidity or hiding cover
1 = high amount of hiding cover and/or poor water clarity
2 = moderate hiding cover and/or moderate water clarity
3 = little hiding cover and good water clarity

Turbidity
Reach area (m^2)

Comments: Poor visibility + fast water made survey difficult. Heavy rains morning of and previous night. Very turbid water.

In pool, similar algal/bacterial mats to MCL backwater.

Reviewed by (initials):______
Date:______

BENTHIC MACROINVERTEBRATE FIELD DATA SHEET

STREAM NAME SF Sauk	LOCATION HC - SFSK - 09
STATION #________ RIVERMILE________	STREAM CLASS
LAT ____________ LONG ____________	RIVER BASIN Skagit
STORET #	AGENCY U
INVESTIGATORS HAH, BAS, JHS	LOT NUMBER
FORM COMPLETED BY BAS	DATE 8/23/13 TIME 10 30 [✓ AM] PM REASON FOR SURVEY

HABITAT TYPES

Indicate the percentage of each habitat type present
☒ Cobble 35 % ☐ Snags_____% ☐ Vegetated Banks_____% ☒ Sand 15 %
☐ Submerged Macrophytes_____% ☒ Other (Boulder) 50 %

SAMPLE COLLECTION

Gear used ☒ D-frame ☐ kick-net ☐ Other ________________

How were the samples collected? ☒ wading ☐ from bank ☐ from boat

Indicate the number of jabs/kicks taken in each habitat type.
☒ Cobble 8 ☐ Snags_____ ☐ Vegetated Banks_____ ☐ Sand_____
☐ Submerged Macrophytes_____ ☐ Other ( )_____

GENERAL COMMENTS

QUALITATIVE LISTING OF AQUATIC BIOTA

Indicate estimated abundance: 0 = Absent/Not Observed, 1 = Rare, 2 = Common, 3= Abundant, 4 = Dominant

Periphyton	0	1	2	3	4	Slimes	0	1	2	3	4
Filamentous Algae	0	1	2	3	4	Macroinvertebrates	0	1	2	3	4
Macrophytes	0	1	2	3	4	Fish	0	1	2	3	4

FIELD OBSERVATIONS OF MACROBENTHOS

Indicate estimated abundance: 0 = Absent/Not Observed, 1 = Rare (1-3 organisms), 2 = Common (3-9 organisms), 3= Abundant (>10 organisms), 4 = Dominant (>50 organisms)

Porifera	0	1	2	3	4	Anisoptera	0	1	2	3	4	Chironomidae	0	1	2	3	4
Hydrozoa	0	1	2	3	4	Zygoptera	0	1	2	3	4	Ephemeroptera	0	1	2	3	4
Platyhelminthes	0	1	2	3	4	Hemiptera	0	1	2	3	4	Trichoptera	0	1	2	3	4
Turbellaria	0	1	2	3	4	Coleoptera	0	1	2	3	4	Other	0	1	2	3	4
Hirudinea	0	1	2	3	4	Lepidoptera	0	1	2	3	4						
Oligochaeta	0	1	2	3	4	Sialidae	0	1	2	3	4						
Isopoda	0	1	2	3	4	Corydalidae	0	1	2	3	4						
Amphipoda	0	1	2	3	4	Tipulidae	0	1	2	3	4						
Decapoda	0	1	2	3	4	Empididae	0	1	2	3	4						
Gastropoda	0	1	2	3	4	Simuliidae	0	1	2	3	4						
Bivalvia	0	1	2	3	4	Tabinidae	0	1	2	3	4						
						Culcidae	0	1	2	3	4						

PERIPHYTON FIELD DATA SHEET

STREAM NAME SF Sauk
LOCATION HC-SFSR-09
STATION #________ RIVERMILE________
STREAM CLASS
LAT ____________ LONG ____________
RIVER BASIN Skagit
STORET #
AGENCY
INVESTIGATORS MAH BAS, JKS
LOT NUMBER
FORM COMPLETED BY BAS
DATE 8/28/13
TIME 1030 [✓ AM] PM
REASON FOR SURVEY

HABITAT TYPES

Indicate the percentage of each habitat type present 85
☑ Sand-Silt-Mud-Muck 12 % ☒ Gravel-Cobble [illegible] % ☐ Bedrock_____%
☑ Small Woody Debris 3 % ☐ Large Woody Debris_____% ☐ Plants, Roots_____%
☒ Riffle 40 % ☐ Run_____% ☒ Pool 60 %
☒ Canopy 0 %

SAMPLE COLLECTION

Gear used ☐ suction device ☐ bar clamp sample ☒ scraping ☐ Other ____________

How were the samples collected? ☒ wading ☐ from bank ☐ from boat

If natural habitat collections, indicate the number of samples taken in each habitat type.
☐ Sand-Silt-Mud-Muck_____% ☒ Gravel-Cobble 100 % ~8 ☐ Bedrock_____%
☐ Small Woody Debris_____% ☐ Large Woody Debris_____% ☐ Plants, Roots_____%

GENERAL COMMENTS

Rocks much less slippery + discolored by periphyton than in other sites. Effluent brownish in color, filtered rapidly.

QUALITATIVE LISTING OF AQUATIC BIOTA

Indicate estimated abundance: **0 = Absent/Not Observed, 1 = Rare (<5%), 2 = Common (5% - 30%), 3= Abundant (30% - 70%), 4 = Dominant (>70%)**

Periphyton	0	1	[✓ 2]	3	4	Slimes	[✓ 0]	1	2	3	4
Filamentous Algae	[✓ 0]	1	2	3	4	Macroinvertebrates	0	~~1~~	[✓ 2]	3	4
Macrophytes	[✓ 0]	1	2	3	4	Fish	0	1	[✓ 2]	3	4

Photograph 34 – October 23, 2012. View of the large pool (along the left bank) at the upper end of the sampling reach.

Photograph 35 – October 23, 2012. View of the lower portion of the sampling reach from the downstream end; eroding slope along the left bank.

Photograph 36 – August 28, 2013. Red staining evident within the reach. Breaking the rocks suggested the staining was intrusive.

Photograph 37 – August 28, 2013. Red staining evident within the reach. Aufwuchs also present.

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APPENDIX B
Sediment Bioassay Laboratory Reports

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for double-sided printing.

Report

of

Test No. 848-1

Assessment of Freshwater Sediments as part of the Monte Cristo Mining Area Remedial Investigation, Phase 3, Using a 28-day Amphipod, *Hyalella azteca*, Sediment Bioassay.

Submitted to

Hart Crowser, Inc.
120 Third Avenue South, Suite 110
Edmonds, WA 98020

Submitted by

Northwestern Aquatic Sciences
3814 Yaquina Bay Road
P.O. Box 1437
Newport, OR 97365

October 29, 2013

TOXICITY TEST REPORT

TEST IDENTIFICATION

Test No.: 848-1

Title: Toxicity of freshwater sediments using a 28-day Amphipod, *Hyalella azteca*, sediment bioassay as part of the Monte Cristo Mining Area, Remedial Investigation, Phase 3.

Protocol No.: NAS XXX HA4c, February 11, 2000. Revision 3 (4-26-05). Based on ASTM 2001 (Standard test methods for measuring the toxicity of sediment-associated contaminants with fresh water invertebrates, E1706-00), Am. Soc. Test. Mat., Phila., PA, and EPA Method 100.1 (Methods for measuring the toxicity and bioaccumulation of sediment-associated contaminants with freshwater invertebrates, EPA/600/R-99/064).

STUDY MANAGEMENT

Study Sponsor: Hart Crowser, Inc., 120 Third Avenue South, Suite 110, Edmonds, WA 98020

Sponsor's Study Monitor: Ms. Michelle Havey

Testing Laboratory: Northwestern Aquatic Sciences, P.O. Box 1437, Newport, OR 97365

Test Location: Newport laboratory

Laboratory's Study Personnel: G.J. Irissarri, B.S., Proj. Man./Study Dir.; L.K. Nemeth, B.A., M.B.A., QA Officer; R.S. Caldwell, PhD, Sr. Toxicologist; G.A. Buhler, B.S., Aq. Toxicologist; Y. Nakahama, Sr.Tech.; S.F. Knowlton, B.S., Tech.; S. Gage, B.A., Tech.

Study Schedule:

Test Beginning: 9-10-13, 1130 hrs.

Test Ending: 10-8-13, 1030 hrs.

Disposition of Study Records: All raw data, reports and other study records are stored at Northwestern Aquatic Sciences, 3814 Yaquina Bay Rd., Newport, OR 97365.

Statement of Quality Assurance: The test data were reviewed by the Quality Assurance Unit to assure that the study was performed in accordance with the protocol and standard operating procedures. This report is an accurate reflection of the raw data.

TEST MATERIAL

Test Sediments: Freshwater test sediments collected as part of the Monte Cristo Mining Area, Remedial Investigation, Phase 3. Details are as follows:

NAS Sample No.	4562G	4563G	4564G	4565G
Description	HC-SFSR-09	HC-SFSR-07	HC-MCL	HC-SFSR-03
Collection Date	8/28/13	8/22/13	8/27/13	8/23/13
Receipt Date	8/31/13	8/31/13	8/31/13	8/31/13

NAS Sample No.	4566G	4567G	4568G
Description	HC-GC-01	HC-GC-05	HC-76-02
Collection Date	8/24/13	8/25/13	8/26/13
Receipt Date	8/31/13	8/31/13	8/31/13

Control Sediment: The negative control sediment (NAS#4569G) was collected on 9-1-13 from an area approximately one mile east of the Hwy. 101 bridge at Beaver Creek, approx. 8 miles south of Newport, OR.

Treatments: Homogenized at test set up by mixing using stainless steel implements.

Storage: All test and control sediments were stored at 4°C in the dark in sealed containers until used.

TEST WATER

Source: Dechlorinated municipal tap water.

Date of Preparation: Thirteen batches of test water were collected between: 9/3/13 and 10/7/13

Water Qualitym (mean ± SD):

pH: 7.6 ± 0.3 (n=13)

conductivity: 100 ± 4 μmhos/cm (n=13)

hardness: 26 ± 0 mg/L as $CaCO_3$ (n=13)

alkalinity: 39 ± 3 mg/L as $CaCO_3$. (n=13)
total chlorine: All batches were < 0.02 mg/L
Pretreatment: Dechlorinated and aerated ≥24 hr.

TEST ORGANISMS

Species: *Hyalella azteca,* amphipod.
Age/Size: 7-8 days old
Source: Chesapeake Cultures, Hayes, VA; received 9-7-13
Acclimation: Holding conditions prior to testing averaged: Temperature, 22.3 ± 0.4 °C; dissolved oxygen, 10.0 ± 3.4 mg/L; pH, 7.7 ± 0.3; conductivity, 371 ± 142 µmhos/cm; hardness, 120 ± 60 mg/L as $CaCO_3$; and alkalinity, 128 ± 59 mg/L as $CaCO_3$. Photoperiod, 16:8, L:D. Half of the water was replaced daily with dechlorinated municipal tap water during holding. Animals were fed YTC daily during holding.

TEST PROCEDURES AND CONDITIONS

The following is an abbreviated statement of the test procedures and a statement of the test conditions actually employed. See the test protocol (Appendix I) for a more detailed description of the test procedures used in this study.

Test Chambers: 300 ml high-form glass beakers
Test Volumes: 100 ml sediment layer; 175 ml test water.
Replicates/Treatment: 8 (plus an additional replicate for day 28 sulfide & ammonia measurements)
Organisms/Treatment: 80
Water Volume Changes: 2 water volumes per day
Aeration: None.
Feeding: Animals are fed 1.0 ml of YTC suspension per beaker daily.
Effects Criteria: 1) survival after 28 days, and 2) average individual dry weight after 28 days. Death is defined as no visible movement or response to tactile stimulation. Missing organisms were considered to be dead.
Water Quality and Other Test Conditions: The temperature, dissolved oxygen, conductivity, pH, hardness, alkalinity, and ammonia-nitrogen were measured in the overlying water of one replicate test container per treatment on days 0 and 28 of the test. Temperature was measured daily, pH and dissolved oxygen three times per week, and conductivity weekly, in the overlying water of one replicate test container per treatment. Hardness and alkalinity were measured with titrimetric methods. Total ammonia and dissolved sulfide were measured in the pore water from the bulk sediment at test initiation and in an added replicate beaker at test termination. Interstitial water samples were obtained by centrifugation. Total soluble sulfide and total ammonia N were measured using Hach reagents based on the methylene blue (EPA Method 376.2) and salicylate (Clin. Chim. Acta 14:403, 1996) colorimetric methods, respectively; samples were not distilled prior to analysis. The photoperiod was 16:8, L:D.

DATA ANALYSIS METHODS

Survival and mortality were calculated for each replicate as follows:

percent survival = 100 x (number surviving/initial number tested)
percent mortality = 100 x (number dead/initial number tested)

average individual dry weight = (final wt. - tare wt.)/initial number,
where:
final wt. = tare wt. + dry weight of organisms recovered on day 28, in mg

Means and standard deviations for the biological endpoints described above, and for water quality data, were computed using Microsoft Excel 2010.

PROTOCOL DEVIATIONS

None

REFERENCE TOXICANT TEST

The reference toxicant test is a multi-concentration toxicity test using potassium chloride, to evaluate the performance of the test organisms used in the sediment toxicity test. The performance is evaluated by comparing the results of this test with historical results obtained at the laboratory. A summary of the reference toxicant test result is given below. The reference toxicant test raw data are found in Appendix III.

Test No.: 999-3208
Reference Toxicant and Source: Potassium Chloride (KCl), Fisher Lot #114689.
Test Date: 9-10-13.
Dilution Water Used: Moderately hard synthetic water prepared from Milli-Q® deionized water.
Result: 96-hr LC50, 0.34 g/L. This result is within the laboratory's control chart warning limits (0.30 – 0.47 g/L).

TEST RESULTS

Observations of water quality in the overlying water throughout the test are summarized in Table 1. A detailed tabulation of the water quality results by sample and test day can be found in Appendix II. Interstitial total ammonia and dissolved sulfide measurements of bulk sediments are listed in Table 2. The means and standard deviations of percent mortality and average dry weight of *Hyalella* exposed for 28 days to sediments are summarized in Table 3. Detailed data organized by sample and replicate, and summary statistics for these observations, are given in Appendix II.

All water quality observations were within the protocol specified ranges. Ammonia-N in the overlying water ranged from <0.1 to 0.3 mg/L for all day 0 and day 28 measurements. Interstitial bulk sediment values for ammonia-N for all initial and day 28 measurements ranged from <0.5 to 1.9 mg/L. Interstitial bulk sediment values for total sulfides for all initial and day 28 measurements were <0.1 mg/L.

The test met the survival acceptability criteria specified in the test protocol with 7.5% mean control mortality (≤20% required). The reference toxicant (positive control) EC50 result was within the laboratory's control chart limits (0.34 g/L; control chart mean ± 2 S.D. = 0.38 ± 0.08). It is concluded, therefore, that the test has developed fully acceptable data for use in making management decisions.

STUDY APPROVAL

Gerald Irissarri 10-27-13
Project Manager/Study Director Date

Julie R. Fiore 10-28-13
Quality Assurance Unit Date

Linda K. Nemeth 10/23/13
Assistant Laboratory Director Date

Table 1. Summary of water quality conditions during tests of the amphipod, *Hyalella azteca*, exposed to freshwater sediments.

Water Quality Parameter	Mean ± S.D.	Minimum	Maximum	N
Temperature (°C)	22.8 ± 0.4	22.0	23.5	232
Dissolved oxygen (mg/L)	7.1 ± 0.6	5.6	8.9	112
Conductivity (µmhos/cm)	107 ± 6	97	121	48
pH	7.2 ± 0.2	6.6	7.9	112
Hardness (mg/L as $CaCO_3$)	28 ± 7	17	34	16
Alkalinity (mg/L as $CaCO_3$)	37 ± 5	30	40	16
Total ammonia (mg/L)	---	<0.1	0.3	16

Table 2. Interstitial total ammonia-N and dissolved sulfide in test sediments porewater prior to test initiation and at test termination.

NAS Sample No.	Sample Description	Bulk Sediment		Test Termination	
		Ammonia (mg/L)	Sulfide (mg/L)	Ammonia (mg/L)	Sulfide (mg/L)
4569G	Control	1.0	<0.1	1.9	<0.1
4562G	HC-SFSR-09	0.8	<0.1	0.8	<0.1
4563G	HC-SFSR-07	<0.5	<0.1	0.6	<0.1
4564G	HC-MCL	0.9	<0.1	1.1	<0.1
4565G	HC-SFSR-03	<0.5	<0.1	1.8	<0.1
4566G	HC-GC-01	<0.5	<0.1	0.8	<0.1
4567G	HC-GC-05	0.5	<0.1	1.8	<0.1
4568G	HC-76-02	<0.5	<0.1	0.8	<0.1

Table 3. Mortality and growth results of *Hyalella azteca* 20-day sediment toxicity test.

NAS Sample No.	Sample Description	Percent mortality (Mean ± SD)	Average dry wt/amphipod (mg) (Mean ± SD)
4569G	Control	7.5 ± 7.1	0.26 ± 0.04
4562G	HC-SFSR-09	5.0 ± 5.3	0.42 ± 0.05
4563G	HC-SFSR-07	6.3 ± 5.2	0.35 ± 0.04
4564G	HC-MCL	5.0 ± 5.3	0.31 ± 0.04
4565G	HC-SFSR-03	5.0 ± 7.6	0.36 ± 0.06
4566G	HC-GC-01	7.5 ± 8.9	0.35 ± 0.04
4567G	HC-GC-05	3.8 ± 5.2	0.33 ± 0.04
4568G	HC-76-02	10.0 ± 10.7	0.31 ± 0.02

APPENDIX I

PROTOCOL

TEST PROTOCOL

FRESHWATER AMPHIPOD, *HYALELLA AZTECA*, 28-DAY SEDIMENT SURVIVAL AND GROWTH TEST

1. INTRODUCTION

1.1 Purpose of Study: The purpose of this study is to characterize the chronic toxicity of freshwater sediments using a 28-day exposure and survival and growth endpoints with the amphipod, *Hyalella azteca*.

1.2 Referenced Method: This protocol is based on ASTM Method E 1706-00 (ASTM 2001) and EPA Method 100.1 (EPA/600/R-99/064)

1.3 Summary of Method: A summary of test conditions for the amphipod 28-day sediment survival and growth test is tabulated below. The test with *Hyalella azteca* is conducted at 23 ± 1°C with a 16L:8D photoperiod at an illuminance of about 100-1000 lux. Test chambers are 300-mL high-form lipless beakers containing 100 mL of sediment and 175 mL of overlying water. Ten 7-8day old amphipods are used in each replicate. The number of replicates/treatment depends on the objective of the test. Eight replicates are recommended for routine testing. Amphipods in each test chamber are fed 1.0 mL of YCT food daily. Each chamber receives two volume additions per day of overlying water. Test endpoints include survival and growth.

2. STUDY MANAGEMENT

2.1 Sponsor's Name and Address:

____
____
____
____

2.2 Sponsor's Study Monitor:

____

2.3 Name of Testing Laboratory:
Northwestern Aquatic Sciences
3814 Yaquina Bay Road, P.O. Box 1437
Newport, OR 97365.

2.4 Test Location:

____

2.5 Laboratory's Personnel to be Assigned to the Study:
Study Director: ____________________
Quality Assurance Unit: ____________________
Aquatic Toxicologist: ____________________
Aquatic Toxicologist: ____________________

2.6 Proposed Testing Schedule: Tests are normally begun within 14 days of sample collection. Reference toxicant test to be run concurrently.

2.7 Good Laboratory Practices: The test is conducted following the principles of Good Laboratory Practices (GLP) as defined in the EPA/TSCA Good Laboratory Practice regulations revised August 17, 1989 (40 CFR Part 792).

3. TEST MATERIAL

The test materials are freshwater sediments. The control, reference, and test sediments are placed in solvent cleaned 1 L glass jars fitted with PTFE-lined screw caps. At the laboratory the samples are stored at 4°C in the dark. The original sealed containers may be stored for up to 8 weeks prior to testing, depending on the testing requirements. If jars are not not full when received or if sediment is removed for testing, headspaces should be filled with nitrogen to retard deterioration. A negative control sediment is collected from a clean site. In addition, a reference sediment, a clean sediment with physical characteristics similar to the test sediments, may be employed as a comparison station.

4. TEST WATER

Test water (overlying water) at NAS is normally dechlorinated tap water or moderately hard synthetic water. Synthetic dilution water is prepared from Milli-Q reagent grade water and reagent grade chemicals. Test water may also be well water, surface water, site water, or other water depending on the study design. The hardness or other water quality parameters of the dilution water may need to be adjusted to meet the study design.

5. TEST ORGANISMS

5.1 Species: amphipod, *Hyalella azteca.*

5.2 Source: Cultured at NAS. Alternatively, animals may be purchased from a reputable commercial supplier.

5.3 Age: 7-8 days old at start of test

5.4 Acclimation and Pretest Observation: Cultures are maintained at 23 ± 1°C under a 16:8 L:D photoperiod. Cultured amphipods are fed dried maple leaves with YTC. Rabbit chow, Tetramin® or TetraFin® flakes may also be used. Acclimation of test organisms to the test water may be desirable, depending on culture water, but it is not required. If test organisms are to be acclimated, fifty percent of the holding water is changed daily with the addition of test water.

6. DESCRIPTION OF TEST SYSTEM

6.1 Test Chambers and Environmental Control: Test chambers used in the toxicity test are 300-mL high-form lipless glass beakers. Test chambers are maintained at constant temperature by partial immersion in a temperature-controlled water bath or by placement in a temperature-controlled room. Aeration is not empolyed unless dissolved oxygen drops below 2.5 mg/L. The test is conducted under an illuminance of 100-1000 lux with a 16L:8D photoperiod.

6.2 Cleaning: All laboratory glassware, including test chambers, is cleaned as described in EPA/600/4-90/027F. New glassware and test systems are soaked 15 minutes in tap water and scrubbed with detergent (or cleaned in automatic dishwasher); rinsed twice with tap water; carefully rinsed once with fresh, dilute (10%, V:V) hydrochloric or nitric acid to remove scale, metals, and bases; rinsed twice with deionized water; rinsed once with acetone to remove organic compounds (using a fume hood or canopy); and rinsed three times with deionized water. Test systems and chambers are rinsed again with dilution water just before use.

7. EXPERIMENTAL DESIGN AND TEST PROCEDURES

7.1 Experimental Design: The test involves exposure of amphipods to test, control, and reference sediments. The sediments are placed on the bottom of the test containers and are overlain with test water. The test exposure is for 28 days. The renewal of overlying water consists of two volume additions per day, either continuous or intermittent. Each treatment consists of eight replicate test containers, each containing 10 organisms. Test chamber positions are completely randomized. Test organisms are randomly distributed to the test chambers. Blind testing is normally used.

7.2 Setup of Test Containers: Sediments are homogenized and placed in test chambers on the day before addition of test organisms. Sediment (100 ml) is placed into each of eight replicate beakers. After addition of the sediment, 175 ml of test water is gently added to each beaker in a manner to prevent resuspension. The overlying water is replaced twice daily. The test begins when amphipods are introduced to the test chambers. Initial water quality measurements are taken prior to the addition of test organisms.

7.3 Effect Criterion: The effect criteria used in the 28-day amphipod bioassay are mortality and growth. Death is defined as the lack of movement of body or appendages on response to tactile stimulation. Growth is measured as change in dry weight.

7.4 Test Conditions: No aeration is employed unless dissoved oxygen falls below 2.5 mg/L. The test temperature employed is 23 ± 1°C. A 16:8, L:D photoperiod is used. Illumination is supplied by daylight fluorescent lamps at 100-1000lux. The overlying water is replaced twice daily.

7.5 Beginning the Test: On the day the test begins, amphipods are impartially counted into small containers of test water (10/container). The test is begun by rinsing test organisms into the equilibrated test containers. For the growth endpoint, time-zero weight data should be collected.

7.6 Feeding: Amphipods are fed 1.0 mL of YCT daily per test chamber. A feeding may be skipped if there is a build up of excess food. However, all beakers must be treated similarly.

7.7 Test Duration, Type and Frequency of Observations, and Methods: The duration of the toxicity test is 28 days. The type and frequency of observations to be made are summarized as follows:

TYPE OF OBSERVATION	TIMES OF OBSERVATION
BIOLOGICAL DATA	
Survival, growth	Day 28
PHYSICAL AND CHEMICAL DATA	
Hardness, alkalinity, conductivity, and ammonia-N	Beginning and end of test in overlying water of one replicate beaker from each treatment.
Temperature	Daily in overlying water of one replicate beaker from each treatment.
Conductivity	Weekly
Dissolved oxygen and pH	3X/week
Optional pore water ammonia and/or sulfide	In test sediments prior to initiating the tests. Optionally in sediments from sacrificial test chambers at test beginning and/or end.

Dissolved oxygen is measured using a polarographic oxygen probe calibrated according to the manufacturer's recommendations. The pH is measured using a pH probe and a properly calibrated meter with scale divisions of 0.1 pH units. Temperature is measured with a calibrated mercury thermometer or telethermometer. Conductivity is measured with a conductivity meter. Hardness and alkalinity are measured using titrometric methods. Total soluble sulfide and total ammonia-N were measured using Hach test kits based on the methylene blue (EPA Method 376.2) and salicylate (Clin. Chim. Acta 14:403, 1996) colorimetric methods, respectively; samples were not distilled prior to analysis.

Overlying water should be sampled just before water renewal from about 1 to 2 cm above the sediment surface using a pipet. It may be necessay to pool water samples from individual replicates. The pipet should be checked to make sure no organisms are removed during sampling of overlying water.

7.8 Test Termination: At test termination, the contents of each test container are sieved through a #35 (500 µm mesh) sieve to recover the amphipods. Amphipods from each replicate are put into a 30 mL plastic cup, rinsed with DI water, gently blotted and place into the appropriate tared aluminum weighing pan. The number of survivors for each container is recorded on the datasheet.

7.9 Growth Measurement: Growth is measured as average dry weight of animals in a test replicate at the end of the test on day 28. Pooled animals from each test replicate are gently blotted and placed into tared aluminum weigh pans. The pans are dried at 60-90°C to constant weight. The dried amphipods are placed into a dessicator and weighed as soon as possible to the nearest 0.01 mg (desirable to use 0.001 mg). The total weight of the dried amphipods in each pan is divided by the number of amphipods weighed to obtain an average dry weight per surviving amphipod per replicate.

8. CRITERIA OF TEST ACCEPTANCE

The test results are acceptable if the minimum survival of organisms in the control treatment at the end of the test is at least 80%.

9. DATA ANALYSIS

The endpoints of the toxicity test are survival and growth. Survival is obtained as a direct count of living organisms in each test container at the end of the test. Average amphipod dry weight, also measured at the end of the test, may be used to compare growth between treatment sediments and the control or reference sediment. Ordinarily the following data analysis is performed. Due to special requirements, alternative methods may be used. The means and standard deviations are calculated for each treatment level. Identification of toxic sediments is established by statistical comparison of test endpoints between test and control or reference sediments. Between treatment comparisons may be made using a Student's t-test or Wilcoxon's Two-Sample test, where each treatment is compared to the control or the reference sediment. An arcsine-square root transformation of proportional data, and tests for normality and heterogeneity of variances, are performed prior to statistical comparisons.

10. REPORTING

The final report of the test results must include all of the following standard information at a minimum: name and identification of the test; the investigator and laboratory; date and time of test beginning and end; information on the test material; information on the source and quality of the overlying/test water; detailed information about the test organisms including acclimation conditions; a description of the experimental design and test chambers and other test conditions including feeding, if any, and water quality; definition of the effect criteria and other observations; responses, if any, in the control treatment; tabulation and statistical analysis of measured responses and a summary table of endpoints; a description of the statistical methods used; any unusual information about the test or deviations from procedures; reference toxicant testing information.

11. STUDY DESIGN ALTERATION

Amendments made to the protocol must be approved by the sponsor and study director and should include a description of the change, the reason for the change, the date the change took effect and the dated signatures of the study director and sponsor. Any deviations in the protocol must be described and recorded in the study raw data.

12. REFERENCE TOXICANT

The reference toxicant test is a standard multi-concentration toxicity test using a specified chemical toxicant to evaluate the performance of test organisms used in the study. Reference toxicant tests are 96-hour, water only exposures, not 28-day sediment exposures. The reference toxicant test is run concurrently. Performance is evaluated by comparing the results of the reference toxicant test with historical results (e.g., control charts) obtained at the laboratory.

13. REFERENCED GUIDELINES

ASTM. 2001. Standard Test Methods for Measuring the Toxicity of Sediment-Associated Contaminants with Fresh Water Invertebrates. ASTM Standard Method No. E 1706-00. Am. Soc. Test. Mat., Philadelphia, PA.

U.S. EPA. 2000. Section 11, Test Method 100.1, *Hyalella azteca* 10-d Survival and Growth Test for Sediments, pp. 47-54 In: Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates (Second Edition). EPA/600/R-99/064.

Weber, C.I. (Ed.) 1993. Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms (Fourth Edition). EPA/600/4-90/027F.

14. APPROVALS

____________________________________ for ______________________________
Name Date

____________________________________ for **Northwestern Aquatic Sciences**
Name Date

Appendix A
Test Conditions Summary

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	daylight fluorescent light
5. Illuminance	100-1000 lux
6. Photoperiod	16L:8D
7. Test chamber size	300-mL high-form lipless beakers, (Pyrex® 1040 or equivalent)
8. Sediment volume	100 mL
9. Overlying water volume	175 mL
10. Renewal overlying water	2 volume additions/day (continuous or intermittent)
11. Age of test organisms	7-8 days old at test initiation
12. Organisms per test chamber	10
13. Replicates per treatment	8 recommended for routine testing (depends on design)
14. Organisms per treatment	80
15. Feeding regime	YCT food, fed 1.0 mL daily/chamber
16. Cleaning	if screens are used, clean as needed
17. Aeration	None, unless DO falls below 2.5 mg/L
18. Overlying (test) water	Dechlorinated tap water, culture water, well water, surface water, site water or reconstituted water, depending on study design.
19. Water quality	Hardness, alkalinity, conductivity, ammonia-N beginning and end; temperature daily; conductivity weekly; DO & pH 3X/wk
20. Endpoints	Survival & growth (based on weight)
21. Test acceptability criteria	Minimum control survival of 80%
22. Sample holding	14 days at 4°C in the dark (recommended)
23. Sample volume required	1L (800 mL per sediment)
24. Reference toxicant	Concurrent testing required

APPENDIX II

RAW DATA

TEST DESCRIPTION, MONITORING, AND RESULTS BENCHSHEETS

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-HA4c

HYALELLA AZTECA 28-DAY SOLID PHASE SEDIMENT TEST

Test No. 848-1 Client Hart Crowser Investigator REVIEWED PAGES 1-41 - GJI

STUDY MANAGEMENT

Client: Hart Crowser, Inc., 120 Third Avenue South, Suite 110, Edmonds WA 98020

Client's Study Monitor: Ms. Michelle Havey

Testing Laboratory: Northwestern Aquatic Sciences

Test Location: Newport Laboratory

Laboratory's Study Personnel:

Proj. Man./Study Dir. G.J. Irissarri GJI

QA Officer L.K. Nemeth

1. Yves Nalagan YN
2. GABuhler GB
3. Susan Gage SG
4. SF Knowlton SK
5. R.S. Caldwell RSC
6.
7.
8.

Study Schedule:

Test Beginning: 9-10-13 1130 Test Ending: 10-8-13 1030

TEST MATERIAL

General description (see sample logbook/chain-of-custody for details):

NAS Sample No.:	4562G	4563G	4564G	4565G	4566G
Description:	HC-SFSR-09	HC-SFSR-07	HC-MCL	HC-SFSR-03	HC-GC-01
Collection Date:	8/28/13	8/22/13	8/27/13	8/23/13	8/24/13
Receipt Date:	8/31/13	8/31/13	8/31/13	8/31/13	8/31/13
:					

NAS Sample No.:	4567G	4568G			
Description:	HC-GC-05	HC-76-02			
Collection Date:	8/25/13	8/26/13			
Receipt Date:	8/31/13	8/31/13			
:					

NAS Sample No.:					
Description:					
Collection Date:					
Receipt Date:					
:					

NAS Sample No.:					
Description:					
Collection Date:					
Receipt Date:					
:					

NAS Sample No.:					
Description:					
Collection Date:					
Receipt Date:					
:					

Error codes: 1) correction of handwriting error
2) written in wrong location; entry deleted
3) wrong date deleted, replaced with corrrect date
4) error found in measurement; measurement repeated

Test No. 848-1 Client Hart Crowser Investigator ________

SEDIMENT DESCRIPTIONS -- SUPPLEMENTAL NOTES

Sample No.	Description
4569G	Black fine mud
4562G	Small amount of Coarse sand with rocks
4563G	Coarse sand with white, brown, and orange pieces
4564G	Dark brown thick mud with plant debris + pine cones
4565G	Brown Coarse sand and gravel
4566G	Brown medium size gravel with sand
4567G	Dark brown coarse sand with small rocks and plant debris
4568G	Brown coarse sand with medium gravel

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-HA4c

HYALELLA AZTECA 28-DAY SOLID PHASE SEDIMENT TEST

Test No. 848-1 Client Hart Crowser Investigator ____

TEST WATER

Source: Dechlorinated Newport, OR tap water ⊛ CJ 10-23-13

Date of Collection/Preparation: 9-3-13 TO ~~9-7-13~~ 10-7-13

pH 7.6 ± 0.3 (N=13)

Cond (umhos/cm2) 100 ± 4 (N=13)

Hardness (mg/La0 26 ± 0 (N=13)

Alkalinity (mg/L) 39 ± 3 (N=13)

Total Chlorine (mg/l) <0.02 FOR ALL BATCHES

Treatments: Aerated ≥ 24 hrs

TEST ORGANISMS

Species: *Hyalella azteca* Age: 7-8 DAYS Date received: 9-7-13

Source: Chesapeake Cultures, Hayes, VA

Acclimation Data:

Date	Temp. (deg.C)	pH	DO (mg/L)	Cond umhos/cm	Feeding amount	Feeding description	Water changes	Hardness (mg/L)	Alkalinity (mg/L)
9-7-13	22.8	7.3	>15.0	575	10 mL	YTC	YES	205	210
9-8-13	22.1	8.1	8.5	353	"	"	"	111	130
9-9-13	22.0	7.8	8.4	297	"	"	"	94	90
9-10-13	22.3	7.6	7.9	258	"	"	"	68	80
Mean	22.3	7.7	10.0	371				120	128
S.D.	0.4	0.3	3.4	142				60	59
(N)	4	4	4	4				4	4

Photoperiod during acclimation: 16:8, L:D

TEST PROCEDURES AND CONDITIONS

Test chambers: 300 ml glass beakers

Test volumes: 100 ml of test sediment; 275 ml total volume

Replicates/treatment: (8) 8 PLUS ONE Organisms/treatment: (80) 80 (10/REP)

Test water changes: Twice daily ADDITIONAL REPLICATE FOR MEASURING DAY 28 INTERSTITIAL AMMONIA AND SULFIDE

Aeration: only if DO falls below 2.5 mg/L Beaker placement: Total randomization

Feeding: everyday beginning with day zero Photoperiod: 16:8, L:D

Test temperature (deg.C): 23

Control Sediment:

Source: From an area approximately one mile east of the Hwy. 101 bridge at Beaver Creek, approx. 8 miles south of Newport, OR.

Date collected: 9/1/13

Sieved through — -mm screen

Storage: 4°C in the dark in closed containers. NAS# 4569G

MISCELLANEOUS NOTES

Light Intensity:

Date	Location	Light Intensity (ft-candles*)	Initials

*To convert ft-candles to lux multipy by 10.76

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-HA4c

HYALELLA AZTECA 28-DAY SOLID PHASE SEDIMENT TEST

Test No. 848-1 Client Hart Crowser Investigator ________

Test conducted in (circle one): [✓ room 1] room 2 trailer water bath other:________

Randomization chart: TOP SHELF

5								70	
4								69	
3								68	
2								67	72
1								66	71

FRONT

Randomization chart:

Randomization chart:

Randomization chart:

Test No 848-1 Client Hart Crowser Investigator ______

DAILY RECORD SHEET

Day 0 (9 /10 /13) yr /SK

Beaker No.	Temp.* (deg.C)	DO* (ppm)	Cond.* (umhos/cm)	pH*	Hardness* (mg/L)	Alkalinity* (mg/L)	NH3* (ppm)	Comments
7	22.7	8.1	110	7.0	34	30		Each beaker fed 1.0 ml
14	22.9	8.3	110	7.0	26	30		YTC suspension
23	23.1	8.2	112	6.9	34	40		Initials: yr
39	22.8	7.3	102	6.6	17	40		
43	22.8	8.1	111	6.8	34	30		
51	22.8	8.2	110	6.9	34	40		
58	22.7	8.3	111	6.9	26	40		
64	22.8	7.5	121	6.7	34	40		
								Water changed in all
								beakers.
								Time: 0530
								Initials: GSI
								Water changed in all
								beakers.
								Time: 1655
								Initials: SK

*Water quality measurements to be taken.

Day 1 (9 /11 /13) SK/yr

Beaker No.	Temp.* (deg.C)	DO* (ppm)	Cond.* (umhos/cm)	pH*	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
7	22.5	7.5	113	7.0				Each beaker fed 1.0 ml
14	22.7	7.5	114	7.0				YTC suspension
23	22.9	7.1	119	7.0				Initials: [illegible]
39	22.6	6.9	110	6.8				
43	22.6	7.1	115	6.8				
51	22.5	7.3	114	6.9				
58	22.4	7.7	114	7.0				
64	22.7	6.6	120	6.7				
								Water changed in all
								beakers.
								Time: 0545
								Initials: GAP
								Water changed in all
								beakers.
								Time: 1735
								Initials: SK

*Water quality measurements to be taken.

NORTHWESTERN AQUATIC SCIENCES
PROTOCOL NO. NAS-XXX-HA4c
HYALELLA AZTECA 28-DAY SOLID PHASE SEDIMENT TEST

Test No 848-1 Client Hart Crowser Investigator ______

DAILY RECORD SHEET

Day __2__(9/12/13) YL/SK

Beaker No.	Temp.* (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
7	22.6							Each beaker fed 1.0 ml
14	22.7							YTC suspension
23	23.0							Initials: GTS
39	22.7							
43	22.6							
51	22.6							
58	22.5							
64	22.6							
								Water changed in all
								beakers.
								Time: 0545
								Initials: GTS
								Water changed in all
								beakers.
								Time: 1725
								Initials: SK

*Water quality measurements to be taken.

Day __3__(9/13/13) YL/SK

Beaker No.	Temp.* (deg.C)	DO* (ppm)	Cond. (umhos/cm)	pH*	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
7	22.5	7.1		6.9				Each beaker fed 1.0 ml
14	22.6	7.1		6.9				YTC suspension
23	23.0	7.0		6.9				Initials: YL
39	22.5	7.1		6.8				
43	22.6	7.1		6.8				
51	22.5	7.1		6.8				
58	22.4	7.1		6.9				
64	22.6	6.3		6.6				
								Water changed in all
								beakers.
								Time: 0555
								Initials: YL
								Water changed in all
								beakers.
								Time: 1700
								Initials: SK

*Water quality measurements to be taken.

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-HA4c

HYALELLA AZTECA 28-DAY SOLID PHASE SEDIMENT TEST

Test No 848-1 Client Hart Crowser Investigator ______

DAILY RECORD SHEET

Day 4 (9/14/13) GB

Beaker No.	Temp.* (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
7	23.2							Each beaker fed 1.0 ml
14	23.3							YTC suspension
23	23.3							Initials: GB
39	23.2							
43	23.1							
51	23.2							
58	23.1							
64	23.2							
								Water changed in all
								beakers.
								Time: 0550
								Initials: GB
								Water changed in all
								beakers.
								Time: 1725
								Initials: AJ

*Water quality measurements to be taken.

Day 5 (9/15/13) YL /SK

Beaker No.	Temp.* (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
7	22.5							Each beaker fed 1.0 ml
14	22.7							YTC suspension
23	22.9							Initials: YL
39	22.5							
43	22.6							
51	22.5							
58	22.4							
64	22.5							
								Water changed in all
								beakers.
								Time: 0615
								Initials: YL
								Water changed in all
								beakers.
								Time: 1755
								Initials: SK

*Water quality measurements to be taken.

Test No 848-1 Client Hart Crowser Investigator ______

DAILY RECORD SHEET

Day 6 (9/16/13) Y/SK

Beaker No.	Temp.* (deg.C)	DO* (ppm)	Cond. (umhos/cm)	pH*	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)
7	22.4	7.3		7.5			
14	22.4	7.7		7.5			
23	22.6	7.3		7.5			
39	22.3	7.1		7.5			
43	22.4	7.2		7.5			
51	22.4	7.2		7.5			
58	22.2	7.3		7.5			
64	22.4	6.7		7.4			

Comments

Each beaker fed 1.0 ml YTC suspension
Initials: Y

Water changed in all beakers.
Time: 0540
Initials: Y

Water changed in all beakers.
Time: 1730
Initials: SK

*Water quality measurements to be taken.

Day 7 (9/17/13) Y/SK

Beaker No.	Temp.* (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)
7	22.4						
14	22.7						
23	22.9						
39	22.5						
43	22.6						
51	22.6						
58	22.5						
64	22.4						

Comments

Each beaker fed 1.0 ml YTC suspension
Initials: Y

Water changed in all beakers.
Time: 0600
Initials: Y

Water changed in all beakers.
Time: 1740
Initials: SK

*Water quality measurements to be taken.

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HYALELLA AZTECA 28-DAY SOLID PHASE SEDIMENT TEST

Test No 848-1 Client Hart Crowser Investigator ______

DAILY RECORD SHEET

Day 8 (9/18/13) SK

Beaker No.	Temp.* (deg.C)	DO* (ppm)	Cond.* (umhos/cm)	pH*	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
7	23.1	6.8	106	7.4				Each beaker fed 1.0 ml
14	23.2	7.0	106	7.5				YTC suspension
23	23.4	6.9	109	7.5				Initials: GB
39	23.0	6.8	105	7.4				
43	23.1	6.7	108	7.4				
51	23.0	6.9	107	7.4				
58	22.9	7.0	107	7.4				
64	23.1	6.4	112	7.4				
								Water changed in all
								beakers.
								Time: 0510
								Initials: GB
								Water changed in all
								beakers.
								Time: 1700
								Initials: SK

*Water quality measurements to be taken.

Day 9 (9/19/13) SK

Beaker No.	Temp.* (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
7	23.1							Each beaker fed 1.0 ml
14	23.2							YTC suspension
23	23.4							Initials: GB
39	23.3							
43	23.3							
51	23.2							
58	23.3							
64	23.1							
								Water changed in all
								beakers.
								Time: 0600
								Initials: GB
								Water changed in all
								beakers.
								Time: 1735
								Initials: SK

*Water quality measurements to be taken.

Test No 848-1 Client Hart Crowser Investigator ______

DAILY RECORD SHEET

Day 10 (9/20/13) SK

Beaker No.	Temp.* (deg.C)	DO* (ppm)	Cond. (umhos/cm)	pH*	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
7	22.8	7.2	9-20-13 SK ④	~~6.5~~	7.1			Each beaker fed 1.0 ml
14	23.0	7.3	9-20-13 SK ④	~~6.6~~	7.1			YTC suspension
23	23.1	7.3	9-20-13 SK ④	~~6.6~~	7.1			Initials:
39	22.6	7.1		6.8				
43	22.9	7.1		6.9				
51	22.4	7.2		7.0				
58	22.8	7.2		7.0				
64	22.9	6.6		7.0				
								Water changed in all
								beakers.
								Time: 0540
								Initials:
								Water changed in all
								beakers.
								Time: 1805
								Initials: SK

*Water quality measurements to be taken.

Day 11 (9/21/13)

Beaker No.	Temp.* (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
7	22.9							Each beaker fed 1.0 ml
14	23.1							YTC suspension
23	23.1							Initials:
39	22.9							
43	23.0							
51	22.9							
58	22.9							
64	22.9							
								Water changed in all
								beakers.
								Time: 0545
								Initials:
								Water changed in all
								beakers.
								Time: 1755
								Initials:

*Water quality measurements to be taken.

Test No 848-1 Client Hart Crowser Investigator ______

DAILY RECORD SHEET

Day 12 (9/22/13) GB

Beaker No.	Temp.* (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
7	22.2							Each beaker fed 1.0 ml
14	22.1							YTC suspension
23	22.2							Initials: GB
39	22.0							
43	22.0							
51	22.0							
58	22.0							
64	22.1							
								Water changed in all
								beakers.
								Time: 0540
								Initials: GB
								Water changed in all
								beakers.
								Time: 1805
								Initials: SK

*Water quality measurements to be taken.

Day 13 (9/23/13) YK/SK

Beaker No.	Temp.* (deg.C)	DO* (ppm)	Cond. (umhos/cm)	pH*	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
7	23.4	6.6		7.4				Each beaker fed 1.0 ml
14	23.5	6.9		7.4				YTC suspension
23	23.5	6.9		7.4				Initials: YK
39	23 3	6.8		7.3				
43	23.4	6.6		7.2				
51	23.4	6.8		7.2				
58	23.2	6.8		7.2				
64	23 4	6.2		7 2				
								Water changed in all
								beakers.
								Time: 0600
								Initials: YK
								Water changed in all
								beakers.
								Time: 1720
								Initials: SK

*Water quality measurements to be taken.

Test No 848-1 Client Hart Crowser Investigator ______

DAILY RECORD SHEET

Day 14 (9 /24/13)✓/SK

Beaker No.	Temp.* (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
7	23.2							Each beaker fed 1.0 ml
14	23.3							YTC suspension
23	23.4							Initials: Y
39	23.2							
43	23.3							
51	23.3							
58	23.2							
64	23.3							
								Water changed in all
								beakers.
								Time: 0550
								Initials: Y
								Water changed in all
								beakers.
								Time: 1740
								Initials: SK

*Water quality measurements to be taken.

Day 15 (9 /25/13) SK

Beaker No.	Temp.* (deg.C)	DO* (ppm)	Cond.* (umhos/cm)	pH*	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
7	22.8	6.6	106	7.2				Each beaker fed 1.0 ml
14	22.9	6.6	109	7.2				YTC suspension
23	23.0	6.6	106	7.2				Initials: GS
39	22.8	6.2	104	7.2				
43	22.9	6.3	105	7.2				
51	22.8	6.8	104	7.2				
58	22.9	6 8	104	7.3				
64	22.9	5.6	110	7.0				
								Water changed in all
								beakers.
								Time: 0540
								Initials: GS
								Water changed in all
								beakers.
								Time: 1740
								Initials: SK

*Water quality measurements to be taken.

Test No 848-1 Client Hart Crowser Investigator

DAILY RECORD SHEET

Day 16 (9/26/13) SK

Beaker No.	Temp.* (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
7	22.6							Each beaker fed 1.0 ml
14	22.7							YTC suspension
23	22.8							Initials: GB
39	22.6							
43	22.7							
51	22.7							
58	22.6							
64	22.7							
								Water changed in all
								beakers.
								Time: 0540
								Initials: GB
								Water changed in all
								beakers.
								Time: 1705
								Initials: SK

*Water quality measurements to be taken.

Day 17 (9/27/13) SK

Beaker No.	Temp.* (deg.C)	DO* (ppm)	Cond. (umhos/cm)	pH*	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
7	22.6	6.8		7.2				Each beaker fed 1.0 ml
14	22.7	7.1		7.2				YTC suspension
23	22.7	7.1		7.2				Initials: Y
39	22.7	6.7		7 3				
43	22.8	6.9		7 3				
51	22.7	7.3		7 3				
58	22.7	7.2		7.3				
64	22.8	6.4		7.2				
								Water changed in all
								beakers.
								Time: 0550
								Initials:
								Water changed in all
								beakers.
								Time: 1650
								Initials: Y

*Water quality measurements to be taken.

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HYALELLA AZTECA 28-DAY SOLID PHASE SEDIMENT TEST

Test No 848-1 Client Hart Crowser Investigator

DAILY RECORD SHEET

Day 18 (9/28/13)

Beaker No.	Temp.* (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
7	22.7							Each beaker fed 1.0 ml
14	22.8							YTC suspension
23	22.9							Initials:
39	22.7							
43	22.8							
51	22.8							
58	22.7							
64	22.7							
								Water changed in all
								beakers.
								Time: 0605
								Initials:
								Water changed in all
								beakers.
								Time: 1750
								Initials:

*Water quality measurements to be taken.

Day 19 (9/29/13)

Beaker No.	Temp.* (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
7	22.4							Each beaker fed 1.0 ml
14	22.5							YTC suspension
23	22.6							Initials:
39	22.4							
43	22.5							
51	22.4							
58	22.4							
64	22.4							
								Water changed in all
								beakers.
								Time: 0600
								Initials:
								Water changed in all
								beakers.
								Time: 1800
								Initials: SK

*Water quality measurements to be taken.

NORTHWESTERN AQUATIC SCIENCES

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HYALELLA AZTECA 28-DAY SOLID PHASE SEDIMENT TEST

Test No 848-1 Client Hart Crowser Investigator ______

DAILY RECORD SHEET

Day 20 (9/30/13) SK

Beaker No.	Temp.* (deg.C)	DO* (ppm)	Cond. (umhos/cm)	pH*	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
7	23.2	6.6		7.1				Each beaker fed 1.0 ml
14	23.4	6.8		7.1				YTC suspension
23	23.4	6.9		7.2				Initials: Y
39	23.3	6.3		7.1				
43	23.4	6.3		7.1				
51	23.4	7.4		7.1				
58	23.3	7.4		7.1				
64	23.4	6.0		7.1				
								Water changed in all
								beakers.
								Time: 0725
								Initials: GB
								Water changed in all
								beakers.
								Time: 1705
								Initials: Y/SK

*Water quality measurements to be taken.

Day 21 (10/1/13) SK

Beaker No.	Temp.* (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
7	22.7							Each beaker fed 1.0 ml
14	22.8							YTC suspension
23	22.9							Initials: GB
39	22.7							
43	22.9							
51	22.8							
58	22.7							
64	22.9							
								Water changed in all
								beakers.
								Time: 0525
								Initials: GB
								Water changed in all
								beakers.
								Time: 1720
								Initials: Y

*Water quality measurements to be taken.

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-HA4c

HYALELLA AZTECA 28-DAY SOLID PHASE SEDIMENT TEST

Test No 848-1 Client Hart Crowser Investigator ______

DAILY RECORD SHEET

Day 22 (10/2/13) YY/SK

Beaker No.	Temp.* (deg.C)	DO* (ppm)	Cond.* (umhos/cm)	pH*	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
7	22.1	6.9	103	7.3				Each beaker fed 1.0 ml
14	22.3	7.1	102	7.3				YTC suspension
23	22.3	6.9	104	7.3				Initials: GB
39	22.0	6.4	102	7.2				
43	22.2	6.4	103	7.2				
51	22.2	7.9	102	7.2				
58	22.1	7.9	102	7.5				
64	22.3	6.0	107	7.2				
								Water changed in all
								beakers.
								Time: 0545
								Initials: GB
								Water changed in all
								beakers.
								Time: 1655
								Initials: SK

*Water quality measurements to be taken.

Day 23 (10/3/13) SK

Beaker No.	Temp.* (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
7	22.1							Each beaker fed 1.0 ml
14	22.2							YTC suspension
23	22.3							Initials: Y
39	22 1							
43	22.2							
51	22 2							
58	22.1							
64	22.2							
								Water changed in all
								beakers.
								Time: 0645
								Initials: Y
								Water changed in all
								beakers.
								Time: 1735
								Initials: SK

*Water quality measurements to be taken.

Test No 848-1 Client Hart Crowser Investigator

DAILY RECORD SHEET

Day 24 (10/4/13) SK

Beaker No.	Temp.* (deg.C)	DO* (ppm)	Cond. (umhos/cm)	pH*	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
7	22.5	6.6		7.1				Each beaker fed 1.0 ml
14	22.6	6.8		7.1				YTC suspension
23	22.7	7.1		7.2				Initials:
39	22.6	6.4		7.0				
43	22.7	6.6		7.0				
51	22.6	7.9		7.4				
58	22.6	7.8		7.3				
64	22.7	5.8		7.0				
								Water changed in all
								beakers.
								Time: 0550
								Initials:
								Water changed in all
								beakers.
								Time: 1715
								Initials: SK

*Water quality measurements to be taken.

Day 25 (10/5/13)

Beaker No.	Temp.* (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
7	22.6							Each beaker fed 1.0 ml
14	22.7							YTC suspension
23	22.7							Initials:
39	22.6							
43	22.7							
51	22.6							
58	22.6							
64	22.7							
								Water changed in all
								beakers.
								Time: 0550
								Initials:
								Water changed in all
								beakers.
								Time: 1635
								Initials: yr

*Water quality measurements to be taken.

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-HA4c
HYALELLA AZTECA 28-DAY SOLID PHASE SEDIMENT TEST

Test No 848-1 Client Hart Crowser Investigator ______

DAILY RECORD SHEET

Day 26 (10/6/13) GJL

Beaker No.	Temp.* (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
7	22.7							Each beaker fed 1.0 ml
14	22.8							YTC suspension
23	22.8							Initials: GJL
39	22.7							
43	22.8							
51	22.8							
58	22.7							
64	22.8							
								Water changed in all
								beakers.
								Time: 0550
								Initials: Y
								Water changed in all
								beakers.
								Time: 1715
								Initials: GJL

*Water quality measurements to be taken.

Day 27 (10/7/13) YK

Beaker No.	Temp.* (deg.C)	DO* (ppm)	Cond. (umhos/cm)	pH*	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
7	23.0	7.3		7.3				Each beaker fed 1.0 ml
14	23.1	7.9		7.3				YTC suspension
23	23.2	8.0		7.4				Initials: GB
39	23.0	7.2		7.2				
43	23.1	7.3		7.2				
51	23.1	8.9		7.6				
58	23.0	8.8		7.7				
64	23.2	6.7		7.0				
								Water changed in all
								beakers.
								Time: 0548
								Initials: WB
								Water changed in all
								beakers.
								Time: 1730
								Initials: SK

*Water quality measurements to be taken.

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-HA4c

HYALELLA AZTECA 28-DAY SOLID PHASE SEDIMENT TEST

Test No 848-1 Client Hart Crowser Investigator ______

DAILY RECORD SHEET

Day 28 (10 / 8 /13) Y / GSL

Interstitial ammonia & sulfides

Beaker No.	Temp.* (deg.C)	DO* (ppm)	Cond.* (umhos/cm)	pH*	Hardness* (mg/L)	Alkalinity* (mg/L)	NH3* (ppm)	Comments
7	23.2	7.7	97	7.2	26	40		
14	23.3	7.9	99	7.3	26	40		
10/8/13 ① Y 23	23.4	8.1	100	7.~~4~~5	17	40		
39	23.2	7.3	95	7.2	34	40		
43	23.2	7.5	99	7.3	34	40		
① 10/8/13 Y 51	23.~~9~~3	8.9	99	7.9	34	40		
58	23.2	8.7	99	7.9	17	30		
64	23.3	7.1	105	7.2	26	30		
								Water changed in all
								beakers.
								Time: 0540
								Initials: GSL

*Water quality measurements to be taken.

Day ______(/ /)

Beaker No.	Temp. (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments

*Water quality measurements to be taken.

Test No. 848-1 Client Hart Crowser Investigator ______

DAY 28 TEST TERMINATION SHEET

Beaker No.	Number of survivors	Initials
1	10	GB
2	10	GB
3	10	GJI
4	9	GJI
5	9	GB
6	10	GB
7		
8	9	GJI
9	8	GJI
10	10	GB
11	10	GB
12	9	GJI
13	9	GJI
14		
15	9	GB
16	10	GB
17	9	GJI
18	9	GJI
19	9	GB
20	9	GB
21	9	GB
22	10	GB
23		
24	9	GJI
25	10	GJI
26	10	GB
27	9	GB
28	10	GJI
29	9	GJI
30	9	GJI
31	10	GJI
32	10	GJI
33	10	GJI
34	10	GB
35	9	GB
36	10	GJI
37	10	GJI
38	10	GJI
39		
40	9	GJI
41	10	GB
42	7	GB
43		
44	10	GB
45	10	GB
46	9	GJI
47	10	GJI
48	9	GB
49	9	GB
50	10	GJI
51		
52	9	GJI
53	9	GB
54	9	GB
55	10	GJI
56	9	GJI
57	9	GB
58		
59	10	GB
60	8	GJI
61	9	GJI
62	10	GB
63	10	GB
64		
65	10	GB
66	10	GB
67	8	GB
68	10-4-13 GJI ① ~~8~~ 9	GJI
69	8	GB
70	10	GJI
71	8	GB
72	10	GJI

Test No. 848-1 Client Hart Crowser Investigator

ZERO-TIME WEIGHING DATA SHEET

Tare: Date 9-9-13 Oven temp (C.) 62 Drying time (hr.) 26 Initials JRF
Standard Weights: 10 mg: 10.002 100mg: 100.013

Final: Date 9-16-13 Oven temp (C.) 61 Drying time (hr.) 24 Initials JRF
Standard Weights: 10 mg: 10.000 100mg: 100.018

Equip. used: Oven: BLUEM #1 Balance: Sartorius M3P

(Dry overnight at 60-90 degrees C)

Pan #	Tare wt. (mg)	Total wt. (mg)	#weighed	Comments
1	42.861	43.577	10	
2	31.975	32.682	10	
3	40.680	41.330	10	
4	39.690	40.599	10	
5	39.714	40.540	10	

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-HA4c

HYALELLA AZTECA 28-DAY SOLID PHASE SEDIMENT TEST

Test No. 848-1 Client Hart Crowser Investigator ______

WEIGHING DATA SHEET

Tare: Date 9-11-13 Oven temp (C.) 63 Drying time (hr.) 24 Initials JRF
Standard Weights: 10 mg: 10.006 100mg: 100.020

Final #1: Date 10-10-13 Oven temp (C.) 61 Drying time (hr.) 24 Initials JRF
Standard Weights: 10 mg: 10.005 100mg: 100.016

Final #2: Date 10-11-13 Oven temp (C.) 63 Drying time (hr.) 24 Initials JRF
Standard Weights: 10 mg: 10.006 100mg: 100.013

Equip. used. Oven BLUE M#1 Balance SARTORIUS M3P

(Dry overnight at 60-90 degrees C)

Bkr. #	Pan #	Tare wt. (mg)	Total wt. (mg)		no. weighed	put into pans-initials	Comments
			1	2			
1	1	38.983	42.331	42.286	10		
2	2	39.817	44.094	44.039	10		
3	3	38.068	41.298	41.262	10		
4	4	39.691	42.532	42.497	9		
5	5	39.841	43.042	43.011	9		
6	6	42.014	44.655	44.626	10		
7	7						
8	8	39.434	41.453	41.436	9		
9	9	39.436	42.774	42.742	8		
10	10	42.513	45.709	45.645	10		
11	11	41.370	44.207	44.183	10		
12	12	40.147	44.564	44.495	9		
13	13	36.459	39.044	39.026	9		
14	14						
15	15	43.147	46.432	46.407	9		
16	16	41.136	44.523	44.463	10		
17	17	37.485	40.830	40.807	9		
18	18	38.954	41.785	41.739	9		
19	19	38.763	42.676	42.619	9		
20	20	38.974	41.979	41.962	9		
21	21	41.976	45.841	45.794	9		
22	22	40.016	42.634	42.598	10		
23	23						
24	24	40.188	42.438	42.396	9		
25	25	41.623	45.732	45.676	10		
26	26	39.101	42.446	42.395	10		
27	27	37.802	41.342	41.289	9		
28	28	37.941	41.642	41.591	10		
29	29	40.656	43.042	43.006	9		
30	30	40.594	43.624	43.571	9		
31	31	39.563	43.057	43.002	10		
32	32	37.871	41.672	41.635	10		
33	33	38.613	41.493	41.445	10		

Test No. 848-1 Client Hart Crowser Investigator ____

WEIGHING DATA SHEET

See page 22 for information on drying times and temperatures, standard weights,etc.

Bkr. #	Pan #	Tare wt. (mg)	Total wt. (mg)		no. weighed	put into pans-initials	Comments
			1	2			
34	34	40.621	44.155	44.111	10		
35	35	37.758	40.621	40.577	9		
36	36	39.462	43.020	42.963	10		
37	37	40.298	43.484	43.446	10		
38	38	39.625	43.016	42.973	10		
39	39						
40	40	39.157	43.571	43.520	9		
41	41	41.552	45.475	45.434	10		
42	42	40.213	42.324	42.307	7		
43	43						
44	44	36.909	39.792	39.765	10		
45	45	37.503	40.976	40.938	10		
46	46	35.994	39.518	39.490	9		
47	47	37.552	40.251	40.221	10	SK	
48	48	37.238	39.378	39.356	9	SK	
49	49	38.085	41.002	40.977	9	SK	
50	50	36.701	39.365	39.342	10	SK	
51	51						
52	52	40.086	42.992	41.980	9	SK	
53	53	37.069	39.697	39.680	9	SK	
54	54	32.819	35.371	35.352	9	SK	
55	55	37.767	41.014	40.993	10		
56	56	37.085	41.241	41.209	9		
57	57	40.684	43.772	43.740	9		
58	58						
59	59	39.876	43.296	43.255	10		
60	60	39.330	42.197	42.164	8		
61	61	45.127	48.198	48.175	9		
62	62	39.047	42.027	42.007	10		
63	63	39.901	43.551	43.522	10		
64	64						
65	65	34.345	38.605	38.577	10		
66	66	34.673	38 844	38.818	10		
67	67	34.029	36.735	36.721	8		
68	68	33.705	37.124	37.100	9		
69	69	35.120	37.636	37.614	8		
70	70	36.944	40.739	40.697	10		
71	71	36.620	38.904	36.890	8		
72	72	32.964	35.710	35.690	10		
73	73						
74	74						
75	75						
76	76						

Chesapeake Cultures

P.O. Box 507 Hayes, VA 23072 (804)693-4046 (804)694-4704 fax
www.c-cultures.com
growfish@c-cultures.com

Shipment Information

Species Hyalella azteca

Date 9/6/13

Age ~3-4 days 1.2-1.5 mm

P.O. No. verbal

Quantity 975+

Invoice No. 8089

Temperature 24°C Salinity — pH 7.96

Notes

Biologist

Rev' 9-7-13 KAB

Please inspect shipment and report any problem immediately

TAP WATER RECORD

(Dechlorinated Newport, OR city water)

BATCH #	DATE	LOCATION	VOL (gals)	CHLORINE (mg/L)	HARD (mg/L)	ALK (mg/L)	COND µmhos/cm	pH	Init.
335	2-22-13	ROOM#1	60	<0.02	26	30	101	7.3	YL
336	8-13-13	Room#3	100	<0.02	51	30	98	7.7	GB/YL
337	7.2.13	Room#3	55	<0.02	34	30	94	6.7	SK/YL
338	9-3-13	Room#2	200 ~~400~~ 9-3-13	<0.02	26	40	108	7.3	GB/YL
339	9.5-13	Room#3	80	<0.02	26	40	102	7.3	YL
340	9-13-13	Room#1	100	<0.02	26	40	105	6.8	YL
341	9-16-13	ROOM#1	100	<0.02	26	40	103	7.7	YL/GB
342	9-19-13	Room#1	100	<0.02	26	40	97	7.8	GB/SK
343	9-21-13	Room#1	100	<0.02	26	40	104	7.3	GB
344	9-22-13	Room#3	70	<0.02	26	40	98	7.7	GB/SK
345	9-24-13	Room#1	100	<0.02	26	40	95	8.1	YL
346	9-26-13	Room#1	100	<0.02	26	40	99	7.8	GB/SK
347	9-29-13	Room#1	100	<0.02	26	40	99	7.7	YL/SK
348	10-2-13	Room#1	100	<0.02	26	30	96	7.7	GB/YL
349	10-5-13	Room#1	100	<0.02	26	40	97	7.8	GB/GOL
350	10-7-13	Room#1	100	<0.02	26	40	99	7.7	GB/YL
351	10-10-13	Room#1	100	<0.02	26	40	95	7.6	GBS/SK
352	10-14-13	Room#1	100	<0.02	26	40	95	7.7	YL
353	10-17-13	Room#1	100	<0.02	26	40	96	7.6	GB/SK

TEST DATA ANALYSIS RECORDS

Test Number P848-1

Freshwater Sediment Test
28-day Hyalella azteca

data entry verified
against laboratory bench
sheets 10 23-13 JRF

Endpoints Data Entry and Calculations File

BKR=beaker number
INIT=initial number
SURV=number survivors
MORT=number dead=INIT-SURV
PSURV=%survival=100(SURV/INIT)
PMORT=%mortality=100(MORT/INIT)

TARE WT= ashed weight of pan used for that replicate at test termination (mg), or
dry weight of pan if ash-free dry weight is not an endpoint
WT COUNT= number of test organisms weighed at test end
DRY WT= TARE WT + dry weight of test organisms recovered at test termination (mg)
TWT=total biomass=DRY WT-TARE WT
WT=average individual biomass=TWT/WT COUNT

INITIAL WEIGHT				
pan #	tare wt (mg)	final wt (mg)	wt count	avg. wt/ organism
1	42.861	43.577	10	0.0716
2	31.975	32.682	10	0.0707
3	40.68	41.33	10	0.065
4	39.69	40.599	10	0.0909
5	39.714	40.54	10	0.0826
			Mean	0.076

INDEX	BKR	NAS SMPL	CLIENT DESCRIP	REPL		INIT	SURV	MORT	PSURV	PMORT	TARE WT (mg)	WT COUNT	DRY WT (mg)	TWT (mg)	WT (mg)		SURV	MORT	PSURV	PMORT	WT
1	52	4569G	Control	1		10	9	1	90.0	10.0	40.086	9	41.980	1.894	0.210						
2	71	4569G	Control	2		10	8	2	80.0	20.0	36.620	8	38.890	2.270	0.284						
3	22	4569G	Control	3		10	10	0	100.0	0.0	40.016	10	42.598	2.582	0.258						
4	8	4569G	Control	4		10	9	1	90.0	10.0	39.434	9	41.436	2.002	0.222						
5	16	4569G	Control	5		10	10	0	100.0	0.0	41.136	10	44.463	3.327	0.333						
6	6	4569G	Control	6		10	10	0	100.0	0.0	42.014	10	44.626	2.612	0.261	Mean	9.3	0.8	92.5	7.5	0.26
7	48	4569G	Control	7		10	9	1	90.0	10.0	37.238	9	39.356	2.118	0.235	SD	0.7	0.7	7.1	7.1	0.04
8	24	4569G	Control	8		10	9	1	90.0	10.0	40.188	9	42.396	2.208	0.245	n	8	8	8	8	8
9	64	4569G	Control	9	wq replicate																
10	12	4562G	HC-SFSR-09	1		10	9	1	90.0	10.0	40.147	9	44.495	4.348	0.483						
11	65	4562G	HC-SFSR-09	2		10	10	0	100.0	0.0	34.345	10	38.577	4.232	0.423						
12	40	4562G	HC-SFSR-09	3		10	9	1	90.0	10.0	39.157	9	43.520	4.363	0.485						
13	2	4562G	HC-SFSR-09	4		10	10	0	100.0	0.0	39.817	10	44.039	4.222	0.422						
14	21	4562G	HC-SFSR-09	5		10	9	1	90.0	10.0	41.976	9	45.794	3.818	0.424						
15	19	4562G	HC-SFSR-09	6		10	9	1	90.0	10.0	38.763	9	42.619	3.856	0.428	Mean	9.5	0.5	95.0	5.0	0.42
16	63	4562G	HC-SFSR-09	7		10	10	0	100.0	0.0	39.901	10	43.522	3.621	0.362	SD	0.5	0.5	5.3	5.3	0.05
17	59	4562G	HC-SFSR-09	8		10	10	0	100.0	0.0	39.876	10	43.255	3.379	0.338	n	8	8	8	8	8
18	58	4562G	HC-SFSR-09	9	wq replicate																
19	38	4563G	HC-SFSR-07	1		10	10	0	100.0	0.0	39.625	10	42.973	3.348	0.335						
20	68	4563G	HC-SFSR-07	2		10	9	1	90.0	10.0	33.705	9	37.100	3.395	0.377						
21	34	4563G	HC-SFSR-07	3		10	10	0	100.0	0.0	40.621	10	44.111	3.490	0.349						
22	17	4563G	HC-SFSR-07	4		10	9	1	90.0	10.0	37.485	9	40.807	3.322	0.369						
23	37	4563G	HC-SFSR-07	5		10	10	0	100.0	0.0	40.298	10	43.446	3.148	0.315						
24	27	4563G	HC-SFSR-07	6		10	9	1	90.0	10.0	37.802	9	41.289	3.487	0.387	Mean	9.4	0.6	93.8	6.3	0.35
25	54	4563G	HC-SFSR-07	7		10	9	1	90.0	10.0	32.819	9	35.352	2.533	0.281	SD	0.5	0.5	5.2	5.2	0.04
26	15	4563G	HC-SFSR-07	8		10	9	1	90.0	10.0	43.147	9	46.407	3.260	0.362	n	8	8	8	8	8
27	51	4563G	HC-SFSR-07	9	wq replicate																
28	29	4564G	HC-MCL	1		10	9	1	90.0	10.0	40.656	9	43.000	2.344	0.260						
29	70	4564G	HC-MCL	2		10	10	0	100.0	0.0	38.944	10	40.697	3.753	0.375						
30	50	4564G	HC-MCL	3		10	10	0	100.0	0.0	36.701	10	39.342	2.641	0.264						
31	11	4564G	HC-MCL	4		10	10	0	100.0	0.0	41.370	10	44.183	2.813	0.281						
32	62	4564G	HC-MCL	5		10	10	0	100.0	0.0	39.047	10	42.007	2.960	0.296						
33	20	4564G	HC-MCL	6		10	9	1	90.0	10.0	38.974	9	41.962	2.988	0.332	Mean	9.5	0.5	95.0	5.0	0.31
34	5	4564G	HC-MCL	7		10	9	1	90.0	10.0	39.841	9	43.011	3.170	0.352	SD	0.5	0.5	5.3	5.3	0.04
35	35	4564G	HC-MCL	8		10	9	1	90.0	10.0	37.758	9	40.577	2.819	0.313	n	8	8	8	8	8
36	39	4564G	HC-MCL	9	wq replicate																

Page_____of_____

PAGE 26 OF 41

Freshwater Sediment Test
28-day Hyalella azteca

INDEX	BKR	NAS SMPL	CLIENT DESCRIP	REPL		INIT	SURV	MORT	PSURV	PMORT	TARE WT (mg)	WT COUNT	DRY WT (mg)	TWT (mg)	WT (mg)		SURV	MORT	PSURV	PMORT	WT
37	30	4565G	HC-SFSR-03	1		10	9	1	90.0	10.0	40.594	9	43.571	2.977	0.331						
38	72	4565G	HC-SFSR-03	2		10	10	0	100.0	0.0	32.964	10	35.690	2.726	0.273						
39	56	4565G	HC-SFSR-03	3		10	9	1	90.0	10.0	37.085	9	41.209	4.124	0.458						
40	41	4565G	HC-SFSR-03	4		10	10	0	100.0	0.0	41.552	10	45.434	3.882	0.388						
41	9	4565G	HC-SFSR-03	5		10	8	2	80.0	20.0	39.436	8	42.742	3.306	0.413						
42	1	4565G	HC-SFSR-03	6		10	10	0	100.0	0.0	38.983	10	42.286	3.303	0.330	Mean	9.5	0.5	95.0	5.0	0.36
43	26	4565G	HC-SFSR-03	7		10	10	0	100.0	0.0	39.101	10	42.395	3.294	0.329	SD	0.8	0.8	7.6	7.6	0.06
44	28	4565G	HC-SFSR-03	8		10	10	0	100.0	0.0	37.941	10	41.591	3.650	0.365	n	8	8	8	8	8
45	14	4565G	HC-SFSR-03	9	wq replicate																
46	31	4566G	HC-GC-01	1		10	10	0	100.0	0.0	39.563	10	43.002	3.439	0.344						
47	67	4566G	HC-GC-01	2		10	8	2	80.0	20.0	34.029	8	36.721	2.692	0.336						
48	60	4566G	HC-GC-01	3		10	8	2	80.0	20.0	39.330	8	42.164	2.834	0.354						
49	53	4566G	HC-GC-01	4		10	9	1	90.0	10.0	37.069	9	39.680	2.611	0.290						
50	46	4566G	HC-GC-01	5		10	9	1	90.0	10.0	35.994	9	39.490	3.496	0.388						
51	32	4566G	HC-GC-01	6		10	10	0	100.0	0.0	37.871	10	41.635	3.764	0.376	Mean	9.3	0.8	92.5	7.5	0.35
52	45	4566G	HC-GC-01	7		10	10	0	100.0	0.0	37.503	10	40.938	3.435	0.344	SD	0.9	0.9	8.9	8.9	0.04
53	25	4566G	HC-GC-01	8		10	10	0	100.0	0.0	41.623	10	45.676	4.053	0.405	n	8	8	8	8	8
54	23	4566G	HC-GC-01	9	wq replicate																
55	61	4567G	HC-GC-05	1		10	9	1	90.0	10.0	45.127	9	48.175	3.048	0.339						
56	66	4567G	HC-GC-05	2		10	10	0	100.0	0.0	34.673	10	38.818	4.145	0.415						
57	4	4567G	HC-GC-05	3		10	9	1	90.0	10.0	39.691	9	42.497	2.806	0.312						
58	55	4567G	HC-GC-05	4		10	10	0	100.0	0.0	37.767	10	40.993	3.226	0.323						
59	36	4567G	HC-GC-05	5		10	10	0	100.0	0.0	39.462	10	42.963	3.501	0.350						
60	44	4567G	HC-GC-05	6		10	10	0	100.0	0.0	36.909	10	39.765	2.856	0.286	Mean	9.6	0.4	96.3	3.8	0.33
61	49	4567G	HC-GC-05	7		10	9	1	90.0	10.0	38.085	9	40.977	2.892	0.321	SD	0.5	0.5	5.2	5.2	0.04
62	33	4567G	HC-GC-05	8		10	10	0	100.0	0.0	38.613	10	41.445	2.832	0.283	n	8	8	8	8	8
63	43	4567G	HC-GC-05	9	wq replicate																
64	3	4568G	HC-76-02	1		10	10	0	100.0	0.0	38.068	10	41.262	3.194	0.319						
65	69	4568G	HC-76-02	2		10	8	2	80.0	20.0	35.120	8	37.614	2.494	0.312						
66	10	4568G	HC-76-02	3		10	10	0	100.0	0.0	42.513	10	45.645	3.132	0.313						
67	42	4568G	HC-76-02	4		10	7	3	70.0	30.0	40.213	7	42.307	2.094	0.299						
68	47	4568G	HC-76-02	5		10	10	0	100.0	0.0	37.552	10	40.221	2.669	0.267						
69	13	4568G	HC-76-02	6		10	9	1	90.0	10.0	36.459	9	39.026	2.567	0.285	Mean	9.0	1.0	90.0	10.0	0.31
70	18	4568G	HC-76-02	7		10	9	1	90.0	10.0	38.954	9	41.739	2.785	0.309	SD	1.1	1.1	10.7	10.7	0.02
71	57	4568G	HC-76-02	8		10	9	1	90.0	10.0	40.684	9	43.740	3.056	0.340	n	8	8	8	8	8
72	7	4568G	HC-76-02	9	wq replicate																

against laboratory bench
sheets 10 23 13 JMF

Water Quality Data

	NAS	CLIENT			Overlying water							Interstitial water	
BKR	SMPL	DESCRIP	REPL	DAY	TEMP	DO	COND	pH	NH3	HARD	ALK	S	NH3
7	4568G	HC-76-02	9	0	22.7	8.1	110	7.0	<0.1	34	30	<0.1	<0.5
14	4565G	HC-SFSR-03	9	0	22.9	8.3	110	7.0	0.2	26	30	<0.1	<0.5
23	4566G	HC-GC-01	9	0	23.1	8.2	112	6.9	0.2	34	40	<0.1	<0.5
39	4564G	HC-MCL	9	0	22.8	7.3	102	6.6	0.3	17	40	<0.1	0.9
43	4567G	HC-GC-05	9	0	22.8	8.1	111	6.8	0.2	34	30	<0.1	0.5
51	4563G	HC-SFSR-07	9	0	22.8	8.2	110	6.9	0.2	34	40	<0.1	<0.5
58	4562G	HC-SFSR-09	9	0	22.7	8.3	111	6.9	0.2	26	40	<0.1	0.8
64	4569G	Control	9	0	22.8	7.5	121	6.7	0.2	34	40	<0.1	1.0
7	4568G	HC-76-02	9	1	22.5	7.5	113	7.0					
14	4565G	HC-SFSR-03	9	1	22.7	7.5	114	7.0					
23	4566G	HC-GC-01	9	1	22.9	7.1	119	7.0					
39	4564G	HC-MCL	9	1	22.6	6.9	110	6.8					
43	4567G	HC-GC-05	9	1	22.6	7.1	115	6.8					
51	4563G	HC-SFSR-07	9	1	22.5	7.3	114	6.9					
58	4562G	HC-SFSR-09	9	1	22.4	7.7	114	7.0					
64	4569G	Control	9	1	22.7	6.6	120	6.7					
7	4568G	HC-76-02	9	2	22.6								
14	4565G	HC-SFSR-03	9	2	22.7								
23	4566G	HC-GC-01	9	2	23.0								
39	4564G	HC-MCL	9	2	22.7								
43	4567G	HC-GC-05	9	2	22.6								
51	4563G	HC-SFSR-07	9	2	22.6								
58	4562G	HC-SFSR-09	9	2	22.5								
64	4569G	Control	9	2	22.6								
7	4568G	HC-76-02	9	3	22.5	7.1		6.9					
14	4565G	HC-SFSR-03	9	3	22.6	7.1		6.9					
23	4566G	HC-GC-01	9	3	23.0	7.0		6.9					
39	4564G	HC-MCL	9	3	22.5	7.1		6.8					
43	4567G	HC-GC-05	9	3	22.6	7.1		6.8					
51	4563G	HC-SFSR-07	9	3	22.5	7.1		6.8					
58	4562G	HC-SFSR-09	9	3	22.4	7.1		6.9					
64	4569G	Control	9	3	22.6	6.3		6.6					
7	4568G	HC-76-02	9	4	23.2								
14	4565G	HC-SFSR-03	9	4	23.3								
23	4566G	HC-GC-01	9	4	23.3								
39	4564G	HC-MCL	9	4	23.2								
43	4567G	HC-GC-05	9	4	23.1								
51	4563G	HC-SFSR-07	9	4	23.2								
58	4562G	HC-SFSR-09	9	4	23.1								
64	4569G	Control	9	4	23.2								
7	4568G	HC-76-02	9	5	22.5								
14	4565G	HC-SFSR-03	9	5	22.7								
23	4566G	HC-GC-01	9	5	22.9								
39	4564G	HC-MCL	9	5	22.5								
43	4567G	HC-GC-05	9	5	22.6								
51	4563G	HC-SFSR-07	9	5	22.5								
58	4562G	HC-SFSR-09	9	5	22.4								
64	4569G	Control	9	5	22.5								
7	4568G	HC-76-02	9	6	22.4	7.3		7.5					
14	4565G	HC-SFSR-03	9	6	22.4	7.7		7.5					
23	4566G	HC-GC-01	9	6	22.6	7.3		7.5					
39	4564G	HC-MCL	9	6	22.3	7.1		7.5					
43	4567G	HC-GC-05	9	6	22.4	7.2		7.5					
51	4563G	HC-SFSR-07	9	6	22.4	7.2		7.5					
58	4562G	HC-SFSR-09	9	6	22.2	7.3		7.5					
64	4569G	Control	9	6	22.4	6.7		7.4					
7	4568G	HC-76-02	9	7	22.4								

14	4565G	HC-SFSR-03	9	7	22.7			
23	4566G	HC-GC-01	9	7	22.9			
39	4564G	HC-MCL	9	7	22.5			
43	4567G	HC-GC-05	9	7	22.6			
51	4563G	HC-SFSR-07	9	7	22.6			
58	4562G	HC-SFSR-09	9	7	22.5			
64	4569G	Control	9	7	22.4			
7	4568G	HC-76-02	9	8	23.1	6.8	106	7.4
14	4565G	HC-SFSR-03	9	8	23.2	7.0	106	7.5
23	4566G	HC-GC-01	9	8	23.4	6.9	109	7.5
39	4564G	HC-MCL	9	8	23.0	6.8	105	7.4
43	4567G	HC-GC-05	9	8	23.1	6.7	108	7.4
51	4563G	HC-SFSR-07	9	8	23.0	6.9	107	7.4
58	4562G	HC-SFSR-09	9	8	22.9	7.0	107	7.4
64	4569G	Control	9	8	23.1	6.4	112	7.4
7	4568G	HC-76-02	9	9	23.1			
14	4565G	HC-SFSR-03	9	9	23.2			
23	4566G	HC-GC-01	9	9	23.4			
39	4564G	HC-MCL	9	9	23.3			
43	4567G	HC-GC-05	9	9	23.3			
51	4563G	HC-SFSR-07	9	9	23.2			
58	4562G	HC-SFSR-09	9	9	23.3			
64	4569G	Control	9	9	23.1			
7	4568G	HC-76-02	9	10	22.8	7.2		7.1
14	4565G	HC-SFSR-03	9	10	23.0	7.3		7.1
23	4566G	HC-GC-01	9	10	23.1	7.3		7.1
39	4564G	HC-MCL	9	10	22.6	7.1		6.8
43	4567G	HC-GC-05	9	10	22.9	7.1		6.9
51	4563G	HC-SFSR-07	9	10	22.4	7.2		7.0
58	4562G	HC-SFSR-09	9	10	22.8	7.2		7.0
64	4569G	Control	9	10	22.9	6.6		7.0
7	4568G	HC-76-02	9	11	22.9			
14	4565G	HC-SFSR-03	9	11	23.1			
23	4566G	HC-GC-01	9	11	23.1			
39	4564G	HC-MCL	9	11	22.9			
43	4567G	HC-GC-05	9	11	23.0			
51	4563G	HC-SFSR-07	9	11	22.9			
58	4562G	HC-SFSR-09	9	11	22.9			
64	4569G	Control	9	11	22.9			
7	4568G	HC-76-02	9	12	22.2			
14	4565G	HC-SFSR-03	9	12	22.1			
23	4566G	HC-GC-01	9	12	22.2			
39	4564G	HC-MCL	9	12	22.0			
43	4567G	HC-GC-05	9	12	22.0			
51	4563G	HC-SFSR-07	9	12	22.0			
58	4562G	HC-SFSR-09	9	12	22.0			
64	4569G	Control	9	12	22.1			
7	4568G	HC-76-02	9	13	23.4	6.6		7.4
14	4565G	HC-SFSR-03	9	13	23.5	6.9		7.4
23	4566G	HC-GC-01	9	13	23.5	6.9		7.4
39	4564G	HC-MCL	9	13	23.3	6.8		7.3
43	4567G	HC-GC-05	9	13	23.4	6.6		7.2
51	4563G	HC-SFSR-07	9	13	23.4	6.8		7.2
58	4562G	HC-SFSR-09	9	13	23.2	6.8		7.2
64	4569G	Control	9	13	23.4	6.2		7.2
7	4568G	HC-76-02	9	14	23.2			
14	4565G	HC-SFSR-03	9	14	23.3			
23	4566G	HC-GC-01	9	14	23.4			
39	4564G	HC-MCL	9	14	23.2			
43	4567G	HC-GC-05	9	14	23.3			
51	4563G	HC-SFSR-07	9	14	23.3			

58	4562G	HC-SFSR-09	9	14	23.2			
64	4569G	Control	9	14	23.3			
7	4568G	HC-76-02	9	15	22.8	6.6	106	7.2
14	4565G	HC-SFSR-03	9	15	22.9	6.6	105	7.2
23	4566G	HC-GC-01	9	15	23.0	6.6	106	7.2
39	4564G	HC-MCL	9	15	22.8	6.2	104	7.2
43	4567G	HC-GC-05	9	15	22.9	6.3	105	7.2
51	4563G	HC-SFSR-07	9	15	22.8	6.8	104	7.2
58	4562G	HC-SFSR-09	9	15	22.9	6.8	104	7.3
64	4569G	Control	9	15	22.9	5.6	110	7.0
7	4568G	HC-76-02	9	16	22.6			
14	4565G	HC-SFSR-03	9	16	22.7			
23	4566G	HC-GC-01	9	16	22.8			
39	4564G	HC-MCL	9	16	22.6			
43	4567G	HC-GC-05	9	16	22.7			
51	4563G	HC-SFSR-07	9	16	22.7			
58	4562G	HC-SFSR-09	9	16	22.6			
64	4569G	Control	9	16	22.7			
7	4568G	HC-76-02	9	17	22.6	6.8		7.2
14	4565G	HC-SFSR-03	9	17	22.7	7.1		7.2
23	4566G	HC-GC-01	9	17	22.7	7.1		7.2
39	4564G	HC-MCL	9	17	22.7	6.7		7.3
43	4567G	HC-GC-05	9	17	22.8	6.9		7.3
51	4563G	HC-SFSR-07	9	17	22.7	7.3		7.3
58	4562G	HC-SFSR-09	9	17	22.7	7.2		7.3
64	4569G	Control	9	17	22.8	6.4		7.2
7	4568G	HC-76-02	9	18	22.7			
14	4565G	HC-SFSR-03	9	18	22.8			
23	4566G	HC-GC-01	9	18	22.9			
39	4564G	HC-MCL	9	18	22.7			
43	4567G	HC-GC-05	9	18	22.8			
51	4563G	HC-SFSR-07	9	18	22.8			
58	4562G	HC-SFSR-09	9	18	22.7			
64	4569G	Control	9	18	22.7			
7	4568G	HC-76-02	9	19	22.4			
14	4565G	HC-SFSR-03	9	19	22.5			
23	4566G	HC-GC-01	9	19	22.6			
39	4564G	HC-MCL	9	19	22.4			
43	4567G	HC-GC-05	9	19	22.5			
51	4563G	HC-SFSR-07	9	19	22.4			
58	4562G	HC-SFSR-09	9	19	22.4			
64	4569G	Control	9	19	22.4			
7	4568G	HC-76-02	9	20	23.2	6.6		7.1
14	4565G	HC-SFSR-03	9	20	23.4	6.8		7.1
23	4566G	HC-GC-01	9	20	23.4	6.9		7.2
39	4564G	HC-MCL	9	20	23.3	6.3		7.1
43	4567G	HC-GC-05	9	20	23.4	6.3		7.1
51	4563G	HC-SFSR-07	9	20	23.4	7.4		7.1
58	4562G	HC-SFSR-09	9	20	23.3	7.4		7.1
64	4569G	Control	9	20	23.4	6.0		7.1
7	4568G	HC-76-02	9	21	22.7			
14	4565G	HC-SFSR-03	9	21	22.8			
23	4566G	HC-GC-01	9	21	22.9			
39	4564G	HC-MCL	9	21	22.7			
43	4567G	HC-GC-05	9	21	22.9			
51	4563G	HC-SFSR-07	9	21	22.8			
58	4562G	HC-SFSR-09	9	21	22.7			
64	4569G	Control	9	21	22.9			
7	4568G	HC-76-02	9	22	22.1	6.9	103	7.3
14	4565G	HC-SFSR-03	9	22	22.3	7.1	102	7.3
23	4566G	HC-GC-01	9	22	22.3	6.9	104	7.3

39	4564G	HC-MCL	9	22	22.0	6.4	102	7.2					
43	4567G	HC-GC-05	9	22	22.2	6.4	103	7.2					
51	4563G	HC-SFSR-07	9	22	22.2	7.9	102	7.2					
58	4562G	HC-SFSR-09	9	22	22.1	7.9	102	7.5					
64	4569G	Control	9	22	22.3	6.0	107	7.2					
7	4568G	HC-76-02	9	23	22.1								
14	4565G	HC-SFSR-03	9	23	22.2								
23	4566G	HC-GC-01	9	23	22.3								
39	4564G	HC-MCL	9	23	22.1								
43	4567G	HC-GC-05	9	23	22.2								
51	4563G	HC-SFSR-07	9	23	22.2								
58	4562G	HC-SFSR-09	9	23	22.1								
64	4569G	Control	9	23	22.2								
7	4568G	HC-76-02	9	24	22.5	6.6		7.1					
14	4565G	HC-SFSR-03	9	24	22.6	6.8		7.1					
23	4566G	HC-GC-01	9	24	22.7	7.1		7.2					
39	4564G	HC-MCL	9	24	22.6	6.4		7.0					
43	4567G	HC-GC-05	9	24	22.7	6.6		7.0					
51	4563G	HC-SFSR-07	9	24	22.6	7.9		7.4					
58	4562G	HC-SFSR-09	9	24	22.6	7.8		7.3					
64	4569G	Control	9	24	22.7	5.8		7.0					
7	4568G	HC-76-02	9	25	22.6								
14	4565G	HC-SFSR-03	9	25	22.7								
23	4566G	HC-GC-01	9	25	22.7								
39	4564G	HC-MCL	9	25	22.6								
43	4567G	HC-GC-05	9	25	22.7								
51	4563G	HC-SFSR-07	9	25	22.6								
58	4562G	HC-SFSR-09	9	25	22.6								
64	4569G	Control	9	25	22.7								
7	4568G	HC-76-02	9	26	22.7								
14	4565G	HC-SFSR-03	9	26	22.8								
23	4566G	HC-GC-01	9	26	22.8								
39	4564G	HC-MCL	9	26	22.7								
43	4567G	HC-GC-05	9	26	22.8								
51	4563G	HC-SFSR-07	9	26	22.8								
58	4562G	HC-SFSR-09	9	26	22.7								
64	4569G	Control	9	26	22.8								
7	4568G	HC-76-02	9	27	23.0	7.3		7.3					
14	4565G	HC-SFSR-03	9	27	23.1	7.9		7.3					
23	4566G	HC-GC-01	9	27	23.2	8.0		7.4					
39	4564G	HC-MCL	9	27	23.0	7.2		7.2					
43	4567G	HC-GC-05	9	27	23.1	7.3		7.2					
51	4563G	HC-SFSR-07	9	27	23.1	8.9		7.6					
58	4562G	HC-SFSR-09	9	27	23.0	8.8		7.7					
64	4569G	Control	9	27	23.2	6.7		7.0					
7	4568G	HC-76-02	9	28	23.2	7.7	97	7.2	0.2	26	40	<0.1	0.8
14	4565G	HC-SFSR-03	9	28	23.3	7.9	99	7.3	0.2	26	40	<0.1	1.8
23	4566G	HC-GC-01	9	28	23.4	8.1	100	7.5	0.1	17	40	<0.1	0.8
39	4564G	HC-MCL	9	28	23.2	7.3	98	7.2	0.2	34	40	<0.1	1.1
43	4567G	HC-GC-05	9	28	23.2	7.5	99	7.3	0.1	34	40	<0.1	1.8
51	4563G	HC-SFSR-07	9	28	23.3	8.9	99	7.9	0.2	34	40	<0.1	0.6
58	4562G	HC-SFSR-09	9	28	23.2	8.7	99	7.9	<0.1	17	30	<0.1	0.8
64	4569G	Control	9	28	23.3	7.1	105	7.2	0.2	26	30	<0.1	1.9
				Mean	22.8	7.1	107	7.2	0.2	28	37	—	1.1
				SD	0.4	0.6	6	0.2	0.1	7	5	—	0.5
				n	232	112	48	112	16	16	16	16	16
				Min	22.0	5.6	97	6.6	<0.1	17	30	<0.1	<0.5
				Max	23.5	8.9	121	7.9	0.3	34	40	<0.1	1.9

AMMONIA EXPOSURE BENCHSHEETS AND ANALYSIS

Total Ammonia-N in Sediment Pore Water: Computation Worksheet
Salicylate Method (SOP #5492)

Result

	Sample description	Dilution factor	OD655	NH3-N (mg/L)	pH	Salinity (ppt)
	Blank	-----	-----	-----		
	1.0 mg/L NH3-N Std.	-----	0.109	1.00		
	3.0 mg/L NH3-N Std.	-----	0.291	3.00		
	6.0 mg/L NH3-N Std.	-----	0.605	6.00		
	10.0 mg/L NH3-N Std.	-----	1.050	10.00		
	3.0 mg/L spike	-----	0.298	2.88		
	3.0 mg/L spike dupl.	-----	0.300	2.90		
	5.0 mg/L 2nd source		0.500	4.83		
1	4562G	5	0.017	0.82		
2	4563G	5	0.007	ND		
3	4564G	5	0.018	0.87		
4	4565G	5	0.006	ND		
5	4566G	5	0.009	ND		
6	4567G	5	0.011	0.53		
7	4568G	5	0.002	ND		
8	4569G	5	0.020	0.97		
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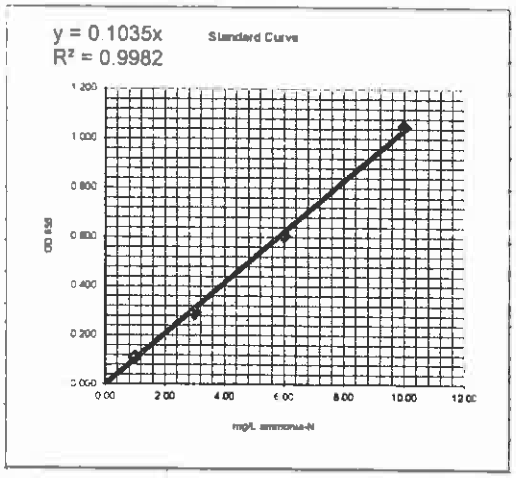

Reporting limit (mg/L) =	0.50
Recovery (%) =	96.2
Precision (RPD) =	-0.67
2nd source (%) =	96.6
Sample volume (ml):	0.10
Dilution factor	5

Sample Set Description:

Test No.: P848

Test Day:

Species:

Sample Type (check)

X Bulk Sediment Porewaters

Test Beaker Porewaters

Overlying Water

Analyst: RSC

Date analysed: 9/9/2013

Total Ammonia-N in Sediment Pore Water: Computation Worksheet
Salicylate Method (SOP #5492)

Result

	Sample description	Dilution factor	OD655	NH3-N (mg/L)	pH	Salinity (ppt)
	Blank	-----	-----	-----		
	1.0 mg/L NH3-N Std.	-----	.109	1.00		
	3.0 mg/L NH3-N Std.	-----	.291	3.00		
	6.0 mg/L NH3-N Std.	-----	.605	6.00		
	10.0 mg/L NH3-N Std.	-----	1.05	10.00		
	3.0 mg/L spike	-----	.298			
	3.0 mg/L spike dupl.	-----	.300			
	5.0 mg/L 2nd source		.506			
1	4562G	5	.017			
2	4563G	5	.007			
3	4564G	5	.018			
4	4565G	5	.006			
5	4566G	5	.009			
6	4567G	5	.011			
7	4568G	5	.002			
8	4569G	5	.020			
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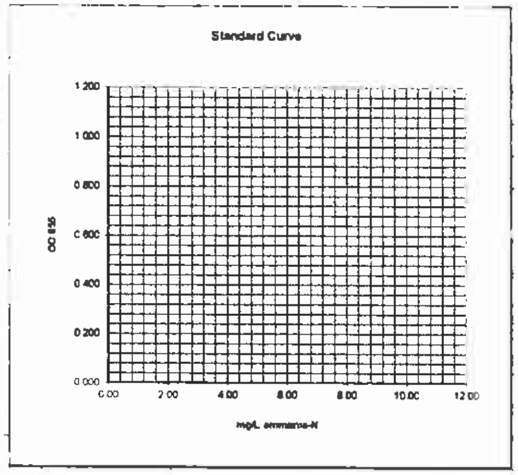

Reporting limit (mg/L) =	0.50
Recovery (%) =	#VALUE!
Precision (RPD) =	#VALUE!
2nd source (%) =	#VALUE!
Sample volume (ml):	0.10
Dilution factor	5

Sample Set Description:

Test No.: P848
Test Day:
Species:

Sample Type (check)

X Bulk Sediment Porewaters
Test Beaker Porewaters
Overlying Water

Analyst: RSC RSC
Date analysed: 9/9/2013

Dissolved Sulfide in Water: Computation Worksheet
Methylene Blue Method (SOP #5550)

Standardization	1	2	3
uL PAO titrant employed	30	29	35
Working Std. Conc. (mg/L):		2.69867	

Result

	Sample description	Dilution factor	OD664	Sulfide (mg/L)
	Blank	-----	-----	-----
	1.0 mL working sulfide std.	-----	0.280	0.54
	2.0 mL working sulfide std.	-----	0.590	1.08
	3.0 mL working sulfide std.	-----	0.870	1.62
	4.0 mL working sulfide std.	-----	1.100	2.16
	5.0 mL working sulfide std.	-----	1.500	2.70
	3.0 mL spike	-----	0.860	1.60
	3.0 mL spike dupl.	-----	0.840	1.56
1	4562G	5	0.005	ND
2	4563G	5	0.001	ND
3	4564G	5	0.010	ND
4	4565G	5	0.001	ND
5	4566G	5	0.001	ND
6	4567G	5	0.003	ND
7	4568G	5	0.002	ND
8	4569G	5	0.006	ND
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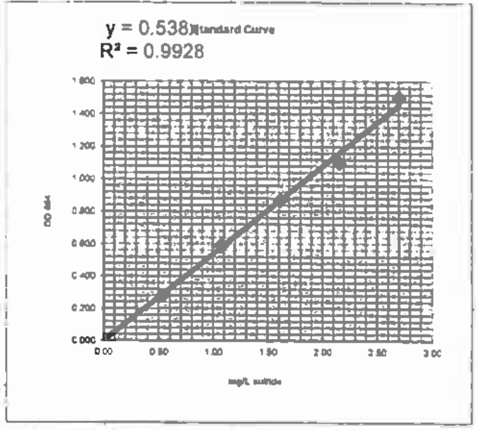

Reporting limit (mg/L) =	0.10
Recovery (%) =	97.4
Precision (RPD) =	2.35
Sample volume (ml):	1.00
Dilution factor	5

Sample Set Description:

Test No.:

Test Day:

Species:

Proj. No.: P848

X Bulk sediment porewaters

Test beaker porewaters

Overlying water

Analyst: RSC

Date analysed: 9/9/2013

Dissolved Sulfide in Water: Computation Worksheet
Methylene Blue Method (SOP #5550)

Standardization

	1	2	3
uL PAO titrant employed	30	29	35
Working Std. Conc. (mg/L):		3.2	

Result

	Sample description	Dilution factor	OD664	Sulfide (mg/L)
	Blank	-----	-----	-----
	1.0 mL working sulfide std.	-----	.280	0.64
	2.0 mL working sulfide std.	-----	.590	1.28
	3.0 mL working sulfide std.	-----	.870	1.92
	4.0 mL working sulfide std.	-----	1.10	2.56
	5.0 mL working sulfide std.	-----	1.50	3.20
	3.0 mL spike	-----	.860	
	3.0 mL spike dupl.	-----	.840	
1	4562G	5	.005	
2	4563G	5	.001	
3	4564G	5	.010	
4	4565G	5	.001	
5	4566G	5	.001	
6	4567G	5	.003	
7	4568G	5	.002	
8	4569G	5	.006	
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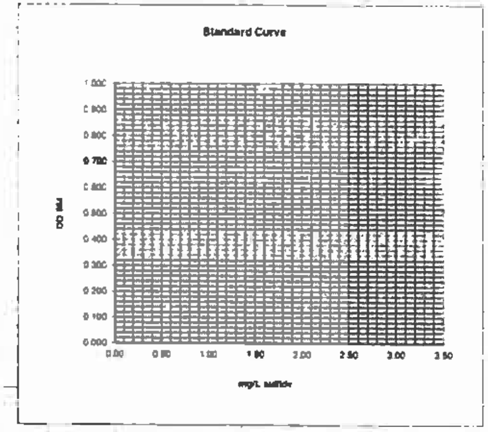

Reporting limit (mg/L) = 0.10

Recovery (%) = #VALUE!
Precision (RPD) = #VALUE!

Sample volume (ml): 1.00
Dilution factor 5

Sample Set Description:

Test No.:
Test Day:
Species:

Proj. No.: P848
X Bulk sediment porewaters
Test beaker porewaters
Overlying water

Analyst: RSC
Date analysed: 9/9/2013

Total Ammonia-N in Sediment Pore Water: Computation Worksheet
Salicylate Method (SOP #5492)

Result

	Sample description	Dilution factor	OD655	NH3-N (mg/L)	pH	Salinity (ppt)
	Blank	-----	-----	-----		
	1.0 mg/L NH_3-N Std.	-----	0.142	1.00		
	3.0 mg/L NH_3-N Std.	-----	0.335	3.00		
	6.0 mg/L NH_3-N Std.	-----	0.718	6.00		
	10.0 mg/L NH_3-N Std.	-----	1.100	10.00		
	3.0 mg/L spike	-----	0.341	3.02		
	3.0 mg/L spike dupl.	-----	0.340	3.01		
	5.0 mg/L 2nd source		0.578	5.12		
1	Day 0 (9-10-13)					
2	7	1	0.009	ND		
3	14	1	0.021	0.19		
4	23	1	0.020	0.18		
5	39	1	0.037	0.33		
6	43	1	0.020	0.18		
7	51	1	0.020	0.18		
8	58	1	0.019	0.17		
9	64	1	0.017	0.15		
10						
11	Day 28 (10-8-13)					
12	7	1	0.023	0.20		
13	14	1	0.021	0.19		
14	23	1	0.012	0.11		
15	39	1	0.018	0.16		
16	43	1	0.013	0.12		
17	51	1	0.017	0.15		
18	58	1	0.010	ND		
19	64	1	0.019	0.17		
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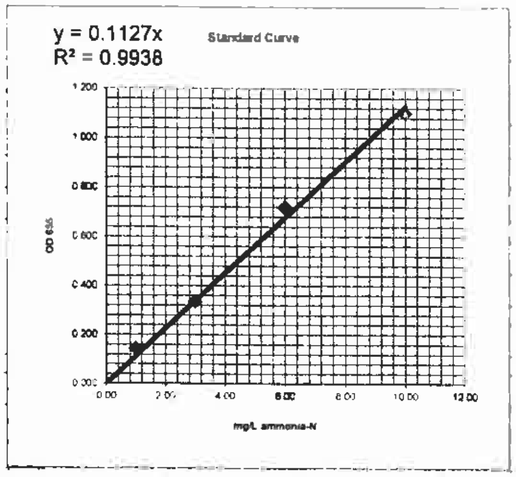

Reporting limit (mg/L) =	0.10
Recovery (%) =	100.5
Precision (RPD) =	0.29
2nd source (%) =	102.4
Sample volume (ml):	0.50
Dilution factor	1

Sample Set Description:

Test No.: 848-1
Test Day: 0 & 28 (9-10-13 & 10-8-13)
Species: *Hyalella*

Sample Type (check)

Bulk Sediment Porewaters
Test Beaker Porewaters
X Overlying Water

Analyst: RSC
Date analysed: 10/8/2013

Total Ammonia-N in Sediment Pore Water: Computation Worksheet
Salicylate Method (SOP #5492)

Result

	Sample description	Dilution factor	OD655	NH_3-N (mg/L)	pH	Salinity (ppt)
	Blank	-----	-----	-----		
	1.0 mg/L NH_3-N Std.	-----	.142	1.00		
	3.0 mg/L NH_3-N Std.	-----	.331	3.00		
	6.0 mg/L NH_3-N Std.	-----	.718	6.00		
	10.0 mg/L NH_3-N Std.	-----	1.10	10.00		
	3.0 mg/L spike	-----	.341			
	3.0 mg/L spike dupl.	-----	.340			
	5.0 mg/L 2nd source		.578			
1	Day 0 (9-10-13)					
2	7	1	.009			
3	14	1	.021			
4	23	1	.020			
5	39	1	.037			
6	43	1	.020			
7	51	1	.020			
8	58	1	.019			
9	64	1	.017			
10						
11	Day 28 (10-8-13)					
12	7	1	.023			
13	14	1	.021			
14	23	1	.012			
15	39	1	.018			
16	43	1	.013			
17	51	1	.017			
18	58	1	.010			
19	64	1	.019			
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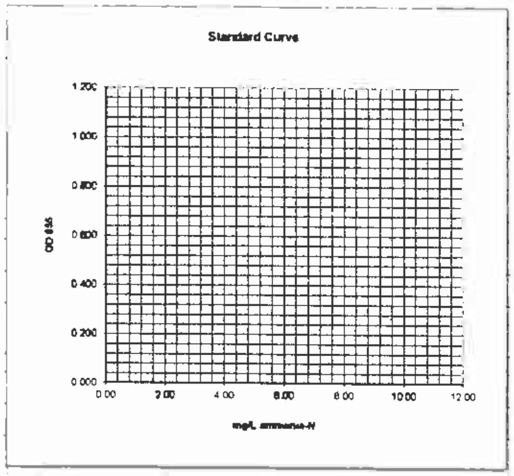

Reporting limit (mg/L) = 0.10

Recovery (%) = #VALUE!
Precision (RPD) = #VALUE!
2nd source (%) = #VALUE!

Sample volume (ml): 0.50
Dilution factor 1

Sample Set Description:
Test No.: 848-1
Test Day: 0 & 28 (9-10-13 & 10-8-13)
Species: *Hyalella*

Sample Type (check)
Bulk Sediment Porewaters
Test Beaker Porewaters
X Overlying Water

Analyst: RSC
Date analysed: 10/8/2013

Total Ammonia-N in Sediment Pore Water: Computation Worksheet
Salicylate Method (SOP #5492)

Result

	Sample description	Dilution factor	OD_{655}	NH_3-N (mg/L)	pH	Salinity (ppt)
	Blank	-----	-----	-----		
	1.0 mg/L NH_3-N Std.	-----	0.142	1.00		
	3.0 mg/L NH_3-N Std.	-----	0.335	3.00		
	6.0 mg/L NH_3-N Std.	-----	0.718	6.00		
	10.0 mg/L NH_3-N Std.	-----	1.100	10.00		
	3.0 mg/L spike	-----	0.341	3.02		
	3.0 mg/L spike dupl.	-----	0.340	3.01		
	5.0 mg/L 2nd source		0.578	5.12		
1	7	5	0.019	0.84		
2	14	5	0.040	1.77		
3	23	5	0.017	0.75		
4	39	5	0.024	1.06		
5	43	5	0.040	1.77		
6	51	5	0.014	0.62		
7	58	5	0.017	0.75		
8	64	5	0.042	1.86		
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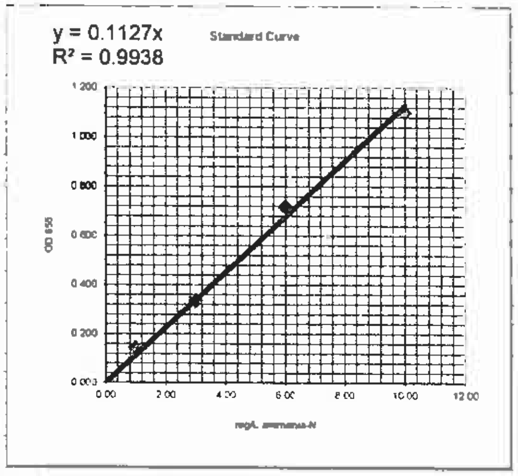

Reporting limit (mg/L) =	0.50
Recovery (%) =	100.5
Precision (RPD) =	0.29
2nd source (%) =	102.4
Sample volume (ml):	0.10
Dilution factor	5

Sample Set Description:

Test No.: 848-1
Test Day: 28 (10-8-13)
Species: *Hyalella*

Sample Type (check)

Bulk Sediment Porewaters
X Test Beaker Porewaters
Overlying Water

Analyst: RSC
Date analysed: 10/8/2013

Total Ammonia-N in Sediment Pore Water: Computation Worksheet
Salicylate Method (SOP #5492)

Result

	Sample description	Dilution factor	OD655	NH3-N (mg/L)	pH	Salinity (ppt)
	Blank	-----	-----	-----		
	1.0 mg/L NH3-N Std.	-----	.142	1.00		
	3.0 mg/L NH3-N Std.	-----	.335	3.00		
	6.0 mg/L NH3-N Std.	-----	.718	6.00		
	10.0 mg/L NH3-N Std.	-----	1.10	10.00		
	3.0 mg/L spike	-----	.341			
	3.0 mg/L spike dupl.	-----	.340			
	5.0 mg/L 2nd source		.578			
1	7	5	.019		7.1	0
2	14	5	.040		7.1	0
3	23	5	.017		7.2	0
4	39	5	.024		6.9	0
5	43	5	.040		6.9	0
6	51	5	.014		7.1	0
7	58	5	.017		7.2	0
8	64	5	.042		7.1	0
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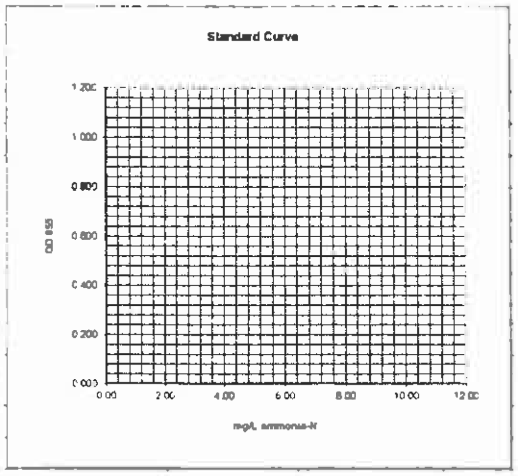

Reporting limit (mg/L) =	0.50
Recovery (%) =	#VALUE!
Precision (RPD) =	#VALUE!
2nd source (%) =	#VALUE!
Sample volume (ml):	0.10
Dilution factor	5

Sample Set Description:

Test No.: 848-1
Test Day: 28 (10-8-13)
Species: *Hyalella*

Sample Type (check)

Bulk Sediment Porewaters
X Test Beaker Porewaters
Overlying Water

Analyst: RSC RSC
Date analysed: 10/8/2013

Dissolved Sulfide in Water: Computation Worksheet
Methylene Blue Method (SOP #5550)

Standardization

	1	2	3
uL PAO titrant employed:	100	102	104
Working Std. Conc. (mg/L):		1.568	

Result

	Sample description	Dilution factor	OD664	Sulfide (mg/L)	pH	Salinity (ppt)
	Blank	—	—	—		
	1.0 mL working sulfide std.	—	0.146	0.31		
	2.0 mL working sulfide std.	—	0.310	0.63		
	3.0 mL working sulfide std.	—	0.464	0.94		
	4.0 mL working sulfide std.	—	0.605	1.25		
	5.0 mL working sulfide std.	—	0.750	1.57		
	3.0 mL spike	—	0.478	0.99		
	3.0 mL spike dupl.	—	0.460	0.95		
1	7	5	0.001	ND		
2	14	5	0.004	ND		
3	23	5	0.002	ND		
4	39	5	0.002	ND		
5	43	5	0.000	ND		
6	51	5	0.001	ND		
7	58	5	0.002	ND		
8	64	5	0.001	ND		
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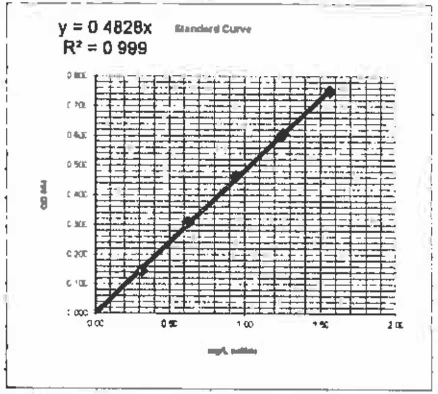

Reporting limit (mg/L) =	0.10
Recovery (%) =	103.2
Precision (RPD) =	3.84
Sample volume (ml):	1.00
Dilution factor	5

Sample Set Description:

Test No.: 848-1
Test Day: 28 (10-8-13)
Species: *Hyalella*

Proj. No.: P848
Bulk sediment porewaters
X Test beaker porewaters
Overlying water

Analyst: RSC
Date analysed: 10/8/2013

Dissolved Sulfide in Water: Computation Worksheet
Methylene Blue Method (SOP #5550)

Standardization

	1	2	3
uL PAO titrant employed	100	102	104
Working Std. Conc. (mg/L):		3.2	

Result

	Sample description	Dilution factor	OD664	Sulfide (mg/L)	pH	Salinity (ppt)
	Blank	----	—	---		
	1.0 mL working sulfide std.	—	.146	0.64		
	2.0 mL working sulfide std.	—	.310	1.28		
	3.0 mL working sulfide std.	----	.464	1.92		
	4.0 mL working sulfide std.	—	.605	2.56		
	5.0 mL working sulfide std.	—	.750	3.20		
	3.0 mL spike	—	.478			
	3.0 mL spike dupl.	—	.460			
1	7	5	.001		7.1	0
2	14	5	.004		7.1	0
3	23	5	.002		7.2	0
4	39	5	.002		6.9	0
5	43	5	.000		6.9	0
6	51	5	.001		7.1	0
7	58	5	.002		7.2	0
8	64	5	.007		7.1	0
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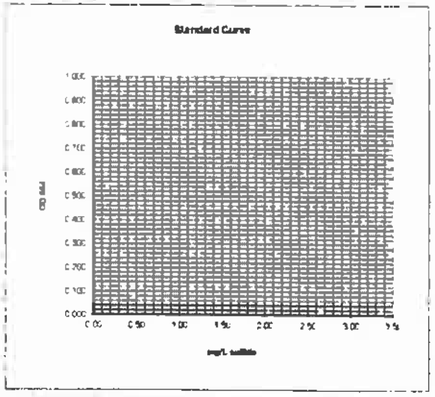

Reporting limit (mg/L) =	0.10
Recovery (%) =	#VALUE!
Precision (RPD) =	#VALUE!
Sample volume (ml):	1.00
Dilution factor	5

Sample Set Description:

Test No.: 848-1
Test Day: 28 (10-8-13)
Species: *Hyalella*

Proj. No.: P848
Bulk sediment porewaters
X Test beaker porewaters
Overlying water

Analyst: RSC RC
Date analysed: 10/8/2013

CHAIN-OF-CUSTODY RECORDS

Sample Custody Record

Samples Shipped to: NW Aquatic

HARTCROWSER

Hart Crowser,
1700 Westlake Avenue North, Suite
Seattle, Washington 98109-6
Office: 206.324.9530 • Fax 206.328.5

JOB 17800-35 LAB NUMBER

PROJECT NAME MCHA

HART CROWSER CONTACT Michelle Harvey
206-683-9199

SAMPLED BY: MAH, BAS, JMS

LAB NO.	SAMPLE ID	DESCRIPTION	DATE	TIME	MATRIX	REQUESTED ANALYSIS Bioassay	NO. OF CONTAINERS	OBSERVATIONS/COMMENTS/ COMPOSITING INSTRUCTIONS
	HC-SFSR-09	3×1L	8/28/13	10.00	sediment	X	3	MASH 45626
	HC-SFSR-07	3×1L	8/22/13	17:30		X	3	45636
	HC-MCL	3×1L	8/27/13	15:35		X	3	45646
	HC-SFSR-03	3×1L	8/23/13	15:30		X	3	45656
	HC-GC-01	3×1L	8/24/13	13:30		X	3	45666
	HC-GC-05	3×1L	8/25/13	12:45		X	3	45676
	HC-76-02	3×1L	8/26/13	10:15		X	3	45686

RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE Michelle Harvey	8/30/13	SIGNATURE Gary Buhler	8-31-13
PRINT NAME Michelle Harvey	TIME	PRINT NAME GARY BUHLER	TIME
COMPANY Hart Crowser	1200	COMPANY MAS	1110

RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE	TIME	SIGNATURE	TIME
PRINT NAME		PRINT NAME	
COMPANY		COMPANY	

SPECIAL SHIPMENT HANDLING OR STORAGE REQUIREMENTS:

COOLER NO.: STORAGE LOCATION:
Temp cooler #1 : 5.1°C
Temp cooler #2 : 2.7°C

See Lab Work Order No. ________
for Other Contract Requirements

TOTAL NUMBER OF CONTAINERS

SAMPLE RECEIPT INFORMATION
CUSTODY SEALS:
☒YES ☐NO ☐N/A
GOOD CONDITION
☒YES ☐NO
TEMPERATURE ________
SHIPMENT METHOD: ☐HAND
☐COURIER ☐OVERNIGHT

TURNAROUND TIME:
☐ 24 HOURS ☐ 1 WEEK
☐48 HOURS ☒STANDARD
☐72 HOURS OTHER ________

White and Yellow Copies to Lab Pink to Project Manager Lab to Return White Copy to Hart Crowser Gold to Sample Custodian

From (425) 329-1146
Karis Pratt
Hart Crowser
120 3RD AVE S STE 110

EDMONDS, WA 98020

Origin ID PAEA

FedEx.
Express

E

J132013062802326

Ship Date 30AUG13
ActWgt 77.5 LB
CAD 3776327/INET3430

Dims 23 X 14 X 15 IN

Delivery Address Bar Code

SHIP TO: (541) 265-7225
BILL SENDER

Gerald Irissarri
Northwestern Aquatic Sciences
3814 Yaquina Bay Rd

NEWPORT, OR 97365

Ref #
Invoice #
PO #
Dept #

SATURDAY 1:30P
PRIORITY OVERNIGHT

TRK# 0201 **7965 8872 7507**

86 ONPA

97365
OR-US
PDX

51AG1/0985/1A0E

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CUSTODY SEAL

Coder 1 of 2

Date 8/30/13

Signature

Nalge Nunc International

I-CHEM™
Brand Products

90009

From (425) 329-1146
Karis Pratt
Hart Crowser
120 3RD AVE S STE 110

EDMONDS WA 98020

Origin ID PAEA

FedEx. Express

E

J13201306280326

Ship Date 30AUG13
ActWgt 59.0 LB
CAD 3776327/INET3430

Dims 23 X 14 X 15 IN

Delivery Address Bar Code

SHIP TO: (541) 265-7225 BILL SENDER
Gerald Irissarri
Northwestern Aquatic Sciences
3814 Yaquina Bay Rd

NEWPORT, OR 97365

Ref # Monte Cristo
Invoice #
PO #
Dept #

SATURDAY 1:30P
PRIORITY OVERNIGHT

TRK# 7965 8876 3972
0201

86 ONPA

97365
OR-US
PDX

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Use of this system constitutes your agreement to the service conditions in the current FedEx Service Guide, available on fedex com FedEx will not be responsible for any claim in excess of $100 per package, whether the result of loss, damage, delay, non-delivery, misdelivery, or misinformation, unless you declare a higher value pay an additional charge document your actual loss and file a timely claim Limitations found in the current FedEx Service Guide apply Your right to recover from FedEx for any loss including intrinsic value of the package loss of sales, income interest, profit, attorney's fees, costs, and other forms of damage whether direct, incidental, consequential or special is limited to the greater of $100 or the authorized declared value Recovery cannot exceed actual documented loss Maximum for items of extraordinary value is $1,000, e g jewelry, precious metals, negotiable instruments and other items listed in our ServiceGuide Written claims must be filed within strict time limits, see current FedEx Service Guide

CUSTODY SEAL

Cooler 2 of 2

Date 8/30/13
Signature

I-CHEM™ Brand Products
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90009

APPENDIX III

RAW DATA – REFERENCE TOXICANT TEST

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS- XXX-HA1

ACUTE TOXICITY TEST (ALL SPECIES)

REVIEWED PAGES 1-8 -WJ

Test No. 999-3208 Client: QC Test Investigator

Test Type (rangefinding/[✓ definitive]) Test Length (hr) 96

Species *Hyalella azteca*

STUDY MANAGEMENT

Client: QC test

Client's Study Monitor: QC test

Testing Laboratory: Northwestern Aquatic Sciences

Test Location: Newport Laboratory

Laboratory's Study Personnel:

Proj. Man./Study Dir. G.J. Irissarri GJI

QA Officer L. K. Nemeth

1. GA Buhler GAB
2. SF Knowlton SK
3. Yves Natalian
4.

Test Beginning: 9-10-13 1105 Test Ending: 9-14-13 1120

TEST MATERIAL

Description: Potassium Chloride Crystals - Lot No.: FISHER 114689

NAS Sample No.				
Date of Collection:				
Date of Receipt:				
Temperature (deg C):				
Dissolved oxygen (mg/L):				
pH:				
Conductivity (umhos/cm):				
Hardness (mg/L):				
Alkalinity (mg/L):				
Salinity (ppt):				
Total chlorine (mg/L):				
Total ammonia-N (mg/L):				
:				

DILUTION WATER

Description: Moderately hard synthetic water

Date of Preparation/Collection: 9-3-13

Water Quality: Cond. (umhos/cm): 282 Salinity (ppt) pH 7.6

Hardness (mg/L as $CaCO_3$): 86 Alkalinity (mg/L as $CaCO_3$): 70

Treatments: Aerated ≥ 24 hrs

TEST LOCATION

Test conducted in (circle one): [✓ room 1] ~~room 2~~ trailer water bath other:

Randomization chart:

REP B	0.125	0.063	0.5	0	1	0.25				
A	0	0.125	1	0.25	0.5	0.063				

Error codes: 1) Correction of handwriting error
2) Written in wrong location; entry deleted
3) Wrong date deleted; replaced with correct date
4) Error found in measurement; measurement repeated

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-HA1

ACUTE TOXICITY TEST (ALL SPECIES)

Test No. 999-3208 Client QC Test Investigator

TEST ORGANISMS

Species: *Hyalella azteca* Age: Size:

Source: Chesapeake Cultures, Hayes, VA Date received: 9-7-13

Acclimation Data:

Date	Temp. (deg.C)	pH	Cond. umhos/cm	DO (mg/L)	Hardness (mg/L)	Alkalinity (mg/L)	Feeding		Water changes
							Amount	description	
9-7-13	22.8	7.3	575	15.0	205	210	10mLs	YTC	yes
9-8-13	22.1	8.1	353	8.5	111	130	〃	〃	〃
9-9-13	22.0	7.8	297	8.4	94	90	〃	〃	〃
9-10-13	22.3	7.6	258	7.9	68	80	〃	〃	〃
Mean	22.3	7.7	371	10.0	120	128			
S.D.	0.4	0.3	142	3.4	60	59			
(N)	(4)	(4)	(4)	(4)	(4)	(4)			

Photoperiod during acclimation: 16:8, L:D

TEST PROCEDURES AND CONDITIONS

Test concentrations (50% series recommended): 1, 0.5, 0.25, 0.125, 0.063 0 g/L

Test chamber: 250 ml glass beakers Test volume: 100 ml

Replicates/treatment: 2 Organisms/treatment: 20 (10/rep)

Test water changes: None Aeration during test: None

Feeding: 0.5 ml YTC suspension per beaker on days 0 and 2

Duration: 24-hr, 48-hr, [✓ 96-hr] Test temperature (deg.C): [✓ 23 ± 1] or 20 ± 1

Beaker placement: Stratified randomization Photoperiod: 16:8, L:D

MISCELLANEOUS NOTES

Test solution preparation:

Working stock: Dissolve 0.5g KCl crystals in dilution water and dilute to 500 mL.
Final conc.: 1.0 g/L.

9-10-13
GSL

Test concentration (g/L)	KCl working stock (ml/200ml)	Dilution water
1	200	Brought up to final volume of 200 ml with dilution water and distributed evenly between two replicates
0.5	100	
0.25	50	
0.125	25	
0.063	12.5	
0	0	

Test No. 999-3208 Client QC Test

DAILY RECORD SHEET

Day 0 (9/10/13) YL/SK

Conc. (g/L)	Temp. (deg.C)	pH	Cond. (umhos/cm)	DO (ppm)	Hardness (mg/L)	Alkalinity (mg/L)	Survivors A	Survivors B
1. 1	24.0	7.8	1970	8.3	94	60	10	10
2. 0.5	23.9	7.7	1161	8.3			10	10
3. 0.25	24.0	7.6	731	8.3			10	10
4. 0.125	23.8	7.6	508	8.3			10	10
5. 0.063	23.9	7.5	400	8.3			10	10
6. 0	23.9	7.5	290	8.3	86	60	10	10

Each beaker fed 0.5 ml YTC suspension. Initials: GB

Day 1 (9/11/13) SK/YL/GB

Conc. (g/L)	Temp. (deg.C)	pH	Cond. (umhos/cm)	DO (ppm)	Hardness (mg/L)	Alkalinity (mg/L)	Survivors A	Survivors B
1. 1	23.8	7.6	1902	7.9			5(50)	6(40)
2. 0.5	23.7	7.7	1110	7.7			8(20)	9(10)
3. 0.25	23.9	7.6	706	7.5			10	10
4. 0.125	23.7	7.6	500	7.5			10	10
5. 0.063	23.7	7.5	402	7.5			10	10
6. 0	23.9	7.5	287	7.5			10	10

Day 2 (9/12/13) VB/YL

Conc. (g/L)	Temp. (deg.C)	pH	Cond. (umhos/cm)	DO (ppm)	Hardness (mg/L)	Alkalinity (mg/L)	Survivors A	Survivors B
1. 1	23.7	7.5	1960	7.7			0(50)	0(60)
2. 0.5	23.5	7.4	1154	7.9			2(60)	2(70)
3. 0.25	23.6	7.4	728	7.9			10	10
4. 0.125	23.4	7.4	516	8.1			10	10
5. 0.063	23.2	7.3	409	7.9			10	10
6. 0	23.4	7.3	297	7.9			10	10

Each beaker fed 0.5 ml YTC suspension. Initials: GB

Day 3 (9/13/13) YL/GB

Conc. (g/L)	Temp. (deg.C)	pH	Cond. (umhos/cm)	DO (ppm)	Hardness (mg/L)	Alkalinity (mg/L)	Survivors A	Survivors B
1. 1	—	—	—	—			0	0
2. 0.5	23.1	7.7	1155	7.7			1(10)	1(10)
3. 0.25	23.2	7.6	722	7.6			10	10
4. 0.125	23.2	7.5	521	7.9			10	10
5. 0.063	23.1	7.6	411	7.7			10	10
6. 0	23.3	7.5	297	7.6			10	10

Day 4 (9/14/13) GB

Conc. (g/L)	Temp. (deg.C)	pH	Cond. (umhos/cm)	DO (ppm)	Hardness (mg/L)	Alkalinity (mg/L)	Survivors A	Survivors B
1. 1	—	—	—	—	—	—	0	0
2. 0.5	24.0	7.7	1178	7.6			1	0(10)
3. 0.25	23.9	7.7	732	7.4			9(10)	9(10)
4. 0.125	23.9	7.7	539	7.5			10	10
5. 0.063	23.9	7.7	428	7.5			10	10
6. 0	23.8	7.7	309	7.4	94	70	10	10

Mean
SD (SEE PAGE 8)
n

Chesapeake Cultures
P.O. Box 507 Hayes, VA 23072 (804)693-4046 (804)694-4704 fax
www.c-cultures.com
growfish@c-cultures.com

Shipment Information

Species Hyalella azteca

Date 9/6/13

Age ~3-4 days 1.2-1.5 mm

P.O. No. verbal

Quantity 975+

Invoice No. 8089

Temperature 24°C Salinity — pH 7.96

Notes

Biologist

Rec'd 9-7-13 GAB

Please inspect shipment and report any problem immediately

Acute 96-hr Toxicity Test-96 Hr Survival

Start Date:	9/10/2013 11:05	Test ID:	999-3208	Sample ID:	REF-Ref Toxicant
End Date:	9/14/2013 11:20	Lab ID:	ORNAS-Northwestern Aquati	Sample Type:	KCL-Potassium chloride
Sample Date:		Protocol:	NASXXXHA1	Test Species:	HA-Hyalella azteca
Comments:					

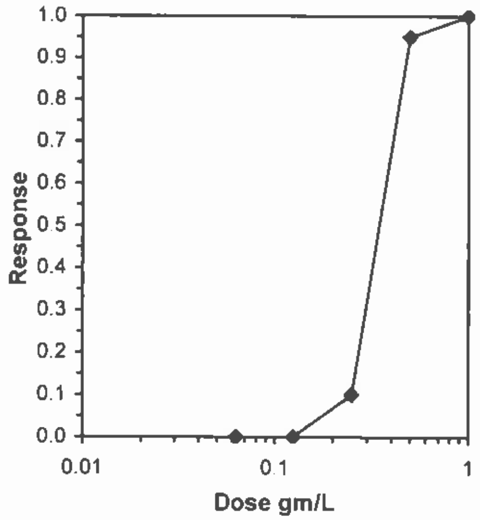
Conc-gm/L	1	2
D-Control	1.0000	1.0000
0.063	1.0000	1.0000
0.125	1.0000	1.0000
0.25	0.9000	0.9000
0.5	0.1000	0.0000
1	0.0000	0.0000

			Transform: Arcsin Square Root					Number	Total
Conc-gm/L	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
D-Control	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	2	0	20
0.063	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	2	0	20
0.125	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	2	0	20
0.25	0.9000	0.9000	1.2490	1.2490	1.2490	0.000	2	2	20
0.5	0.0500	0.0500	0.2403	0.1588	0.3218	47.963	2	19	20
1	0.0000	0.0000	0.1588	0.1588	0.1588	0.000	2	20	20

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Normality of the data set cannot be confirmed				
Equality of variance cannot be confirmed				

Trimmed Spearman-Karber

Trim Level	EC50	95% CL	
0.0%	0.3415	0.3044	0.3831
5.0%	0.3435	0.3040	0.3881
10.0%	0.3464	0.3233	0.3711
20.0%	0.3464	0.3233	0.3711
Auto-0.0%	0.3415	0.3044	0.3831



Reviewed by:_____

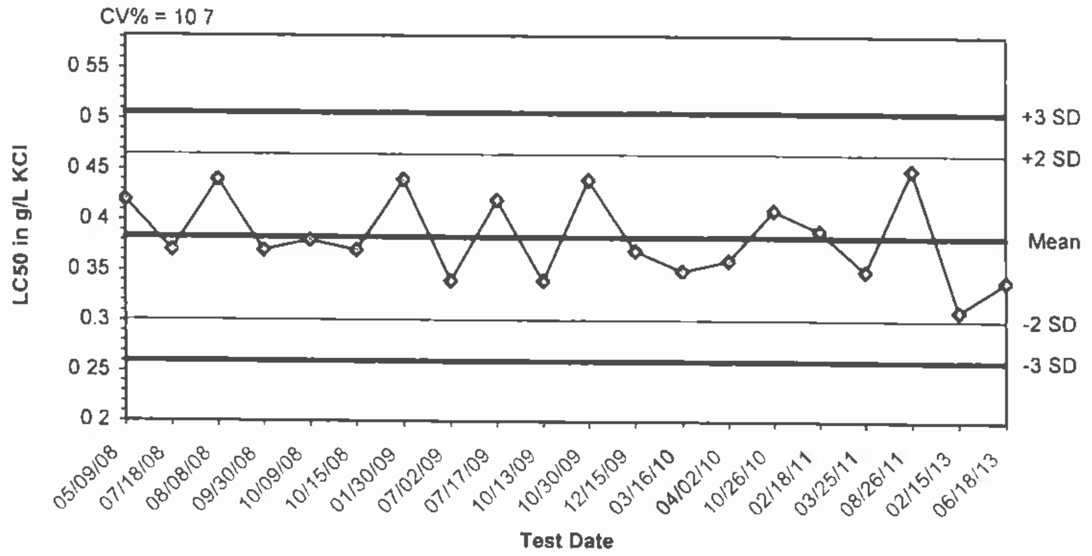
Test: AT-Acute 96-hr Toxicity Test
Species: HA-Hyalella azteca
Sample ID: REF-Ref Toxicant
Start Date: 9/10/2013 11:05
End Date: 9/14/2013 11:2
Test ID: 999-3208
Protocol: NASXXXHA1
Sample Type: KCL-Potassium chloride
Lab ID: ORNAS-Northwestern Aquatic Sciences

Pos	ID	Rep	Group	Start	24 Hr	48 Hr	72 Hr	96 Hr	Notes
	1	1	D-Control	10				10	
	2	2	D-Control	10				10	
	3	1	0.063	10				10	
	4	2	0.063	10				10	
	5	1	0.125	10				10	
	6	2	0.125	10				10	
	7	1	0.250	10				9	
	8	2	0.250	10				9	
	9	1	0.500	10				1	
	10	2	0.500	10				0	
	11	1	1.000	10				0	
	12	2	1.000	10				0	

Comments:
data entry verified against laboratory bench sheets 10.23.13 JDF

Reviewed by:_____

Amphipod, Hyalella azteca, acute reference toxicant test



Dates	Values	Mean	-2 SD	-3 SD	+2 SD	+3 SD
05/09/08	0.4200	0.3830	0.3009	0.2598	0.4651	0.5062
07/18/08	0.3700	0.3830	0.3009	0.2598	0.4651	0.5062
08/08/08	0.4400	0.3830	0.3009	0.2598	0.4651	0.5062
09/30/08	0.3700	0.3830	0.3009	0.2598	0.4651	0.5062
10/09/08	0.3800	0.3830	0.3009	0.2598	0.4651	0.5062
10/15/08	0.3700	0.3830	0.3009	0.2598	0.4651	0.5062
01/30/09	0.4400	0.3830	0.3009	0.2598	0.4651	0.5062
07/02/09	0.3400	0.3830	0.3009	0.2598	0.4651	0.5062
07/17/09	0.4200	0.3830	0.3009	0.2598	0.4651	0.5062
10/13/09	0.3400	0.3830	0.3009	0.2598	0.4651	0.5062
10/30/09	0.4400	0.3830	0.3009	0.2598	0.4651	0.5062
12/15/09	0.3700	0.3830	0.3009	0.2598	0.4651	0.5062
03/16/10	0.3500	0.3830	0.3009	0.2598	0.4651	0.5062
04/02/10	0.3600	0.3830	0.3009	0.2598	0.4651	0.5062
10/26/10	0.4100	0.3830	0.3009	0.2598	0.4651	0.5062
02/18/11	0.3900	0.3830	0.3009	0.2598	0.4651	0.5062
03/25/11	0.3500	0.3830	0.3009	0.2598	0.4651	0.5062
08/26/11	0.4500	0.3830	0.3009	0.2598	0.4651	0.5062
02/15/13	0.3100	0.3830	0.3009	0.2598	0.4651	0.5062
06/18/13	0.3400	0.3830	0.3009	0.2598	0.4651	0.5062

data entry verified against laboratory bench sheets 10-15-13 JRF

Water Quality Data - test #999-3208 Hyalella KCl QC test

Day	Concentration (g/L)	Temperature	pH	Conductivity	DO	Hardness	Alkalinity
0	1	24.0	7.8	1970	8.3	94	60
0	0.5	23.9	7.7	1161	8.3		
0	0.25	24.0	7.6	731	8.3		
0	0.125	23.8	7.6	508	8.3		
0	0.063	23.9	7.5	400	8.3		
0	0	23.9	7.5	290	8.3	86	60
1	1	23.8	7.6	1902	7.9		
1	0.5	23.7	7.7	1110	7.7		
1	0.25	23.9	7.6	706	7.5		
1	0.125	23.7	7.6	500	7.5		
1	0.063	23.7	7.5	402	7.5		
1	0	23.9	7.5	287	7.5		
2	1	23.7	7.5	1960	7.7		
2	0.5	23.5	7.4	1154	7.9		
2	0.25	23.6	7.4	728	7.9		
2	0.125	23.4	7.4	516	8.1		
2	0.063	23.2	7.3	409	7.9		
2	0	23.4	7.3	297	7.9		
3	1						
3	0.5	23.1	7.7	1155	7.7		
3	0.25	23.2	7.6	722	7.6		
3	0.125	23.2	7.5	521	7.9		
3	0.063	23.1	7.6	411	7.7		
3	0	23.3	7.5	297	7.6		
4	1						
4	0.5	24.0	7.7	1178	7.6		
4	0.25	23.9	7.7	732	7.4		
4	0.125	23.9	7.7	539	7.5		
4	0.063	23.9	7.7	428	7.5		
4	0	23.8	7.7	309	7.4	94	70
	MEAN	23.7	7.6		7.8	91	63
	SD	0.3	0.1		0.3	5	6
	N	28	28		28	3	3
	MIN	23.1	7.3		7.4	86	60
	MAX	24.0	7.8		8.3	94	70
		MEAN 1.0 g/L		1944			
		SD		37			
		N		3			
		MEAN 0 g/L		296			
		SD		8			
		N		5			

Report

of

Test No. 848-2

Assessment of Freshwater Sediments as part of the Monte Cristo Mining Area Remedial Investigation, Phase 3, using a 20-day midge, *Chironomus dilutus*, Sediment Bioassay.

Submitted to

Hart Crowser, Inc.
120 Third Avenue South, Suite 110
Edmonds, WA 98020

Submitted by

Northwestern Aquatic Sciences
3814 Yaquina Bay Road
P.O. Box 1437
Newport, OR 97365

October 29, 2013

TOXICITY TEST REPORT

TEST IDENTIFICATION

Test No.: 848-2

Title: Toxicity of freshwater sediments using a 20-day Midge, *Chironomus dilutus*, sediment bioassay as part of the Monte Cristo Mining Area, Remedial Investigation, Phase 3.

Protocol No.: NAS-XXX-CT4c, October 18, 2000. Revision 1 (11-08-03). Based on ASTM 2001 (Standard test methods for measuring the toxicity of sediment-associated contaminants with fresh water invertebrates, E1706-00), Am. Soc. Test. Mat., Phila., PA, and EPA Method 100.2 (Methods for measuring the toxicity and bioaccumulation of sediment-associated contaminants with freshwater invertebrates, EPA/600/R-99/064).

STUDY MANAGEMENT

Study Sponsor: Hart Crowser, Inc., 120 Third Avenue South, Suite 110, Edmonds, WA 98020

Sponsor's Study Monitor: Ms. Michelle Havey

Testing Laboratory: Northwestern Aquatic Sciences, P.O. Box 1437, Newport, OR 97365

Test Location: Newport laboratory

Laboratory's Study Personnel: G.J. Irissarri, B.S., Proj. Man./Study Dir.; L.K. Nemeth, B.A., M.B.A., QA Officer; R.S. Caldwell, PhD, Sr. Toxicologist; G.A. Buhler, B.S., Aq. Toxicologist; Y. Nakahama, Sr.Tech.; S.F. Knowlton, B.S., Tech.; S. Gage, B.A., Tech.

Study Schedule:

Test Beginning: 9-10-13, 1600 hrs.
Test Ending: 9-30-13, 1530 hrs.

Disposition of Study Records: All raw data, reports and other study records are stored at Northwestern Aquatic Sciences, 3814 Yaquina Bay Rd., Newport, OR 97365.

Statement of Quality Assurance: The test data were reviewed by the Quality Assurance Unit to assure that the study was performed in accordance with the protocol and standard operating procedures. This report is an accurate reflection of the raw data.

Test Sediments: Freshwater test sediments collected as part of the Monte Cristo Mining Area, Remedial Investigation, Phase 3. Details are as follows:

NAS Sample No.	4562G	4563G	4564G	4565G
Description	HC-SFSR-09	HC-SFSR-07	HC-MCL	HC-SFSR-03
Collection Date	8/28/13	8/22/13	8/27/13	8/23/13
Receipt Date	8/31/13	8/31/13	8/31/13	8/31/13

NAS Sample No.	4566G	4567G	4568G
Description	HC-GC-01	HC-GC-05	HC-76-02
Collection Date	8/24/13	8/25/13	8/26/13
Receipt Date	8/31/13	8/31/13	8/31/13

Control Sediment: The negative control sediment (NAS#4569G) was collected on 9-1-13 from an area approximately one mile east of the Hwy. 101 bridge at Beaver Creek, approx. 8 miles south of Newport, OR.

Treatments: Homogenized at test set up by mixing using stainless steel implements.

Storage: All test and control sediments were stored at 4°C in the dark in sealed containers until used.

TEST WATER

Source: Dechlorinated municipal tap water.

Date of Preparation: Two batches of test water were collected on: 9/5/13, 9/22/13

Water Quality:

pH: 7.3, 7.7
conductivity: 102, 98 μmhos/cm^2
hardness: 26, 26 mg/L as $CaCO_3$

alkalinity: 40, 40 mg/L as $CaCO_3$.
total chlorine: All batches were < 0.02 mg/L
Pretreatment: Dechlorinated and aerated ≥24 hr.

TEST ORGANISMS

Species: *Chironomus dilutus* (formerly *C. tentans*), midge.
Size: 1st instar
Source: NAS cultures, originally obtained from EPA, Duluth, MN.
Acclimation: Holding conditions for the four days prior to testing averaged: Temperature, 22.4 ± 2.4 °C; dissolved oxygen, 8.4 ± 0.7 mg/L; pH, 7.7 ± 0.5; conductivity, 159 ± 45 µmhos/cm; hardness, 30 ± 5 mg/L as $CaCO_3$; and alkalinity, 40 ± 12 mg/L as $CaCO_3$. Photoperiod was 16:8, L:D.

TEST PROCEDURES AND CONDITIONS

The following is an abbreviated statement of the test procedures and a statement of the test conditions actually employed. See the test protocol (Appendix I) for a more detailed description of the test procedures used in this study.

Test Chambers: 300 ml high-form glass beakers
Test Volumes: 100 ml sediment layer; 175 ml test water.
Replicates/Treatment: 8 (plus an additional replicate for day 20 interstitial sulfide & ammonia measurements)
Organisms/Treatment: 80
Water Volume Changes: 2 water volumes per day
Aeration: None.
Feeding: Animals were fed 1.5 ml of Tetra Fin suspension (1.5 ml contains 6 mg dry solids) per beaker daily.
Effects Criteria: 1) survival after 20 days, and 2) average individual biomass (based on ash-free dry weight) after 20 days. Death is defined as no visible movement or response to tactile stimulation. Missing organisms were considered to be dead.
Water Quality and Other Test Conditions: The temperature, dissolved oxygen, conductivity, pH, hardness, alkalinity and ammonia-nitrogen were measured in the overlying water of one replicate test container per treatment on days 0 and 20 of the test. Temperature was measured daily, pH and dissolved oxygen three times per week, and conductivity weekly, in the overlying water of one replicate test container per treatment. Hardness and alkalinity were measured with titrimetric methods. Total ammonia and sulfide were measured in the pore water from the bulk sediment at test initiation and in an added replicate beaker at test termination. Interstitial water samples were obtained by centrifugation. Total soluble sulfide and total ammonia-N were measured using Hach reagents based on the methylene blue (EPA Method 376.2) and salicylate (Clin. Chim. Acta 14:403, 1996) colorimetric methods, respectively; samples were not distilled prior to analysis. The photoperiod was 16:8, L:D.

DATA ANALYSIS METHODS

Survival and individual biomass were calculated for each replicate as follows:

percent survival = 100 x (number surviving/initial number tested)
average individual ash-free dry wt. = (ash-free dry wt.)/number weighed,
where:
ash-free dry wt. = dry weight of organisms recovered on day 10 – ashed dry weight, in mg

Means and standard deviations for the biological endpoints described above, and for water quality data, were computed using Microsoft Excel 2010.

PROTOCOL DEVIATIONS

None

REFERENCE TOXICANT TEST

The reference toxicant test is a multi-concentration toxicity test using potassium chloride, to evaluate the performance of the test organisms used in the sediment toxicity test. The performance is evaluated by comparing the results of this test with historical results obtained at the laboratory. A summary of the reference toxicant test result is given below. The reference toxicant test raw data are found in Appendix III.

Test No.: 999-3209
Reference Toxicant and Source: Potassium Chloride (KCl), Fisher Lot #114689.
Test Date: 9-10-13.
Dilution Water Used: Moderately hard synthetic water prepared from Milli-Q® deionized water.
Result: 96-hr LC50, 3.30 g/L. This result is within the laboratory's control chart warning limits (1.56 – 3.59 g/L).

TEST RESULTS

Observations of water quality in the overlying water throughout the test are summarized in Table 1. A detailed tabulation of the water quality results by sample and test day can be found in Appendix II. Interstitial ammonia and sulfide measurements are listed in Table 2. The means and standard deviations of percent mortality and growth (ash-free dry wt.) of midges exposed for 20 days to sediments are summarized in Table 3. Detailed data organized by sample and replicate, and summary statistics for these observations, are given in Appendix II.

All water quality observations of overlying water temperature and dissolved oxygen were within the protocol specified ranges. Ammonia-N in the overlying water ranged between <0.1 and 0.6 mg/L for all day 0 and day 20 measurements. Interstitial bulk sediment values for ammonia-N for all initial and day 20 measurements ranged from <0.5 to 1.1 mg/L. Interstitial bulk sediment values for total sulfides for all initial and day 20 measurements were <0.1 mg/L.

The test met the survival and weight acceptability criteria specified in the test protocol with 20.0% mean control mortality (≤30% required) and a control individual mean ash-free dry weight of 2.04 mg per larvae (0.48 mg required). The reference toxicant (positive control) EC50 result was within the laboratory's control chart limits (3.30 g/L; control chart mean ± 2 S.D. = 2.58 ± 1.02). It is concluded, therefore, that the test has developed fully acceptable data for use in making management decisions.

STUDY APPROVAL

Gerald Irissarri 10-27-13
Project Manager/Study Director Date

Julie R. Fiore 10-28-13
Quality Assurance Unit Date

Linda K. Nemeth 10/23/13
Assistant Laboratory Director Date

Table 1. Summary of water quality conditions during tests of the midge, *Chironomus dilutus*, exposed to freshwater sediments.

Water Quality Parameter	Mean ± S.D.	Minimum	Maximum	N
Temperature (°C)	22.9 ± 0.3	22.2	23.5	168
Dissolved oxygen (mg/L)	5.2 ± 1.1	3.5	7.9	80
Conductivity (µmhos/cm)	108 ± 5	99	121	40
pH	6.9 ± 0.3	6.3	7.5	80
Hardness (mg/L as $CaCO_3$)	26 ± 6	17	34	16
Alkalinity (mg/L as $CaCO_3$)	36 ± 5	30	40	16
Total ammonia (mg/L)	---	<0.1	0.6	16

Table 2. Interstitial total ammonia-N and dissolved sulfide in test sediments porewater prior to test initiation and at test termination.

NAS Sample No.	Sample Description	Bulk Sediment		Test Termination	
		Ammonia (mg/L)	Sulfide (mg/L)	Ammonia (mg/L)	Sulfide (mg/L)
4569G	Control	1.0	<0.1	1.1	<0.1
4562G	HC-SFSR-09	0.8	<0.1	<0.5	<0.1
4563G	HC-SFSR-07	<0.5	<0.1	<0.5	<0.1
4564G	HC-MCL	0.9	<0.1	0.9	<0.1
4565G	HC-SFSR-03	<0.5	<0.1	0.5	<0.1
4566G	HC-GC-01	<0.5	<0.1	0.7	<0.1
4567G	HC-GC-05	0.5	<0.1	1.0	<0.1
4568G	HC-76-02	<0.5	<0.1	0.9	<0.1

Table 3. Mortality and growth results of *Chironomus dilutus* 20-day sediment toxicity test

NAS Sample No.	Sample Description	Percent mortality (Mean ± SD)	Average ash-free dry wt/midge (mg)* (Mean ± SD)
4569G	Control	20.0 ± 7.6	2.04 ± 0.63
4562G	HC-SFSR-09	28.8 ± 14.6	2.03 ± 0.83
4563G	HC-SFSR-07	25.0 ± 10.7	1.75 ± 0.22
4564G	HC-MCL	25.0 ± 12.0	1.46 ± 0.22
4565G	HC-SFSR-03	31.3 ± 11.3	1.84 ± 0.23
4566G	HC-GC-01	16.3 ± 10.6	2.04 ± 0.88
4567G	HC-GC-05	16.3 ± 14.1	1.70 ± 0.26
4568G	HC-76-02	36.3 ± 20.7	2.14 ± 0.67

*Pupae were not included in the sample to estimate ash-free dry weight (as per EPA/600/R-99/064, p. 59, section 12.3.8.2)

APPENDIX I

PROTOCOL

TEST PROTOCOL

FRESHWATER MIDGE, *CHIRONOMUS TENTANS*, 20-DAY SEDIMENT TOXICITY TEST

1. INTRODUCTION

1.1 Purpose of Study: The purpose of this study is to characterize the toxicity of freshwater sediments based on midge survival and growth using the midge, *Chironomus tentans*.

1.2 Referenced Method: This protocol is based on EPA Method 100.5 (EPA/600/R-99/064) and ASTM Method E 1706-00 (ASTM 2001).

1.3 Summary of Method: A summary of test conditions for the midge 20-day sediment toxicity test is tabulated below. The 20-day sediment toxicity test with *Chironomus tentans* is conducted at 23°C with a 16L:8D photoperiod at an illuminance of about 100-1000 lux. Test chambers are 300-mL high-form lipless beakers containing 100 mL of sediment and 175 mL of overlying water. Ten <24 hour-old (first-instar) midge larvae are used in each replicate. The number of replicates/treatment depends on the objective of the test. Eight replicates are recommended for routine testing. Midges in each test chamber are fed 1.5 mL (conatins 6.0 mg of dry solids) of fish food flakes suspension daily. Each chamber receives two volume additions per day of overlying water. Overlying water can be culture water, well water, surface water, site water, or reconstituted water. Test endpoints include survival and growth (dry weight or ash-free dry weight (AFDW)).

2. STUDY MANAGEMENT

2.1 Sponsor's Name and Address:

____
____
____
____

2.2 Sponsor's Study Monitor:

____

2.3 Name of Testing Laboratory:
Northwestern Aquatic Sciences
3814 Yaquina Bay Road, P.O. Box 1437
Newport, OR 97365.

2.4 Test Location: ______________________

2.5 Laboratory's Personnel to be Assigned to the Study:
Study Director: ____________________
Quality Assurance Unit: ____________________
Aquatic Toxicologist: ____________________
Aquatic Toxicologist: ____________________

2.6 Proposed Testing Schedule: Sediments should be tested sometime between sediment collection and 8 weeks storage. Sediments that contain high concentrations of labile chemicals such as ammonia and volatile organics should be tested as soon as possible after collection, but no later than within two weeks. A 96-hr, water-only reference toxicant test may be run concurrently, or periodic reference toxicant tests run on cultures may be used to assess organism sensitivity.

2.7 Good Laboratory Practices: The test is conducted following the principles of Good Laboratory Practices (GLP) as defined in the EPA/TSCA Good Laboratory Practice regulations revised August 17, 1989 (40 CFR Part 792).

3. TEST MATERIAL

The test materials are freshwater sediments. The control, reference, and test sediments are placed in solvent cleaned 1 L glass jars fitted with PTFE-lined screw caps. At the laboratory the samples are stored at 4°C in the dark. The original sealed containers may be stored for up to 8 weeks prior to testing, depending on the testing requirements. If jars are not full when received or if sediment is removed for testing, headspaces may be filled with nitrogen to retard deterioration, depending on testing requirements. A negative control sediment is collected from a clean site. In addition, a reference sediment, a clean sediment with physical characteristics similar to the test sediments, is normally employed as a comparison station. Test sediments should be homogenized before use in a test.

4. TEST WATER

Test water (overlying water) at NAS is normally *C. tentans* culture water, which is moderately hard synthetic water at a hardness of 80-100 mg/L as $CaCO_3$ and alkalinity of 60-70 mg/L as $CaCO_3$. Dilution water is prepared from Milli-Q reagent grade water and reagent grade chemicals. Test water may also be well water, surface water or site water depending on the study design.

5. TEST ORGANISMS

5.1 Species: midge, *Chironomus tentans*.

5.2 Source: Cultured at NAS (originally obtained from U.S. EPA Environmental Research Lab, Duluth, MN) or purchased from a reputable commercial supplier.

5.3 Age: < 24 hour-old (first instar) larvae

5.4 Acclimation and Pretest Observation: Cultures are maintained at approximately 23°C under a 16:8 L:D photoperiod. The culture water is moderately hard synthetic water. Midges are fed *Selenastrum* algae and finely ground Tetrafin flakes in suspension (10g Tetrafin in 100 mL Milli-Q water).

6. DESCRIPTION OF TEST SYSTEM

6.1 Test Chambers and Environmental Control: Test chambers used in the toxicity test are 300-mL high-form lipless glass beakers (Pyrex® 1040 or equivalent). Test chambers are maintained at constant temperature by partial immersion in a temperature-controlled water bath or by placement in a temperature-controlled room. Aeration is not empolyed unless dissolved oxygen drops below 2.5 mg/L. The test is conducted under an illuminance of 100-1000 lux with a 16L:8D photoperiod.

6.2 Cleaning: All laboratory glassware, including test chambers, is cleaned as described in EPA/600/4-90/027F. New glassware and test systems are soaked 15 minutes in tap water and scrubbed with detergent (or cleaned in automatic dishwasher); rinsed twice with tap water; carefully rinsed once with fresh, dilute (10%, V:V) hydrochloric or nitric acid to remove scale, metals, and bases; rinsed twice with deionized water; rinsed once with acetone to remove organic compounds (using a fume hood or canopy); and rinsed three times with deionized water. Test systems and chambers are rinsed again with dilution water just before use.

7. EXPERIMENTAL DESIGN AND TEST PROCEDURES

7.1 Experimental Design: The test involves exposure of midge larvae to test, control, and reference sediments. The sediments are placed on the bottom of the test containers and are overlain with test water. The test exposure is for 20 days. The renewal of overlying water consists of two volume additions per day, either continuous or intermittent. Each treatment consists of eight replicate test containers, each containing 10 organisms. Test chamber positions are completely randomized. Test organisms are randomly distributed to the test chambers. Blind testing is normally used.

7.2 Setup of Test Containers: Sediments are homogenized and placed in test chambers on the day before addition of test organisms. Sediment (100 ml) is placed into each of eight replicate beakers. After addition of the sediment, 175 ml of test water is gently added to each beaker in a manner to prevent resuspension. The overlying water is replaced twice daily. The test begins when midges are introduced to the test chambers. Initial water quality measurements are taken prior to the addition of test organisms.

7.3 Effect Criteria: The effect criteria used in the midge bioassay are survival (mortality) and growth. Mortality is defined as the lack of movement of body or appendages on response to tactile stimulation. Growth is determined by using either dry weight or ash-free dry weight measurements.

7.4 Test Conditions: No aeration is employed unless dissoved oxygen falls below 2.5 mg/L. The test temperature employed is 23°C (range of ± 1°C). A 16:8, L:D photoperiod is used. Illumination is supplied by daylight fluorescent lamps at 100-1000 lux. The overlying water is replaced twice daily.

7.5 Beginning the Test: The test is begun by adding the organisms to the equilibrated test containers as previously described.

7.6 Feeding: Midge larvae are fed 1.5 mL daily per test chamber (1.5 mL contains 6.0 mg of dry solids). A feeding may be skipped if there is a build up of excess food. However, all beakers must be treated similarly.

7.7 Test Duration, Type and Frequency of Observations, and Methods: The duration of the toxicity test is 20 days. The type and frequency of observations to be made are summarized as follows:

Type Of Observation	Times Of Observation
Biological Data	
Survival, growth	Day 20
Physical And Chemical Data	
Hardness, alkalinity, ammonia-N, conductivity, pH, dissolved oxygen, and temperature	Beginning and end of test in overlying water of one replicate beaker from each treatment.
Temperature	Daily
DO & pH	3X/week
Conductivity	Weekly

Dissolved oxygen is measured using a polarographic oxygen probe calibrated according to the manufacturer's recommendations. The pH is measured using a pH probe and a properly calibrated meter with scale divisions of 0.1 pH units. Temperature is measured with a calibrated mercury thermometer or telethermometer. Conductivity is measured with a conductivity meter. Hardness and alkalinity are measured using titrometric methods. Ammonia-nitrogen is measured using the salicylate colerimetric method (Clin. Chim. Acta 14:403, 1996).

7.8 Growth Measurement: Growth is measured as ash-free dry weight (AFDW) of animals in a test replicate at the end of the test on day 10. Pooled animals from each test replicate are rinsed with deionized water, gently blotted and placed into tared aluminum weigh pans. The pans are dried at 60-90°C to constant weight. The dried organisms are placed into a dessicator and weighed as soon as possible to the nearest 0.01 mg (desirable to use 0.001 mg). The total weight of the dried midge in each pan is divided by the number of midge weighed to obtain an average dry weight per midge. The dried larvae in the pan are then ashed at 550°C for two hours. The pan with tthe ashed larvae is then reweighed and the tissue mass of the larvae is determined as teh difference between the weight of the dried larvae plus pan and the weight of the ashed larvae plus pan. Pupae or adult organisms are not included in the sample to estimate AFDW.

8. CRITERIA OF TEST ACCEPTANCE

The test results are acceptable if the minimum survival of organisms in the control treatment at the end of the test is at least 70% and the average dry weight of *C. tentans* in the surviving controls is at least 0.6 mg (or 0.48mg/surviving organism as AFDW).

9. DATA ANALYSIS

The endpoints of the toxicity test are survival and growth. Survival is obtained as a direct count of living organisms in each test container at the end of the test. Average midge dry weight or ash-free dry weight, also measured at the end of the test, may be used to compare growth between treatment sediments and the control or reference sediment. Ordinarily the following data analysis is performed. Due to special requirements, alternative methods may be used. The means and standard deviations are calculated for each treatment level. Identification of toxic sediments is established by statistical comparison of test endpoints between test and control or reference sediments. Between treatment comparisons may be made using a Student's t-test or Wilcoxon's Two-Sample test, where each treatment is compared to the control or the reference sediment. An arcsine-square root transformation of proportional data, and tests for normality and heterogeneity of variances, are performed prior to statistical comparisons.

10. REPORTING

The final report of the test results must include all of the following standard information at a minimum: name and identification of the test; the investigator and laboratory; date and time of test beginning and end; information on the test material; information on the source and quality of the overlying/test water; detailed information about the test organisms including acclimation conditions; a description of the experimental design and test chambers and other test conditions including feeding, if any, and water quality; definition of the effect criteria and other observations; responses, if any, in the control treatment; tabulation and statistical analysis of measured responses and a summary table of endpoints; a description of the statistical methods used; any unusual information about the test or deviations from procedures; reference toxicant testing information.

11. STUDY DESIGN ALTERATION

Amendments made to the protocol must be approved by the sponsor and study director and should include a description of the change, the reason for the change, the date the change took effect and the dated signatures of the study director and sponsor. Any deviations in the protocol must be described and recorded in the study raw data.

12. REFERENCE TOXICANT

The reference toxicant test is a standard multi-concentration toxicity test using a specified chemical toxicant to evaluate the performance of test organisms used in the study. Reference toxicant tests are 96-hour, water only exposures, not 20-day sediment exposures. The reference toxicant test is normally run concurrently; however, for this 20-day test periodic reference toxicant tests run on the cultures may be used to evaluate organism sensitivity. Performance is evaluated by comparing the results of the reference toxicant test with historical results (e.g., control charts) obtained at the laboratory.

13. REFERENCED GUIDELINES

ASTM. 2001. Standard Test Methods for Measuring the Toxicity of Sediment-associated Contaminants with Freshwater Invertebrates. ASTM Standard Method No. E 1706-00. Am. Soc. Test. Mat., Philadelphia, PA.

U.S. EPA. 2000. Test Method 100.5, Life-cycle Test for measuring the Effects of Sediment-associated Contaminants on *Chironomus tentans*, pp. 84-91. In: Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates. Second edition. EPA/600/R-99/064.

Weber, C.I. (Ed.) 1993. Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms (Fourth Edition). EPA/600/4-90/027F.

14. APPROVALS

______________________________ for ______________________
Name Date

______________________________ for Northwestern Aquatic Sciences
Name Date

Appendix A
Test Conditions Summary

1. Test type	whole sediment toxicity test with renewal of overlying water
2. Test duration	20 days
3. Temperature	23 ± 1°C
4. Light quality	daylight flourescent light
5. Illuminance	100-1000 lux
6. Photoperiod	16L:8D
7. Test chamber size	300-mL high-form lipless beakers (Pyrex® 1040 or equivalent)
8. Sediment volume	100 mL
9. Overlying water volume	175 mL
10. Renewal overlying water	2 volume additions/day (continuous or intermittent)
11. Age of test organisms	< 24 hour-old (first instar) larvae
12. Organisms per test chamber	10
13. Replicates per treatment	8 recommended for routine testing (depends on design)
14. Organisms per treatment	80
15. Feeding regime	Fish food flakes, fed 1.5 mL daily/chamber (1.5 mL contains 6.0 mg of dry solids)
16. Aeration	None, unless DO falls below 2.5 mg/L
17. Overlying (test) water	Culture water, well water, surface water, site water or reconstituted water
18. Water quality	Hardness, alkalinity, conductivity, and ammonia-N beginning and end; temperature daily; dissolved oxygen, pH 3X/week and conductivity weekly
19. Endpoints	Survival and growth (ash-free dry weight.)
20. Test acceptability criteria	Minimum control survival of 70%; mean AFDW of surviving control organisms = 0.48 mg
21. Sample holding	up to 8 weeks at 4°C in the dark (14 days when volatiles in sediments)
22. Sample volume required	1L (800 mL per sediment)
23. Reference toxicant	KCl

APPENDIX II

RAW DATA

TEST DESCRIPTION, MONITORING, AND RESULTS BENCHSHEETS

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-CT4c

CHIRONOMUS DILUTUS 20-DAY SOLID PHASE SEDIMENT TEST

Test No. 848-~~1~~ 2 GJI 9-10-13 Client Hart Crowser Investigator REVIEWED PAGES 1-36 -GJI

STUDY MANAGEMENT

Client: Hart Crowser, Inc., 120 Third Avenue South, Suite 110, Edmonds WA 98020
Client's Study Monitor: Ms. Michelle Havey
Testing Laboratory: Northwestern Aquatic Sciences
Test Location: Newport Laboratory
Laboratory's Study Personnel:
Proj. Man./Study Dir. G.J. Irissarri GJI
QA Officer L.K. Nemeth
1. Wes Nakahara
2. GA Buhler GAB
3. Susan Gage
4. S F Knowlton SK
5. R.S. CALDWELL
6.
7.
8.

Study Schedule:
Test Beginning: 9-10-13 1600 Test Ending: 9-30-13 1530

TEST MATERIAL

General description (see sample logbook/chain-of-custody for details):

NAS Sample No.:	4562G	4563G	4564G	4565G	4566G
Description:	HC-SFSR-09	HC-SFSR-07	HC-MCL	HC-SFSR-03	HC-GC-01
Collection Date:	8/28/13	8/22/13	8/27/13	8/23/13	8/24/13
Receipt Date:	8/31/13	8/31/13	8/31/13	8/31/13	8/31/13
:					

NAS Sample No.:	4567G	4568G			
Description:	HC-GC-05	HC-76-02			
Collection Date:	8/25/13	8/26/13			
Receipt Date:	8/31/13	8/31/13			
:					

NAS Sample No.:					
Description:					
Collection Date:					
Receipt Date:					
:					

NAS Sample No.:					
Description:					
Collection Date:					
Receipt Date:					
:					

NAS Sample No.:					
Description:					
Collection Date:					
Receipt Date:					
:					

Error codes: 1) correction of handwriting error
2) written in wrong location; entry deleted
3) wrong date deleted, replaced with corrrect date
4) error found in measurement; measurement repeated

NORTHWESTERN AQUATIC SCIENCES
PROTOCOL NO. NAS-XXX-CT4c
CHIRONOMUS DILUTUS 20-DAY SOLID PHASE SEDIMENT TEST

Test No. 848-2 Client Hart Crowser Investigator ______

SEDIMENT DESCRIPTIONS – SUPPLEMENTAL NOTES

Sample No.	Description
4569G	Black fine mud
4562G	Small amount of coarse sand with Rocks
4563G	Coarse sand with white, brown and orange pieces.
4564G	Dark brown thick mud with plant debris + pine cones
4565G	Brown coarse sand and gravel
4566G	Brown medium size gravel with sand.
4567G	Dark brown coarse sand with small rocks + some plant debris
4568G	Brown coarse sand with medium gravel

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-CT4c

CHIRONOMUS DILUTUS. 20-DAY SOLID PHASE SEDIMENT TEST

Test No. 848-2 Client Hart Crowser Investigator

TEST WATER

Source: Dechlorinated Newport, OR tap water
Date of Collection: 9-5-13, 9-22-13
pH 7.3, 7.7
Cond (umhos/cm2) 102, 98
Hardness (mg/L) 26, 26
Alkalinity (mg/L) 40, 40
Total Chlorine (mg/L) <0.02, <0.02
Treatments: AERATED ≥ 24 HRS

TEST ORGANISMS

Species: *Chironomus dilutus* Age: <24 HRS 1st instar
Source: NAS CULTURES Date received: —

Acclimation Data:

Date	Temp. (deg.C)	pH	DO (mg/L)	Cond. umhos/cm	Hardness (mg/L)	Alkalinity (mg/L)	Feeding	Water changes
9-7-13	21.9	7.1	8.5	129	26	30	None	NONE
9-8-13	19.3	8.3	9.1	123	34	30	↓	↓
9-9-13	24.2	7.9	8.3	161	26	50		
9-10-13	24.3	7.6	7.5	222	34	50		
Mean	22.4	7.7	8.4	159	30	40		
S.D.	2.4	0.5	0.7	45	5	12		
(N)	4	4	4	4	4	4		

Photoperiod during acclimation: 16:8, L:D

TEST PROCEDURES AND CONDITIONS

Test chambers: 300 ml glass beakers
Test volumes: 100 ml of test sediment; 275 ml total volume
Replicates/treatment: (8) 8 (PLUS Organisms/treatment: (80) 80 (10/REP)
Test water changes: Twice daily ONE ADDITIONAL REPL. FOR DAY 20 INTERSTITIAL AMMONIA & SULFDE MEASUREMENT
Aeration: only if DO falls below 2.5 mg/L Beaker placement: Total randomization
Feeding: everyday beginning with day zero Photoperiod: 16:8, L:D
Test temperature (°C): 23 ± 1

Control Sediment:

Source: From an area approximately one mile east of the Hwy. 101 bridge at Beaver Creek, approx. 8 miles south of Newport, OR.
Date collected: 9/1/13
Sieved through — -mm screen
Storage: 4°C in the dark in closed containers. NAS# 4569G

MISCELLANEOUS NOTES

Light intensity:

Date	Location	Light Intensity (ft-candles*)	Initials
9-26-13	(N) 5 $\bar{X}$ = 91.9	91.9	Y

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-CT4c

CHIRONOMUS DILUTUS 20-DAY SOLID PHASE SEDIMENT TEST

Test No. 848-2 Client Hart Crowser Investigator ________

Test conducted in (circle one): room 1 room 2 trailer water bath other: Room 3

Randomization chart: TOP SHELF

6									72
5									71
4	→								70
3									69
2									68
1									67

FRONT

Randomization chart:

Randomization chart:

Test No. 848-2 Client Hart Crowser Investigator ______

DAILY RECORD SHEET

Day 0 (9/10/13) YL/SK

Beaker No.	Temp.* (deg.C)	DO* (ppm)	Cond.* (umhos/cm)	pH*	Hardness* (mg/L)	Alkalinity* (mg/L)	NH3* (ppm)	Comments
2	22.9	6.8	120	6.7	34	40		Each beaker fed 1.5 ml
7	22.8	7.7	106	6.9	26	40		Tetra Fin suspension
10	22.7	6.5	115	6.7	34	30		Initials: GJS
32	22.5	7.7	104	6.8	34	30		
45	22.4	7.3	101	6.7	26	40		
48	22.9	7.9	105	6.8	26	40		
69	23.0	7.8	106	6.8	34	30		
72	23.1	7.9	107	6.9	26	30		
								Water changed in all
								beakers.
								Time: 0540
								Initials: GJL
								Water changed in all
								beakers.
								Time: —
								Initials: —

*Water quality measurements to be taken.

Day 1 (9/11/13) SK/YL

9/11/3 ED Y

Beaker No.	Temp.* (deg.C)	DO* (ppm)	Cond.* (umhos/cm)	pH*	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
2	23.1	5.7	119	6.6				Each beaker fed 1.5 ml
7	22.6	~~4.75~~ 9	108	6.7				Tetra Fin suspension
10	22.7	4.7	117	6.6				Initials: GJS
32	22.8	5.7	106	6.7				
45	22.5	5.9	102	6.7				
48	22.9	6.1	107	6.8				
69	23.3	5.5	109	6.7				
72	23.2	5.7	110	6.7				
								Water changed in all
								beakers.
								Time: 0555
								Initials: GJS
								Water changed in all
								beakers.
								Time: 1630
								Initials: Y

*Water quality measurements to be taken.

CHIRONOMUS DILUTUS 20-DAY SOLID PHASE SEDIMENT TEST

Test No. 848-2 Client Hart Crowser Investigator ______

DAILY RECORD SHEET

Day 2 (9/12/13) YL

Beaker No.	Temp.* (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
2	22.9							Each beaker fed 1.5 ml
7	22.9							Tetra Fin suspension
10	22.8							Initials: GB
32	22.7							
45	22.6							
48	23.0							
69	23.4							
72	23.3							
								Water changed in all
								beakers.
								Time: 0505
								Initials: GB
								Water changed in all
								beakers.
								Time: 1620
								Initials: YL

*Water quality measurements to be taken.

Day 3 (9/13/13) YL/SK

Beaker No.	Temp.* (deg.C)	DO* (ppm)	Cond. (umhos/cm)	pH*	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
2	23.0	4.8		6.5				Each beaker fed 1.5 ml
7	22.9	5.9		6.6				Tetra Fin suspension
10	22.8	4.1		6.6				Initials: YL
32	22.6	5.9		6.7				
45	22.6	5.5		6.6				
48	23.0	5.6		6.7				
69	23.3	5.7		6.8				
72	23.3	4.9		6.8				
								Water changed in all
								beakers. 9-13
								Time: 0540
								Initials: YL
								Water changed in all
								beakers.
								Time: 1120
								Initials: SK

*Water quality measurements to be taken.

Test No. 848-2 Client Hart Crowser Investigator ______

DAILY RECORD SHEET

Day 4 (9/14/13) GB

Beaker No.	Temp.* (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
2	23.1							Each beaker fed 1.5 ml
7	23.0							Tetra Fin suspension
10	22.9							Initials: GB
32	22.8							
45	22.7							
48	22.7							
69	23.3							
72	23.4							
								Water changed in all
								beakers.
								Time: 0505
								Initials: ND
								Water changed in all
								beakers.
								Time: 1640
								Initials:

*Water quality measurements to be taken.

Day 5 (9/15/13) Y/SK

Beaker No.	Temp.* (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
2	23.2							Each beaker fed 1.5 ml
7	23.1							Tetra Fin suspension
10	23.0							Initials: Y
32	22.9							
45	22.9							
48	23.1							
69	23.5							
72	23.4							
								Water changed in all
								beakers.
								Time: 0538
								Initials: Y
								Water changed in all
								beakers.
								Time: 1650
								Initials: SK

*Water quality measurements to be taken.

NORTHWESTERN AQUATIC SCIENCES
PROTOCOL NO. NAS-XXX-CT4c

CHIRONOMUS DILUTUS 20-DAY SOLID PHASE SEDIMENT TEST

Test No. 848-2 Client Hart Crowser Investigator ______

DAILY RECORD SHEET

Day 6 (9/16/13) YL/SK

Beaker No.	Temp.* (deg.C)	DO* (ppm)	Cond. (umhos/cm)	pH*	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
2	23.0	5.9		6.8				Each beaker fed 1.5 ml
7	22.9	6.1		6.8				Tetra Fin suspension
10	22.8	5.3		6.8				Initials: YL
32	22.6	6.1		6.9				
45	22.6	6.3		6.9				
48	23.0	5.8		6.9				
69	23.3	5.7		6.9				
72	23.2	5.7		7.0				
								Water changed in all
								beakers.
								Time: 0500
								Initials: Y
								Water changed in all
								beakers.
								Time: 1610
								Initials: SK

*Water quality measurements to be taken.

Day 7 (9/17/13) YL/SK

Beaker No.	Temp.* (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
2	23.1							Each beaker fed 1.5 ml
7	23.0							Tetra Fin suspension
10	22.8							Initials: Y
32	22.6							
45	22.6							
48	23.0							
69	23.3							
72	23.3							
								Water changed in all
								beakers.
								Time: 0520
								Initials: Y
								Water changed in all
								beakers.
								Time: 1600
								Initials: GB

*Water quality measurements to be taken.

NORTHWESTERN AQUATIC SCIENCES

PROTOCOL NO. NAS-XXX-CT4c

CHIRONOMUS DILUTUS 20-DAY SOLID PHASE SEDIMENT TEST

Test No. 848-2 Client Hart Crowser Investigator ____

DAILY RECORD SHEET

Day 8 (9/18/13) SK

Beaker No.	Temp.* (deg.C)	DO* (ppm)	Cond.* (umhos/cm)	pH*	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
2	23 0	4.2	121	6 3				Each beaker fed 1.5 ml
7	22.9	4.2	112	6 4				Tetra Fin suspension
10	22 8	3 5	117	6.4				Initials: GB
32	22.5	4.1	109	6 5				
45	22.5	3.8	110	6.5				
48	23 0	4.1	110	6.5				
69	23 3	3.9	112	6.6				
72	23.3	3 8	113	6.6				
								Water changed in all beakers.
								Time: 0450
								Initials: GB
								Water changed in all beakers.
								Time: 1015
								Initials: SK

*Water quality measurements to be taken.

Day 9 (9/19/13) SK

Beaker No.	Temp.* (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
2	23.0							Each beaker fed 1.5 ml
7	22.9							Tetra Fin suspension
10	22.7							Initials: GB
32	22.5							
45	22,5							
48	23.0							
69	23 4							
72	23.3							
								Water changed in all beakers.
								Time: 0450
								Initials: GB
								Water changed in all beakers.
								Time: 1015
								Initials: SK

*Water quality measurements to be taken.

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CHIRONOMUS DILUTUS 20-DAY SOLID PHASE SEDIMENT TEST

Test No. 848-2 Client Hart Crowser Investigator ______

DAILY RECORD SHEET

Day 10 (9/20/13) SK

Beaker No.	Temp.* (deg.C)	DO* (ppm)	Cond. (umhos/cm)	pH*	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
2	22.9	4.0		6.6				Each beaker fed 1.5 ml
7	22.8	4.0		6.7				Tetra Fin suspension
10	22.7	3.9		6.7				Initials: GB
32	22.4	3.9		6.7				
45	22.4	4.1		6.8				
48	22.9	4.4		6.8				
69	23.2	4.4		6.8				
72	23.2	4.1		6.8				
								Water changed in all
								beakers.
								Time: 0445
								Initials: GB
								Water changed in all
								beakers.
								Time: 1640
								Initials: SK

*Water quality measurements to be taken.

Day 11 (9/21/13) GB

Beaker No.	Temp.* (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
2	22.9							Each beaker fed 1.5 ml
7	22.9							Tetra Fin suspension
10	22.7							Initials: GB
32	22.5							
45	22.6							
48	23.0							
69	23.3							
72	23.3							
								Water changed in all
								beakers.
								Time: 0450
								Initials: GB
								Water changed in all
								beakers.
								Time: 1645
								Initials:

*Water quality measurements to be taken.

Test No. 848-2 Client Hart Crowser Investigator ______

DAILY RECORD SHEET

Day 12 (9/22/13) GTB

Beaker No.	Temp.* (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
2	22.8							Each beaker fed 1.5 ml
7	226							Tetra Fin suspension
10	226							Initials: GTB
32	224							
45	22.2							
48	22.7							
69	22.9							
72	23.0							
								Water changed in all
								beakers.
								Time: 0500
								Initials: GTB
								Water changed in all
								beakers.
								Time: 1650
								Initials: SK

*Water quality measurements to be taken.

Day 13 (9/23/13) YK /SK

Beaker No.	Temp.* (deg.C)	DO* (ppm)	Cond. (umhos/cm)	pH*	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
2	23.1	3.7		6.8				Each beaker fed 1.5 ml
7	23.0	4.4		6.8				Tetra Fin suspension
10	22.8	4.1		6.8				Initials: YK
32	22.6	3.8		6.8				
45	22.6	4.1		6.8				
48	23.1	4.2		6.8				
69	23.4	4.0		6.9				
72	23.4	4.4		6.9				
								Water changed in all
								beakers.
								Time: 0520
								Initials: YK
								Water changed in all
								beakers.
								Time: 1610
								Initials: SK

*Water quality measurements to be taken.

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CHIRONOMUS DILUTUS 20-DAY SOLID PHASE SEDIMENT TEST

Test No. 848-2 Client Hart Crowser Investigator ______

DAILY RECORD SHEET

Day 14 (9/24/13)YL /SK.

Beaker No.	Temp.* (deg.C)	DO (ppm)	.Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
2	23.1							Each beaker fed 1.5 ml
7	22.9							Tetra Fin suspension
10	22.8							Initials: YL
32	22.6							
45	22.5							
48	23.0							
69	23.3							
72	23.4							
								Water changed in all
								beakers.
								Time: 0510
								Initials: YL
								Water changed in all
								beakers.
								Time: 1620
								Initials: SK

*Water quality measurements to be taken.

Day 15 (9/25/13)YL

Beaker No.	Temp.* (deg.C)	DO* (ppm)	Cond.* (umhos/cm)	pH*	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
2	23.0	4.1	112	7.0				Each beaker fed 1.5 ml
7	22.8	4.5	107	7.1				Tetra Fin suspension
10	22.7	3.9	107	7.0				Initials: GB
32	22.5	4.0	106	7.0				
45	22.5	3.7	104	7.0				
48	22.8	4.3	108	7.0				
69	23.2	4.5	109	7.0				
72	23.2	4.3	110	7.1				
								Water changed in all
								beakers.
								Time: 0455
								Initials: GB
								Water changed in all
								beakers.
								Time: 1555
								Initials: YL

*Water quality measurements to be taken.

CHIRONOMUS DILUTUS 20-DAY SOLID PHASE SEDIMENT TEST

Test No. 848-2 Client Hart Crowser Investigator ______

DAILY RECORD SHEET

Day 16 (9/26/13) SK

Beaker No.	Temp.* (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
2	23.0							Each beaker fed 1.5 ml
7	22.7							Tetra Fin suspension
10	22.6							Initials: SB
32	22.4							
45	22.2							
48	22.8							
69	23.2							
72	23.1							
								Water changed in all
								beakers.
								Time: 0450
								Initials: SK
								Water changed in all
								beakers. (1)SK 9-26-13
								Time: ~~1655~~ 1555
								Initials: SK

*Water quality measurements to be taken.

Day 17 (9/27/13) SK

Beaker No.	Temp.* (deg.C)	DO* (ppm)	Cond. (umhos/cm)	pH*	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
2	23.0	5.4		7.0				Each beaker fed 1.5 ml
7	22.9	5.7		7.1				Tetra Fin suspension
10	22.6	5.4		7.2				Initials: YL
32	22.5	5.4		7.2				
45	22.4	5.3		7.1				
48	22.9	5.7		7.2				
69	23.2	6.0		7.2				
72	23.2	5.8		7.2				
								Water changed in all
								beakers.
								Time: 0505
								Initials: YL
								Water changed in all
								beakers.
								Time: 1605
								Initials: YL

*Water quality measurements to be taken.

Test No. 848-2 Client Hart Crowser Investigator ______

DAILY RECORD SHEET

Day 18 (9/28/13)

Beaker No.	Temp.* (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
2	22.7							Each beaker fed 1.5 ml
7	22.7							Tetra Fin suspension
10	22.5							Initials:
32	22.5							
45	22.5							
48	22.8							
69	23.1							
72	23.1							
								Water changed in all
								beakers.
								Time: 0525
								Initials:
								Water changed in all
								beakers.
								Time: 11:35
								Initials:

*Water quality measurements to be taken.

Day 19 (9/29/13)

Beaker No.	Temp.* (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
2	23.0							Each beaker fed 1.5 ml
7	22.8							Tetra Fin suspension
10	22.6							Initials:
32	22.5							
45	22.5							
48	22.9							
69	23.2							
72	23.2							
								Water changed in all
								beakers.
								Time: 0525
								Initials:
								Water changed in all
								beakers. SK ① 9-29-13
								Time: ~~1745~~ 1645
								Initials: SK

*Water quality measurements to be taken.

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-CT4c

CHIRONOMUS DILUTUS 20-DAY SOLID PHASE SEDIMENT TEST

Test No. 848-2 Client Hart Crowser Investigator ______

DAILY RECORD SHEET

Day 20 (9 / 30 13) GB/SK

Measure interstitial ammonia & sulfides

Beaker No.	Temp.* (deg.C)	DO* (ppm)	Cond.* (umhos/cm)	pH*	Hardness* (mg/L)	Alkalinity* (mg/L)	NH3* (ppm)	Comments
2	23.0	4.8	106	7.3	26	30		
7	22.8	6.2	101	7.5	17	40		
10	22.7	5.6	102	7.4	26	40		
32	22.6	5.7	101	7.3	17	30		
45	22.6	5.7	99	7.3	17	40		
48	23.0	6 2	103	7 3	26	30		
69	23 3	5.8	106	7.3	17	40		
72	23.3	6.0	105	7.3	26	40		
								Water changed in all
								beakers.
								Time: 0655
								Initials:

*Water quality measurements to be taken.

Day ______(/ /)

Beaker No.	Temp. (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments

*Water quality measurements to be taken.

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-CT4c

CHIRONOMUS DILUTUS 20-DAY SOLID PHASE SEDIMENT TEST

Test No. 848-2 Client Hart Crowser Investigator ____

DAY 20 TEST TERMINATION SHEET

Beaker No.	Number of survivors	Initials	
1	8	OB	
2			
3	8	YL	1-exuviate
4	9	OB	
5	6	OB	
6	2	YL	
7			
8	6	OB	
9	8	OB	
10			
11	5	YL	
12	7	YL	
13	3	OB	4-pupae
14	8	OB	
15	8	YL	
16	4	OB	3-pupae+1exuviae
17	2	OB	2 pupae +1exuviae
18	5	YL	
19	7	YL	
20	1	OB	-4 pupae
21	7	YL	1- pupae
22	9	YL	
23	4	OB	-2pupae +1exuviae
24	9	OB	
25	8	OB	+ 1 pupae
26	6	OB	+ 2 pupae
27	8	YL	
28	9	YL	
29	7	YL	1 pupae
30	6	YL	1 exuviate
31	6	OB	+ 1 pupae
32			
33	2	OB	+5pupae + 1exuviate
34	9	OB	+1 pupae
35	6	OB	
36	9	YL	
37	10	YL	
38	7	OB	+ 1 pupae
39	4	OB	+3 pupae
40	8	YL	
41	10	YL	
42	~~3~~ 2	OB	+3 pupae + 2exuviae
43	6	OB	+1 pupae
44	8	OB	
45			

Beaker No.	Number of survivors	Initials	
46	9	YL	
47	7	YL	
48			
49	7	OB	
50	3	OB	+1 pupae
51	8	YL	
52	7	YL	
53	5	OB	+2 pupae
54	5	OB	+1 pupae +2 exuviae
55	6	OB	+1 pupae
56	8	OB	
57	8	YL	+1 exuviate
58	5	YL	+ 2 pupae
59	8	OB	
60	6	OB	
61	5	YL	+ 1 pupae + 1 exuviate
62	7	YL	+ 1 pupae + 1 exuviate
63	3	OB	+ 3 pupae
64	9	OB	
65	7	OB	
66	4	OB	+2 pupae + 2 exuviae
67	7	YL	+ 1 exuviate
68	6	YL	
69			
70	9	OB	
71	7	OB	+1 pupae
72			

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CHIRONOMUS DILUTUS 20-DAY SOLID PHASE SEDIMENT TEST

Test No. 848-2 Client Hart Crowser Investigator

WEIGHING DATA SHEET

Tare. Date 9-11-13 Oven temp (C.) 550 Drying time (hr.) 2 Initials JRF
Standard Weights: 10 mg: 10.008 100mg: 100.020

Final #1: Date 10-2-13 Oven temp (C.) 61 Drying time (hr.) 24 Initials JRF
Standard Weights: 10 mg: 10.009 100mg: 100.016

Final #2: Date 10-3-13 Oven temp (C.) 60 Drying time (hr.) 23 Initials JRF
Standard Weights: 10 mg: 10.009 100mg: 100.019

Final #3: Date 10-4-13 Oven temp (C.) 550 Drying time (hr.) 2 hr Initials JRF
Standard Weights: 10 mg: 10.006 100mg: 100.017

Equip. used: Oven BLUE M#1, FISHER ISOTEMP MUFFLE FURNACE Balance SARTORIUS M3P

(Dry overnight at 60-90 degrees C) **(Final ashing is at 550 degrees C for 2 hours)**

Bkr. #	Pan #	Tare wt. (mg)	Dry total wt. (mg)		no. weighed	put into pans-initials	Ash weight (mg)	
			1	2				
1	1	92.50	111.01	110.93	8	JF	97.43	
2	2							
3	3	93.08	115.12	115.03	8	JF	101.39	
4	4	96.30	111.35	111.29	9	JF	100.37	
5	5	90.41	104.24	104.18	6	JF	92.98	
6	6	98.14	106.99	106.96	2	JF	100.74	
7	7							
8	8	92.21	109.61	109.50	6	JF	96.87	
9	9	88.95	99.88	99.82	8	JF	91.32	
10	10							
11	11	93.41	105.88	105.81	5	JF	95.08	
12	12	92.72	109.96	109.90	7	JF	98.17	
13	13	92.48	99.94	99.92	3	JF	94.38	
14	14	96.11	115.01	114.86	8	JF	100.78	
15	15	93.35	113.20	113.07	8	JF	98.80	
16	16	99.66	113.74	113.64	4	JF	101.33	
17	17	91.41	95.29	95.27	2	JF	91.87	
18	18	100.41	115.99	115.91	5	JF	104.64	
19	19	91.39	108.76	108.61	7	JF	96.28	
20	20	100.47	104.80	104.75	1	JF	100.70	
21	21	100.18	118.01	117.85	7	JF	105.17	
22	22	89.46	108.43	108.27	9	JF	94.42	
23	23	87.86	100.16	100.05	4	JF	89.65	
24	24	95.88	109.82	109.75	9	JF	99.65	
25	25	94.04	110.58	110.50	8	JF	98.52	
26	26	94.03	109.06	108.97	6	JF	96.79	
27	27	89.63	107.54	107.45	8	JF	94.99	
28	28	97.18	116.51	116.44	9	JF	103.29	
29	29	95.38	110.50	110.45	7	JF	99.58	
30	30	98.80	114.50	114.44	6	JF	103.40	
31	31	95.49	111.71	111.64	6	JF	99.52	
32	32							
33	33	94.10	104.69	104.65	2	JF	96.29	

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-CT4c
CHIRONOMUS DILUTUS 20-DAY SOLID PHASE SEDIMENT TEST

Test No. 848-2 Client Hart Crowser Investigator ______

WEIGHING DATA SHEET

See page 17 for information on drying times and temperatures, standard weights,etc.

Bkr. #	Pan #	Tare wt. (mg)	Total wt. (mg)		no. weighed	put into pans-initials	Ash weight (mg)	
			1	2				
34	34	94.80	117.92	117.86	9	af	103.90	
35	35	91.58	102.76	102.72	6	af	94.39	
36	36	93.28	114.67	114.61	9	af	101.74	
37	37	98.58	120.32	120.25	10	af	103.93	
38	38	94.30	112.80	112.74	7	af	98.99	
39	39	98.78	109.55	109.51	4	af	101.79	
40	40	95.56	114.93	114.86	8	af	101.52	
41	41	97.10	118.20	118.15	10	af	103.92	
42	42	98.67	102.79	102.78	2	af	99.51	
43	43	98.62	113.46	113.42	6	af	103.08	
44	44	85.78	107.12	107.03	8	af	91.13	
45	45							
46	46	94.99	114.41	114.32	9	af	99.76	
47	47	98.38	115.72	115.60	7	af	102.63	
48	48							
49	49	92.59	112.53	112.39	7	af	97.94	
50	50	98.99	111.22	111.10	5	af	102.65	
51	51	87.18	104.11	103.95	8	af	92.82	
52	52	83.06	99.56	99.45	7	af	86.20	
53	53	93.72	105.95	105.87	5	af	97.52	
54	54	93.29	107.00	106.91	5	af	98.00	
55	55	89.05	108.19	108.02	6	af	96.00	
56	56	93.97	112.50	112.36	8	af	98.32	
57	57	94.24	113.16	113.02	8	af	99.06	
58	58	88.22	96.55	96.46	5	af	89.45	
59	59	95.03	110.41	110.26	8	af	98.69	
60	60	91.73	103.98	103.82	6	af	93.41	
61	61	85.30	98.56	98.45	5	af	88.01	
62	62	96.35	109.94	109.83	7	af	100.05	
63	63	80.51	92.43	92.31	3	af	82.65	
64	64	93.88	113.45	113.19	9	af	98.14	
65	65	80.08	95.81	95.68	7	af	83.15	
66	66	87.94	100.38	100.27	4	af	91.15	
67	67	87.82	105.92	105.78	7	af	92.15	
68	68	88.08	102.05	101.92	6	af	91.11	
69	69							
70	70	88.49	107.96	107.98	9	af	95.05	
71	71	84.09	103.49	103.51	7	af	90.58	
72	72							
73	73							
74	74							
75	75							
76	76							

RAW DATA DIVIDER PAGE
Test No. 848-2

TEST DATA ANALYSIS RECORDS

Test Number: 848-2

Freshwater Sediment Test
20-Day Chironomus dilutus

data entry verified against
laboratory bench sheets
10-23-13 JMF

Endpoints Data Entry and Calculations File

BKR=beaker number
INIT=initial number
SURV=number survivors
MORT=number dead=INIT-SURV
PSURV=%survival=100(SURV/INIT)
PMORT=%mortality=100(MORT/INIT)

TARE WT= ashed weight of pan used for that replicate at test termination (mg), or dry weight of pan if ash-free dry weight is not an endpoint
WT COUNT= number of test organisms weighed at test end
DRY WT= TARE WT + dry weight of test organisms recovered at test termination (mg)
TWT=total biomass=DRY WT-TARE WT
WT=average individual biomass=TWT/WT COUNT

ASHED DRY WT= weight of ashed pan + weight of ashed test organisms recovered at test termination
TAFDW=DRY WT - ASHED DRY WT= total ash-free organism weight for given replicate
AFDW=average individual ash-free biomass=TAFDW/WT COUNT

INDEX	BKR	NAS SMPL	CLIENT DESCRIP	REPL		INIT	SURV	MORT	PSURV	PMORT	TARE WT (mg)	WT COUNT	DRY WT (mg)	ASHED DRY WT (mg)	TWT (mg)	WT (mg)	TAFDW (mg)	AFDW (mg)		SURV	MORT	PSURV	PMORT	WT	AFDW
1	66	4569G	Control	1		10	8	2	80.0	20.0	87.94	4	100.27	91.15	12.33	3.08	9.12	2.28							
2	44	4569G	Control	2		10	8	2	80.0	20.0	85.78	8	107.03	91.13	21.25	2.66	15.90	1.99							
3	23	4569G	Control	3		10	7	3	70.0	30.0	87.86	4	100.05	89.65	12.19	3.05	10.40	2.60							
4	16	4569G	Control	4		10	8	2	80.0	20.0	99.66	4	113.64	101.33	13.98	3.50	12.31	3.08							
5	22	4569G	Control	5		10	9	1	90.0	10.0	89.46	9	108.27	94.42	18.81	2.09	13.85	1.54	Mean	8.0	2.0	80.0	20.0	2.59	2.04
6	9	4569G	Control	6		10	8	2	80.0	20.0	88.95	8	99.82	91.32	10.87	1.36	8.50	1.06	SD	0.8	0.8	7.6	7.6	0.69	0.63
7	49	4569G	Control	7		10	7	3	70.0	30.0	92.59	7	112.39	97.94	19.80	2.83	14.45	2.06	n	8	8	8	8	8	8
8	64	4569G	Control	8		10	9	1	90.0	10.0	93.88	9	113.19	98.14	19.31	2.15	15.05	1.67							
9	2	4569G	Control	9	wq replicate	10																			
10	20	4562G	HC-SFSR-09	1		10	5	5	50.0	50.0	100.47	1	104.75	100.70	4.28	4.28	4.05	4.05							
11	38	4562G	HC-SFSR-09	2		10	8	2	80.0	20.0	94.30	7	112.74	98.99	18.44	2.63	13.75	1.96							
12	65	4562G	HC-SFSR-09	3		10	7	3	70.0	30.0	80.08	7	95.68	83.15	15.60	2.23	12.53	1.79							
13	1	4562G	HC-SFSR-09	4		10	8	2	80.0	20.0	92.50	8	110.93	97.43	18.43	2.30	13.50	1.69							
14	46	4562G	HC-SFSR-09	5		10	9	1	90.0	10.0	94.99	9	114.32	99.76	19.33	2.15	14.56	1.62	Mean	7.1	2.9	71.3	28.8	2.54	2.03
15	30	4562G	HC-SFSR-09	6		10	7	3	70.0	30.0	98.80	6	114.44	103.40	15.64	2.61	11.04	1.84	SD	1.5	1.5	14.6	14.6	0.74	0.83
16	29	4562G	HC-SFSR-09	7		10	8	2	80.0	20.0	95.38	7	110.45	99.58	15.07	2.15	10.87	1.55	n	8	8	8	8	8	8
17	17	4562G	HC-SFSR-09	8		10	5	5	50.0	50.0	91.41	2	95.27	91.87	3.86	1.93	3.40	1.70							
18	72	4562G	HC-SFSR-09	9	wq replicate	10																			
19	5	4563G	HC-SFSR-07	1		10	6	4	60.0	40.0	90.41	6	104.18	92.98	13.77	2.30	11.20	1.87							
20	62	4563G	HC-SFSR-07	2		10	9	1	90.0	10.0	96.35	7	109.83	100.05	13.48	1.93	9.78	1.40							
21	61	4563G	HC-SFSR-07	3		10	7	3	70.0	30.0	85.30	5	98.45	88.01	13.15	2.63	10.44	2.09							
22	42	4563G	HC-SFSR-07	4		10	7	3	70.0	30.0	98.67	2	102.78	99.51	4.11	2.06	3.27	1.64							
23	13	4563G	HC-SFSR-07	5		10	7	3	70.0	30.0	92.48	3	99.92	94.38	7.44	2.48	5.54	1.85	Mean	7.5	2.5	75.0	25.0	2.30	1.75
24	25	4563G	HC-SFSR-07	6		10	9	1	90.0	10.0	94.04	8	110.50	98.52	16.46	2.06	11.98	1.50	SD	1.1	1.1	10.7	10.7	0.26	0.22
25	47	4563G	HC-SFSR-07	7		10	7	3	70.0	30.0	98.38	7	115.60	102.63	17.22	2.46	12.97	1.85	n	8	8	8	8	8	8
26	21	4563G	HC-SFSR-07	8		10	8	2	80.0	20.0	100.18	7	117.85	105.17	17.67	2.52	12.68	1.81							
27	48	4563G	HC-SFSR-07	9	wq replicate	10																			
28	35	4564G	HC-MCL	1		10	6	4	60.0	40.0	91.58	6	102.72	94.39	11.14	1.86	8.33	1.39							
29	24	4564G	HC-MCL	2		10	9	1	90.0	10.0	95.88	9	109.75	99.65	13.87	1.54	10.10	1.12							
30	53	4564G	HC-MCL	3		10	7	3	70.0	30.0	93.72	5	105.87	97.52	12.15	2.43	8.35	1.67							
31	43	4564G	HC-MCL	4		10	7	3	70.0	30.0	98.62	6	113.42	103.08	14.80	2.47	10.34	1.72							
32	4	4564G	HC-MCL	5		10	9	1	90.0	10.0	96.30	9	111.29	100.37	14.99	1.67	10.92	1.21	Mean	7.5	2.5	75.0	25.0	2.05	1.46
33	59	4564G	HC-MCL	6		10	8	2	80.0	20.0	95.03	8	110.26	98.69	15.23	1.90	11.57	1.45	SD	1.2	1.2	12.0	12.0	0.36	0.22
34	51	4564G	HC-MCL	7		10	8	2	80.0	20.0	87.18	8	103.95	92.82	16.77	2.10	11.13	1.39	n	8	8	8	8	8	8
35	50	4564G	HC-MCL	8		10	6	4	60.0	40.0	98.99	5	111.10	102.65	12.11	2.42	8.45	1.69							
36	45	4564G	HC-MCL	9	wq replicate	10																			
37	11	4565G	HC-SFSR-03	1		10	5	5	50.0	50.0	93.41	5	105.81	95.08	12.40	2.48	10.73	2.15							
38	58	4565G	HC-SFSR-03	2		10	7	3	70.0	30.0	88.22	5	96.46	89.45	8.24	1.65	7.01	1.40							
39	56	4565G	HC-SFSR-03	3		10	8	2	80.0	20.0	93.97	8	112.36	98.32	18.39	2.30	14.04	1.76							
40	68	4565G	HC-SFSR-03	4		10	6	4	60.0	40.0	88.08	6	101.92	91.11	13.84	2.31	10.81	1.80							
41	26	4565G	HC-SFSR-03	5		10	8	2	80.0	20.0	94.03	6	108.97	96.79	14.94	2.49	12.18	2.03	Mean	6.9	3.1	68.8	31.3	2.27	1.84
42	67	4565G	HC-SFSR-03	6		10	8	2	80.0	20.0	87.82	7	105.78	92.15	17.96	2.57	13.63	1.95	SD	1.1	1.1	11.3	11.3	0.30	0.23
43	60	4565G	HC-SFSR-03	7		10	6	4	60.0	40.0	91.73	6	103.82	93.41	12.09	2.02	10.41	1.74	n	8	8	8	8	8	8
44	52	4565G	HC-SFSR-03	8		10	7	3	70.0	30.0	83.06	7	99.45	86.20	16.39	2.34	13.25	1.89							
45	69	4565G	HC-SFSR-03	9	wq replicate	10																			
46	55	4566G	HC-GC-01	1		10	7	3	70.0	30.0	89.05	6	108.02	96.00	18.97	3.16	12.02	2.00							
47	36	4566G	HC-GC-01	2		10	9	1	90.0	10.0	93.28	9	114.61	101.74	21.33	2.37	12.87	1.43							
48	54	4566G	HC-GC-01	3		10	8	2	80.0	20.0	93.29	5	106.91	98.00	13.62	2.72	8.91	1.78							
49	3	4566G	HC-GC-01	4		10	9	1	90.0	10.0	93.08	8	115.03	101.39	21.95	2.74	13.64	1.71							

INDEX	BKR	NAS SMPL	CLIENT DESCRIP	REPL		INIT	SURV	MORT	PSURV	PMORT	TARE WT (mg)	WT COUNT	DRY WT (mg)	ASHED DRY WT (mg)	TWT (mg)	WT (mg)	TAFDW (mg)	AFDW (mg)		SURV	MORT	PSURV	PMORT	WT	AFDW
50	57	4566G	HC-GC-01	5		10	9	1	90.0	10.0	94.24	8	113.02	99.06	18.78	2.35	13.96	1.75	Mean	8.4	1.6	83.8	16.3	2.98	2.04
51	39	4566G	HC-GC-01	6		10	7	3	70.0	30.0	98.78	4	109.51	101.79	10.73	2.68	7.72	1.93	SD	1.1	1.1	10.6	10.6	0.96	0.88
52	34	4566G	HC-GC-01	7		10	10	0	100.0	0.0	94.80	9	117.86	103.90	23.06	2.56	13.96	1.55	n	8	8	8	8	8	8
53	33	4566G	HC-GC-01	8		10	8	2	80.0	20.0	94.10	2	104.65	96.29	10.55	5.28	8.36	4.18							
54	10	4566G	HC-GC-01	9	wq replicate	10																			
55	28	4567G	HC-GC-05	1		10	9	1	90.0	10.0	97.18	9	116.44	103.29	19.26	2.14	13.15	1.46							
56	8	4567G	HC-GC-05	2		10	6	4	60.0	40.0	92.21	6	109.50	96.87	17.29	2.88	12.63	2.11							
57	15	4567G	HC-GC-05	3		10	8	2	80.0	20.0	93.38	8	113.07	98.80	19.69	2.46	14.27	1.78							
58	14	4567G	HC-GC-05	4		10	8	2	80.0	20.0	96.11	8	114.86	100.78	18.75	2.34	14.08	1.76							
59	70	4567G	HC-GC-05	5		10	9	1	90.0	10.0	88.49	9	107.98	95.05	19.49	2.17	12.93	1.44	Mean	8.4	1.6	83.8	16.3	2.37	1.70
60	31	4567G	HC-GC-05	6		10	7	3	70.0	30.0	95.49	6	111.64	99.52	16.15	2.69	12.12	2.02	SD	1.4	1.4	14.1	14.1	0.29	0.26
61	37	4567G	HC-GC-05	7		10	10	0	100.0	0.0	98.58	10	120.25	103.93	21.67	2.17	16.32	1.63	n	8	8	8	8	8	8
62	41	4567G	HC-GC-05	8		10	10	0	100.0	0.0	97.10	10	118.15	103.92	21.05	2.11	14.23	1.42							
63	7	4567G	HC-GC-05	9	wq replicate	10																			
64	27	4568G	HC-76-02	1		10	8	2	80.0	20.0	89.63	8	107.45	94.99	17.82	2.23	12.46	1.56							
65	18	4568G	HC-76-02	2		10	5	5	50.0	50.0	100.41	5	115.91	104.64	15.50	3.10	11.27	2.25							
66	71	4568G	HC-76-02	3		10	8	2	80.0	20.0	84.09	7	103.51	90.58	19.42	2.77	12.93	1.85							
67	40	4568G	HC-76-02	4		10	8	2	80.0	20.0	95.56	8	114.86	101.52	19.30	2.41	13.34	1.67							
68	19	4568G	HC-76-02	5		10	7	3	70.0	30.0	91.39	7	108.61	96.28	17.22	2.46	12.33	1.76	Mean	6.4	3.6	63.8	36.3	2.97	2.14
69	63	4568G	HC-76-02	6		10	6	4	60.0	40.0	80.51	3	92.31	82.65	11.80	3.93	9.66	3.22	SD	2.1	2.1	20.7	20.7	0.80	0.67
70	12	4568G	HC-76-02	7		10	7	3	70.0	30.0	92.72	7	109.90	98.17	17.18	2.45	11.73	1.68	n	8	8	8	8	8	8
71	6	4568G	HC-76-02	8		10	2	8	20.0	80.0	98.14	2	106.96	100.74	8.82	4.41	6.22	3.11							
72	32	4568G	HC-76-02	9	wq replicate	10																			

data entry verified against laboratory bench sheets
10 23-13 SMF

Water Quality Data

	NAS	CLIENT			Overlying water							Interstitial water	
BKR	SMPL	DESCRIP	REPL	DAY	TEMP	DO	COND	pH	NH3	HARD	ALK	S	NH3
2	4569G	Control	9	0	22.9	6.8	120	6.7	<0.1	34	40	<0.1	1.0
7	4567G	HC-GC-05	9	0	22.8	7.7	106	6.9	0.2	26	40	<0.1	0.5
10	4566G	HC-GC-01	9	0	22.7	6.5	115	6.7	0.6	34	30	<0.1	<0.5
32	4568G	HC-76-02	9	0	22.5	7.7	104	6.8	<0.1	34	30	<0.1	<0.5
45	4564G	HC-MCL	9	0	22.4	7.3	101	6.7	0.1	26	40	<0.1	0.9
48	4563G	HC-SFSR-07	9	0	22.9	7.9	105	6.8	<0.1	26	40	<0.1	<0.5
69	4565G	HC-SFSR-03	9	0	23.0	7.8	106	6.8	<0.1	34	30	<0.1	<0.5
72	4562G	HC-SFSR-09	9	0	23.1	7.9	107	6.9	<0.1	26	30	<0.1	0.8
2	4569G	Control	9	1	23.1	5.7	119	6.6					
7	4567G	HC-GC-05	9	1	22.6	5.9	108	6.7					
10	4566G	HC-GC-01	9	1	22.7	4.7	117	6.6					
32	4568G	HC-76-02	9	1	22.8	5.7	106	6.7					
45	4564G	HC-MCL	9	1	22.5	5.9	102	6.7					
48	4563G	HC-SFSR-07	9	1	22.9	6.1	107	6.8					
69	4565G	HC-SFSR-03	9	1	23.3	5.5	109	6.7					
72	4562G	HC-SFSR-09	9	1	23.2	5.7	110	6.7					
2	4569G	Control	9	2	22.9								
7	4567G	HC-GC-05	9	2	22.9								
10	4566G	HC-GC-01	9	2	22.8								
32	4568G	HC-76-02	9	2	22.7								
45	4564G	HC-MCL	9	2	22.6								
48	4563G	HC-SFSR-07	9	2	23.0								
69	4565G	HC-SFSR-03	9	2	23.4								
72	4562G	HC-SFSR-09	9	2	23.3								
2	4569G	Control	9	3	23.0	4.8		6.5					
7	4567G	HC-GC-05	9	3	22.9	5.9		6.6					
10	4566G	HC-GC-01	9	3	22.8	4.1		6.6					
32	4568G	HC-76-02	9	3	22.6	5.9		6.7					
45	4564G	HC-MCL	9	3	22.6	5.5		6.6					
48	4563G	HC-SFSR-07	9	3	23.0	5.6		6.7					
69	4565G	HC-SFSR-03	9	3	23.3	5.7		6.8					
72	4562G	HC-SFSR-09	9	3	23.3	4.9		6.8					
2	4569G	Control	9	4	23.1								
7	4567G	HC-GC-05	9	4	23.0								
10	4566G	HC-GC-01	9	4	22.9								
32	4568G	HC-76-02	9	4	22.8								
45	4564G	HC-MCL	9	4	22.7								
48	4563G	HC-SFSR-07	9	4	22.7								
69	4565G	HC-SFSR-03	9	4	23.3								
72	4562G	HC-SFSR-09	9	4	23.4								
2	4569G	Control	9	5	23.2								
7	4567G	HC-GC-05	9	5	23.1								
10	4566G	HC-GC-01	9	5	23.0								
32	4568G	HC-76-02	9	5	22.9								
45	4564G	HC-MCL	9	5	22.9								
48	4563G	HC-SFSR-07	9	5	23.1								
69	4565G	HC-SFSR-03	9	5	23.5								
72	4562G	HC-SFSR-09	9	5	23.4								
2	4569G	Control	9	6	23.0	5.9		6.8					
7	4567G	HC-GC-05	9	6	22.9	6.1		6.8					
10	4566G	HC-GC-01	9	6	22.8	5.3		6.8					
32	4568G	HC-76-02	9	6	22.6	6.1		6.9					
45	4564G	HC-MCL	9	6	22.6	6.3		6.9					
48	4563G	HC-SFSR-07	9	6	23.0	5.8		6.9					
69	4565G	HC-SFSR-03	9	6	23.3	5.7		6.9					
72	4562G	HC-SFSR-09	9	6	23.2	5.7		7.0					
2	4569G	Control	9	7	23.1								

7	4567G	HC-GC-05	9	7	23.0			
10	4566G	HC-GC-01	9	7	22.8			
32	4568G	HC-76-02	9	7	22.6			
45	4564G	HC-MCL	9	7	22.6			
48	4563G	HC-SFSR-07	9	7	23.0			
69	4565G	HC-SFSR-03	9	7	23.3			
72	4562G	HC-SFSR-09	9	7	23.3			
2	4569G	Control	9	8	23.0	4.2	121	6.3
7	4567G	HC-GC-05	9	8	22.9	4.2	112	6.4
10	4566G	HC-GC-01	9	8	22.8	3.5	117	6.4
32	4568G	HC-76-02	9	8	22.5	4.1	109	6.5
45	4564G	HC-MCL	9	8	22.5	3.8	110	6.5
48	4563G	HC-SFSR-07	9	8	23.0	4.1	110	6.5
69	4565G	HC-SFSR-03	9	8	23.3	3.9	112	6.6
72	4562G	HC-SFSR-09	9	8	23.3	3.8	113	6.6
2	4569G	Control	9	9	23.0			
7	4567G	HC-GC-05	9	9	22.9			
10	4566G	HC-GC-01	9	9	22.7			
32	4568G	HC-76-02	9	9	22.5			
45	4564G	HC-MCL	9	9	22.5			
48	4563G	HC-SFSR-07	9	9	23.0			
69	4565G	HC-SFSR-03	9	9	23.4			
72	4562G	HC-SFSR-09	9	9	23.3			
2	4569G	Control	9	10	22.9	4.0		6.6
7	4567G	HC-GC-05	9	10	22.8	4.0		6.7
10	4566G	HC-GC-01	9	10	22.7	3.9		6.7
32	4568G	HC-76-02	9	10	22.4	3.9		6.7
45	4564G	HC-MCL	9	10	22.4	4.1		6.8
48	4563G	HC-SFSR-07	9	10	22.9	4.4		6.8
69	4565G	HC-SFSR-03	9	10	23.2	4.4		6.8
72	4562G	HC-SFSR-09	9	10	23.2	4.1		6.8
2	4569G	Control	9	11	22.9			
7	4567G	HC-GC-05	9	11	22.9			
10	4566G	HC-GC-01	9	11	22.7			
32	4568G	HC-76-02	9	11	22.5			
45	4564G	HC-MCL	9	11	22.6			
48	4563G	HC-SFSR-07	9	11	23.0			
69	4565G	HC-SFSR-03	9	11	23.3			
72	4562G	HC-SFSR-09	9	11	23.3			
2	4569G	Control	9	12	22.8			
7	4567G	HC-GC-05	9	12	22.6			
10	4566G	HC-GC-01	9	12	22.6			
32	4568G	HC-76-02	9	12	22.4			
45	4564G	HC-MCL	9	12	22.2			
48	4563G	HC-SFSR-07	9	12	22.7			
69	4565G	HC-SFSR-03	9	12	22.9			
72	4562G	HC-SFSR-09	9	12	23.0			
2	4569G	Control	9	13	23.1	3.7		6.8
7	4567G	HC-GC-05	9	13	23.0	4.4		6.8
10	4566G	HC-GC-01	9	13	22.8	4.1		6.8
32	4568G	HC-76-02	9	13	22.6	3.8		6.8
45	4564G	HC-MCL	9	13	22.6	4.1		6.8
48	4563G	HC-SFSR-07	9	13	23.1	4.2		6.8
69	4565G	HC-SFSR-03	9	13	23.4	4.0		6.9
72	4562G	HC-SFSR-09	9	13	23.4	4.4		6.9
2	4569G	Control	9	14	23.1			
7	4567G	HC-GC-05	9	14	22.9			
10	4566G	HC-GC-01	9	14	22.8			
32	4568G	HC-76-02	9	14	22.6			
45	4564G	HC-MCL	9	14	22.5			
48	4563G	HC-SFSR-07	9	14	23.0			

69	4565G	HC-SFSR-03	9	14	23.3								
72	4562G	HC-SFSR-09	9	14	23.4								
2	4569G	Control	9	15	23 0	4.1	112	7.0					
7	4567G	HC-GC-05	9	15	22.8	4.5	107	7 1					
10	4566G	HC-GC-01	9	15	22.7	3.9	107	7.0					
32	4568G	HC-76-02	9	15	22.5	4.0	106	7.0					
45	4564G	HC-MCL	9	15	22.5	3.7	104	7.0					
48	4563G	HC-SFSR-07	9	15	22.8	4.3	108	7.0					
69	4565G	HC-SFSR-03	9	15	23.2	4.5	109	7.0					
72	4562G	HC-SFSR-09	9	15	23.2	4.3	110	7 1					
2	4569G	Control	9	16	23.0								
7	4567G	HC-GC-05	9	16	22.7								
10	4566G	HC-GC-01	9	16	22.6								
32	4568G	HC-76-02	9	16	22.4								
45	4564G	HC-MCL	9	16	22.2								
48	4563G	HC-SFSR-07	9	16	22.8								
69	4565G	HC-SFSR-03	9	16	23.2								
72	4562G	HC-SFSR-09	9	16	23.1								
2	4569G	Control	9	17	23.0	5.4		7.0					
7	4567G	HC-GC-05	9	17	22.9	5.7		7.1					
10	4566G	HC-GC-01	9	17	22.6	5.4		7.2					
32	4568G	HC-76-02	9	17	22.5	5.4		7.2					
45	4564G	HC-MCL	9	17	22.4	5.3		7.1					
48	4563G	HC-SFSR-07	9	17	22.9	5.7		7.2					
69	4565G	HC-SFSR-03	9	17	23.2	6.0		7.2					
72	4562G	HC-SFSR-09	9	17	23.2	5.8		7.2					
2	4569G	Control	9	18	22.7								
7	4567G	HC-GC-05	9	18	22.7								
10	4566G	HC-GC-01	9	18	22.5								
32	4568G	HC-76-02	9	18	22.5								
45	4564G	HC-MCL	9	18	22.5								
48	4563G	HC-SFSR-07	9	18	22.8								
69	4565G	HC-SFSR-03	9	18	23.1								
72	4562G	HC-SFSR-09	9	18	23.1								
2	4569G	Control	9	19	23.0								
7	4567G	HC-GC-05	9	19	22.8								
10	4566G	HC-GC-01	9	19	22.6								
32	4568G	HC-76-02	9	19	22.5								
45	4564G	HC-MCL	9	19	22.5								
48	4563G	HC-SFSR-07	9	19	22.9								
69	4565G	HC-SFSR-03	9	19	23.2								
72	4562G	HC-SFSR-09	9	19	23.2								
2	4569G	Control	9	20	23.0	4.8	106	7.3	0.4	26	30	<0.1	1.1
7	4567G	HC-GC-05	9	20	22.8	6.2	101	7.5	0.4	17	40	<0.1	1.0
10	4566G	HC-GC-01	9	20	22.7	5.6	102	7.4	0.4	26	40	<0.1	0.7
32	4568G	HC-76-02	9	20	22.6	5.7	101	7.3	0.4	17	30	<0.1	0.9
45	4564G	HC-MCL	9	20	22.6	5.7	99	7.3	0.3	17	40	<0.1	0.9
48	4563G	HC-SFSR-07	9	20	23.0	6.2	103	7.3	0.3	26	30	<0.1	<0.5
69	4565G	HC-SFSR-03	9	20	23.3	5.8	106	7.3	0.5	17	40	<0.1	0.5
72	4562G	HC-SFSR-09	9	20	23.3	6.0	105	7.3	0.3	26	40	<0.1	<0.5
			Mean		22.9	5.2	108	6.9	—	26	36	—	—
			SD		0.3	1.1	5	0.3	—	6	5	—	—
			n		168	80	40	80	16	16	16	16	16
			Min		22.2	3.5	99	6.3	<0.1	17	30	<0.1	<0.5
			Max		23.5	7.9	121	7.5	0.6	34	40	<0.1	1.1

AMMONIA EXPOSURE BENCHSHEETS AND ANALYSIS

Total Ammonia-N in Sediment Pore Water: Computation Worksheet
Salicylate Method (SOP #5492)

Result

	Sample description	Dilution factor	OD_{655}	NH_3-N (mg/L)	pH	Salinity (ppt)
	Blank	-----	-----	-----		
	1.0 mg/L NH_3-N Std.	-----	0.109	1.00		
	3.0 mg/L NH_3-N Std.	-----	0.291	3.00		
	6.0 mg/L NH_3-N Std.	-----	0.605	6.00		
	10.0 mg/L NH_3-N Std.	-----	1.050	10.00		
	3.0 mg/L spike	-----	0.298	2.88		
	3.0 mg/L spike dupl.	-----	0.300	2.90		
	5.0 mg/L 2nd source		0.500	4.83		
1	4562G	5	0.017	0.82		
2	4563G	5	0.007	ND		
3	4564G	5	0.018	0.87		
4	4565G	5	0.006	ND		
5	4566G	5	0.009	ND		
6	4567G	5	0.011	0.53		
7	4568G	5	0.002	ND		
8	4569G	5	0.020	0.97		
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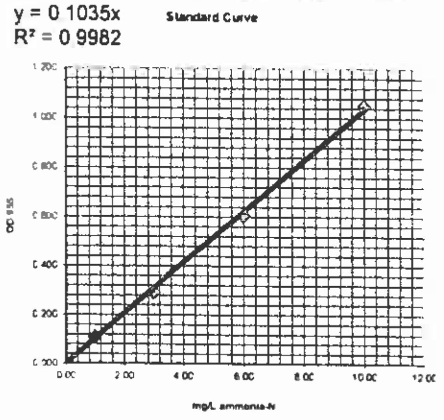

Reporting limit (mg/L) =	0.50
Recovery (%) =	96.2
Precision (RPD) =	-0.67
2nd source (%) =	96.6
Sample volume (ml):	0.10
Dilution factor	5

Sample Set Description:

Test No.: P848

Test Day:

Species:

Sample Type (check)

X Bulk Sediment Porewaters

Test Beaker Porewaters

Overlying Water

Analyst: RSC

Date analysed: 9/9/2013

Total Ammonia-N in Sediment Pore Water: Computation Worksheet
Salicylate Method (SOP #5492)

Result

	Sample description	Dilution factor	OD655	NH3-N (mg/L)	pH	Salinity (ppt)
	Blank	-----	-----	-----		
	1.0 mg/L NH3-N Std	-----	.109	1.00		
	3.0 mg/L NH3-N Std	-----	.291	3.00		
	6.0 mg/L NH3-N Std	-----	.605	6.00		
	10.0 mg/L NH3-N Std	-----	1.05	10.00		
	3.0 mg/L spike	-----	.298			
	3.0 mg/L spike dupl.	-----	.300			
	5.0 mg/L 2nd source		.500			
1	4562G	5	.017			
2	4563G	5	.007			
3	4564G	5	.018			
4	4565G	5	.006			
5	4566G	5	.009			
6	4567G	5	.011			
7	4568G	5	.002			
8	4569G	5	.020			
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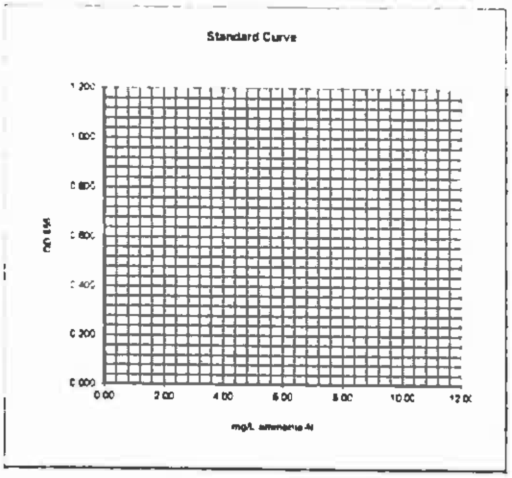

Reporting limit (mg/L) =	0.50
Recovery (%) =	#VALUE!
Precision (RPD) =	#VALUE!
2nd source (%) =	#VALUE!
Sample volume (ml):	0.10
Dilution factor	5

Sample Set Description:

Test No.: P848

Test Day:

Species:

Sample Type (check)

X Bulk Sediment Porewaters

Test Beaker Porewaters

Overlying Water

Analyst: RSC RSC

Date analysed: 9/9/2013

Dissolved Sulfide in Water: Computation Worksheet
Methylene Blue Method (SOP #5550)

Standardization

	1	2	3
uL PAO titrant employed	30	29	35
Working Std. Conc. (mg/L)		2.69867	

Result

	Sample description	Dilution factor	OD664	Sulfide (mg/L)
	Blank	-----	-----	-----
	1.0 mL working sulfide std	-----	0.280	0.54
	2.0 mL working sulfide std.	-----	0.590	1.08
	3.0 mL working sulfide std	-----	0.870	1.62
	4.0 mL working sulfide std	-----	1.100	2.16
	5.0 mL working sulfide std.	-----	1.500	2.70
	3.0 mL spike	-----	0.860	1.60
	3.0 mL spike dupl.	-----	0.840	1.56
1	4562G	5	0.005	ND
2	4563G	5	0.001	ND
3	4564G	5	0.010	ND
4	4565G	5	0.001	ND
5	4566G	5	0.001	ND
6	4567G	5	0.003	ND
7	4568G	5	0.002	ND
8	4569G	5	0.006	ND
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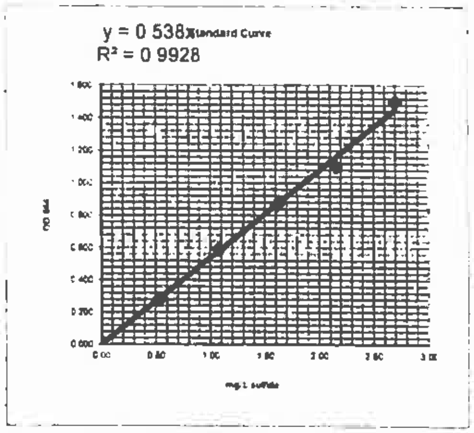

Reporting limit (mg/L) =	0.10
Recovery (%) =	97.4
Precision (RPD) =	2.35
Sample volume (ml):	1.00
Dilution factor	5

Sample Set Description:

Test No.:
Test Day:
Species:

Proj. No.: P848
X Bulk sediment porewaters
Test beaker porewaters
Overlying water

Analyst: RSC
Date analysed: 9/9/2013

Dissolved Sulfide in Water: Computation Worksheet
Methylene Blue Method (SOP #5550)

Standardization

	1	2	3
uL PAO titrant employed	30	29	35
Working Std Conc (mg/L)		32	

Result

	Sample description	Dilution factor	OD664	Sulfide (mg/L)
	Blank	-----	-----	-----
	1.0 mL working sulfide std.	-----	.280	0.64
	2.0 mL working sulfide std	-----	.590	1.28
	3.0 mL working sulfide std.	-----	.870	1.92
	4.0 mL working sulfide std.	-----	1.10	2.56
	5.0 mL working sulfide std	-----	1.50	3.20
	3.0 mL spike	-----	.860	
	3.0 mL spike dupl.	-----	.840	
1	4562G	5	.005	
2	4563G	5	.001	
3	4564G	5	.010	
4	4565G	5	.001	
5	4566G	5	.001	
6	4567G	5	.003	
7	4568G	5	002	
8	4569G	5	.006	
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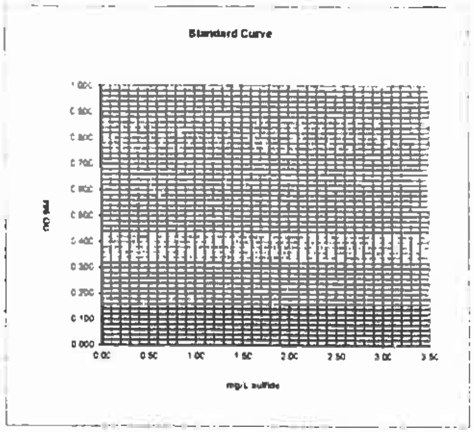

Reporting limit (mg/L) = 0.10

Recovery (%) = #VALUE!
Precision (RPD) = #VALUE!

Sample volume (ml): 1.00
Dilution factor 5

Sample Set Description:

Test No.:
Test Day:
Species:

Proj. No.: P848
X Bulk sediment porewaters
Test beaker porewaters
Overlying water

Analyst: RSC
Date analysed: 9/9/2013

Total Ammonia-N in Sediment Pore Water: Computation Worksheet
Salicylate Method (SOP #5492)

Result

	Sample description	Dilution factor	OD655	NH3-N (mg/L)	pH	Salinity (ppt)
	Blank	-----	-----	-----		
	1.0 mg/L NH3-N Std.	-----	0.142	1.00		
	3.0 mg/L NH3-N Std.	-----	0.335	3.00		
	6.0 mg/L NH3-N Std.	-----	0.718	6.00		
	10.0 mg/L NH3-N Std.	-----	1.100	10.00		
	3.0 mg/L spike	-----	0.341	3.02		
	3.0 mg/L spike dupl.	-----	0.340	3.01		
	5.0 mg/L 2nd source		0.578	5.12		
1	Day 0 (9-10-13)					
2	2	1	0.011	ND		
3	7	1	0.027	0.24		
4	10	1	0.065	0.58		
5	32	1	0.010	ND		
6	45	1	0.015	0.13		
7	48	1	0.002	ND		
8	69	1	0.010	ND		
9	72	1	0.009	ND		
10						
11	Day 20 (9-30-13)					
12	2	1	0.043	0.38		
13	7	1	0.049	0.43		
14	10	1	0.048	0.43		
15	32	1	0.040	0.35		
16	45	1	0.029	0.26		
17	48	1	0.037	0.33		
18	69	1	0.051	0.45		
19	72	1	0.038	0.34		
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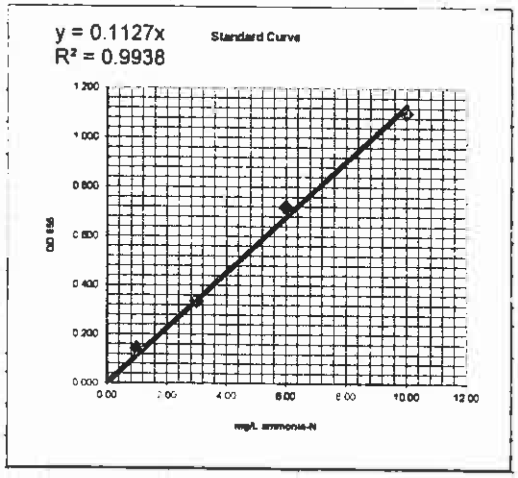

Reporting limit (mg/L) = 0.10

Recovery (%) = 100.5
Precision (RPD) = 0.29
2nd source (%) = 102.4

Sample volume (ml): 0.50
Dilution factor 1

Sample Set Description:
Test No.: 848-2
Test Day: 0 & 20 (9-10-13 & 9-30-13)
Species: *Chironomus*

Sample Type (check)
Bulk Sediment Porewaters
Test Beaker Porewaters
X Overlying Water

Analyst: RSC
Date analysed: 10/8/2013

Total Ammonia-N in Sediment Pore Water: Computation Worksheet
Salicylate Method (SOP #5492)

Result

	Sample description	Dilution factor	OD655	NH3-N (mg/L)	pH	Salinity (ppt)
	Blank	-----	—	----		
	1.0 mg/L NH3-N Std.	-----	.142	1.00		
	3.0 mg/L NH3-N Std.	-----	.335	3.00		
	6.0 mg/L NH3-N Std.	-----	.718	6.00		
	10.0 mg/L NH3-N Std.	-----	1.10	10.00		
	3.0 mg/L spike	-----	.341			
	3.0 mg/L spike dupl.	-----	.340			
	5.0 mg/L 2nd source		.578			
1	Day 0 (9-10-13)					
2	2	1	.011			
3	7	1	.027			
4	10	1	.065			
5	32	1	.010			
6	45	1	.015			
7	48	1	.002			
8	69	1	.010			
9	72	1	.004			
10						
11	Day 20 (9-30-13)					
12	2	1	.043			
13	7	1	.049			
14	10	1	.048			
15	32	1	.040			
16	45	1	.029			
17	48	1	.037			
18	69	1	.051			
19	72	1	.038			
20						
21						
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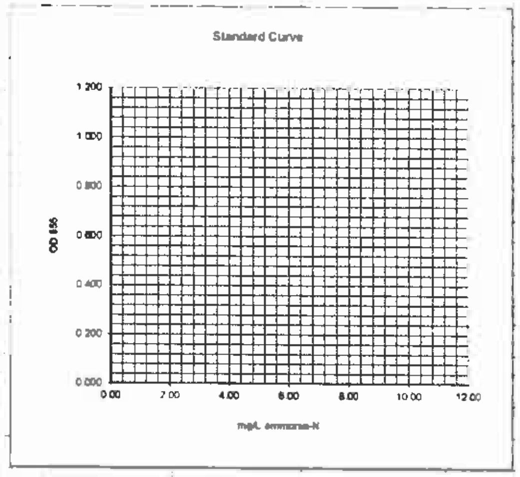

Reporting limit (mg/L) =	0.10
Recovery (%) =	#VALUE!
Precision (RPD) =	#VALUE!
2nd source (%) =	#VALUE!
Sample volume (ml):	0.50
Dilution factor	1

Sample Set Description:

Test No.: 848-2

Test Day: 0 & 20 (9-10-13 & 9-30-13)

Species: *Chironomus*

Sample Type (check)

Bulk Sediment Porewaters

Test Beaker Porewaters

X Overlying Water

Analyst: RSC RSC

Date analysed: 10/8/2013

Total Ammonia-N in Sediment Pore Water: Computation Worksheet
Salicylate Method (SOP #5492)

Result

	Sample description	Dilution factor	OD655	NH3-N (mg/L)	pH	Salinity (ppt)
	Blank	-----	-----	-----		
	1.0 mg/L NH3-N Std.	-----	0.132	1.00		
	3.0 mg/L NH3-N Std.	-----	0.320	3.00		
	6.0 mg/L NH3-N Std.	-----	0.695	6.00		
	10.0 mg/L NH3-N Std.	-----	1.100	10.00		
	3.0 mg/L spike	-----	0.328	2.94		
	3.0 mg/L spike dupl.	-----	0.334	3.00		
	5.0 mg/L 2nd source		0.558	5.01		
1	2	5	0.024	1.08		
2	7	5	0.023	1.03		
3	10	5	0.016	0.72		
4	32	5	0.019	0.85		
5	45	5	0.021	0.94		
6	48	5	0.010	ND		
7	69	5	0.012	0.54		
8	72	5	0.011	ND		
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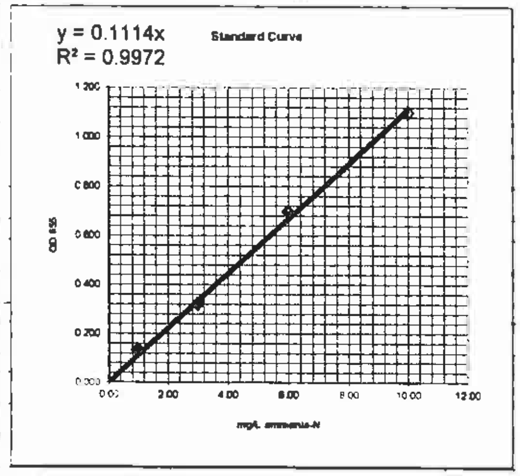

Reporting limit (mg/L) = 0.50

Recovery (%) = 99.0
Precision (RPD) = -1.81
2nd source (%) = 100.1

Sample volume (ml): 0.10
Dilution factor 5

Sample Set Description:
Test No.: 848-2
Test Day: 20 (9-30-13)
Species: *Chironomus*

Sample Type (check)
Bulk Sediment Porewaters
X Test Beaker Porewaters
Overlying Water

Analyst: RSC
Date analysed: 9/30/2013

Total Ammonia-N in Sediment Pore Water: Computation Worksheet
Salicylate Method (SOP #5492)

Result

	Sample description	Dilution factor	OD655	NH3-N (mg/L)	pH	Salinity (ppt)
	Blank	-----	-----	-----		
	1.0 mg/L NH3-N Std.	-----	.132	1.00		
	3.0 mg/L NH3-N Std.	-----	.320	3.00		
	6.0 mg/L NH3-N Std.	-----	.645	6.00		
	10.0 mg/L NH3-N Std.	-----	1.10	10.00		
	3.0 mg/L spike	-----	.328			
	3.0 mg/L spike dupl.	-----	.334			
	5.0 mg/L 2nd source		.558			
1	2	5	.024			
2	7	5	.023			
3	10	5	.015			
4	32	5	.019			
5	45	5	.021			
6	48	5	.010			
7	69	5	.012			
8	72	5	.011			
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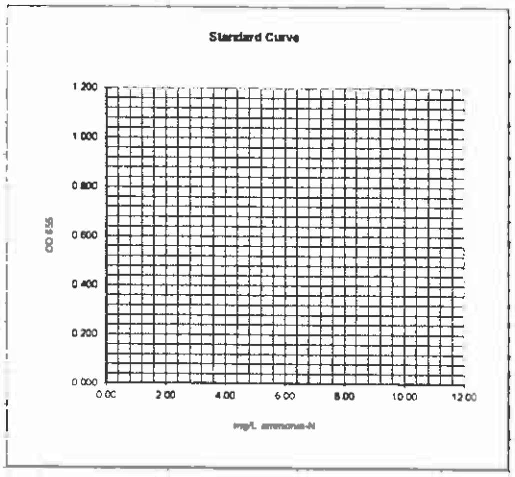

Reporting limit (mg/L) =	0.50
Recovery (%) =	#VALUE!
Precision (RPD) =	#VALUE!
2nd source (%) =	#VALUE!
Sample volume (ml):	0.10
Dilution factor	5

Sample Set Description:

Test No.: 848-2
Test Day: 20 (9-30-13)
Species: *Chironomus*

Sample Type (check)

Bulk Sediment Porewaters
X Test Beaker Porewaters
Overlying Water

Analyst: RSC
Date analysed: 9/30/2013

Dissolved Sulfide in Water: Computation Worksheet
Methylene Blue Method (SOP #5550)

Standardization

	1	2	3
uL PAO titrant employed:	100	97	90
Working Std. Conc. (mg/L):		1.66933	

Result

	Sample description	Dilution factor	OD664	Sulfide (mg/L)	pH	Salinity (ppt)
	Blank	—	—	—		
	1.0 mL working sulfide std.	—	0.156	0.33		
	2.0 mL working sulfide std.	—	0.340	0.67		
	3.0 mL working sulfide std.	—	0.498	1.00		
	4.0 mL working sulfide std.	—	0.660	1.34		
	5.0 mL working sulfide std.	—	0.780	1.67		
	3.0 mL spike	—	0.522	1.08		
	3.0 mL spike dupl.	—	0.487	1.01		
1	2	5	0.000	ND		
2	7	5	0.001	ND		
3	10	5	0.002	ND		
4	32	5	0.001	ND		
5	45	5	0.000	ND		
6	48	5	0.000	ND		
7	69	5	0.001	ND		
8	72	5	0.000	ND		
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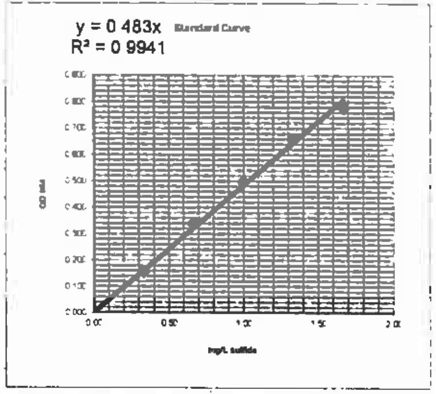

Reporting limit (mg/L) = 0.10

Recovery (%) = 104.2
Precision (RPD) = 6.94

Sample volume (ml): 1.00
Dilution factor 5

Sample Set Description:

Test No.: 848-2
Test Day: 20 (9-30-13)
Species: *Chironomus*

Proj. No.: P848
Bulk sediment porewaters
X Test beaker porewaters
Overlying water

Analyst: RSC
Date analysed: 9/30/2013

Dissolved Sulfide in Water: Computation Worksheet
Methylene Blue Method (SOP #5550)

Standardization

	1	2	3
uL PAO titrant employed.	100	97	90
Working Std. Conc. (mg/L):		3.2	

Result

	Sample description	Dilution factor	OD664	Sulfide (mg/L)	pH	Salinity (ppt)
	Blank	—	—	—		
	1.0 mL working sulfide std.	—	.156	0.64		
	2.0 mL working sulfide std.	—	.340	1.28		
	3.0 mL working sulfide std.	—	.498	1.92		
	4.0 mL working sulfide std.	—	.660	2.56		
	5.0 mL working sulfide std.	—	.780	3.20		
	3.0 mL spike	—	.522			
	3.0 mL spike dupl.	—	.487			
1	2	5	.000			
2	7	5	.001			
3	10	5	.002			
4	32	5	.001			
5	45	5	.000			
6	48	5	.000			
7	69	5	.001			
8	72	5	.000			
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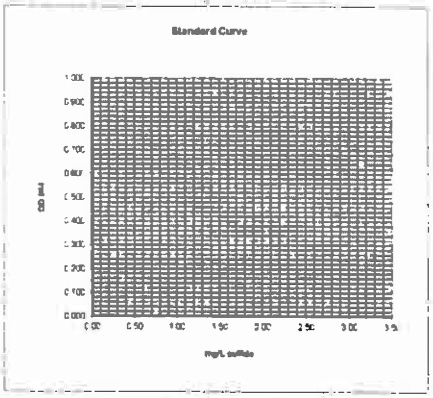

Reporting limit (mg/L) =	0.10
Recovery (%) =	#VALUE!
Precision (RPD) =	#VALUE!
Sample volume (ml):	1.00
Dilution factor	5

Sample Set Description:

Test No.: 848-2
Test Day: 20 (9-30-13)
Species: ~~Hyalella~~ Chironomus RSC 9/30/13
Proj. No.: P848
Bulk sediment porewaters
X Test beaker porewaters
Overlying water

Analyst: RSC
Date analysed: 9/30/2013

CHAIN-OF-CUSTODY RECORDS

Sample Custody Record

Samples Shipped to: NW Aquatic

HARTCROWSER

Hart Crowser, In
1700 Westlake Avenue North, Suite 20
Seattle, Washington 98109-621
Office: 206.324.9530 • Fax 206.328.55

JOB 17800-35 LAB NUMBER

PROJECT NAME HCHA

HART CROWSER CONTACT Michelle Harvey 206-683-9199

SAMPLED BY: MAH, BAS, JMS

LAB NO.	SAMPLE ID	DESCRIPTION	DATE	TIME	MATRIX	Bioassay	NO. OF CONTAINERS	OBSERVATIONS/COMMENTS/ COMPOSITING INSTRUCTIONS
	HC-SFSR-09	3×1L	8/28/13	10:00	sediment	X	3	MASH 45626
	HC-SFSR-07	3×1L	8/22/13	17.30		X	3	45636
	HC-MCL	3×1L	8/27/13	15:35		X	3	45646
	HC-SFSR-03	3×1L	8/23/13	15:30		X	3	45656
	HC-GC-01	3×1L	8/24/13	13:30		X	3	45666
	HC-GC-05	3×1L	8/25/13	12:45		X	3	45676
	HC-76-02	3×1L	8/26/13	10:15		X	3	45686

RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE Michelle Harvey	8/30/13	SIGNATURE Gary Buhler	8-31-13
PRINT NAME Michelle Harvey	TIME	PRINT NAME GARY BUHLER	TIME
COMPANY Hart Crowser	1200	COMPANY MAS	1110
RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE	TIME	SIGNATURE	TIME
PRINT NAME		PRINT NAME	
COMPANY		COMPANY	

SPECIAL SHIPMENT HANDLING OR STORAGE REQUIREMENTS:

COOLER NO.:
Temp cooler #1 : 5.1°C
Temp cooler #2 : 2.7°C

STORAGE LOCATION:

See Lab Work Order No. ____
for Other Contract Requirements

TOTAL NUMBER OF CONTAINERS

SAMPLE RECEIPT INFORMATION
CUSTODY SEALS:
☒YES ☐NO ☐N/A
GOOD CONDITION
☒YES ☐NO
TEMPERATURE ____
SHIPMENT METHOD: ☐HAND
☐COURIER ☐OVERNIGHT

TURNAROUND TIME:
☐ 24 HOURS ☐ 1 WEEK
☐48 HOURS ☒STANDARD
☐72 HOURS OTHER ____

White and Yellow Copies to Lab   Pink to Project Manager   Lab to Return White Copy to Hart Crowser   Gold to Sample Custodian

From (425) 329-1146
Kans Pratt
Hart Crowser
120 3RD AVE S STE 110

EDMONDS WA 98020

Origin ID PAEA

FedEx.
Express

E

J13C1306280326

Ship Date 30AUG13
ActWgt 77.5 LB
CAD 3776327/INET3430

Dims 23 X 14 X 15 IN

Delivery Address Bar Code

SHIP TO: (541) 265-7225 **BILL SENDER**

Gerald Irissarri
Northwestern Aquatic Sciences
3814 Yaquina Bay Rd

NEWPORT, OR 97365

Ref #
Invoice #
PO #
Dept #

SATURDAY 1:30P
PRIORITY OVERNIGHT

TRK# 7965 8872 7507
0201

86 ONPA

97365
OR-US
PDX

51AG1/0DB0/1A0E

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1 Use the 'Print' button on this page to print your label to your laser or inkjet printer
2 Fold the printed page along the horizontal line
3 Place label in shipping pouch and affix it to your shipment so that the barcode portion of the label can be read and scanned

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Use of this system constitutes your agreement to the service conditions in the current FedEx Service Guide, available on fedex com FedEx will not be responsible for any claim in excess of $100 per package, whether the result of loss, damage, delay, non-delivery, misdelivery or misinformation, unless you declare a higher value, pay an additional charge, document your actual loss and file a timely claim Limitations found in the current FedEx Service Guide apply Your right to recover from FedEx for any loss, including intrinsic value of the package, loss of sales, income interest profit, attorney's fees, costs, and other forms of damage whether direct, incidental, consequential, or special is limited to the greater of $100 or the authorized declared value Recovery cannot exceed actual documented loss Maximum for items of extraordinary value is $1,000, e g jewelry precious metals, negotiable instruments and other items listed in our ServiceGuide Written claims must be filed within strict time limits see current FedEx Service Guide

CUSTODY SEAL

Cooler 1 of 2

Date 8/30/13
Signature

Nalge Nunc International
I-CHEM™
Brand Products

90009

From (425) 329 1146
Kara Pratt
Hart Crowser
120 3RD AVE S STE 110

EDMONDS WA 98020

Origin ID PAEA

FedEx Express

E

Ship Date 30AUG13
ActWgt 59 0 LB
CAD 3776327/INET3430

Dims 23 X 14 X 15 IN

Delivery Address Bar Code

SHIP TO: (541) 265 7225

BILL SENDER

Gerald Irissarri
Northwestern Aquatic Sciences
3814 Yaquina Bay Rd

NEWPORT, OR 97365

Ref # Monte Cristo
Invoice #
PO #
Dept #

SATURDAY 1:30P
PRIORITY OVERNIGHT

TRK# 7965 8876 3972
0201

86 ONPA

97365
OR US
PDX

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3 Place label in shipping pouch and affix it to your shipment so that the barcode portion of the label can be read and scanned

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Use of this system constitutes your agreement to the service conditions in the current FedEx Service Guide, available on fedex com FedEx will not be responsible for any claim in excess of $100 per package whether the result of loss damage, delay non-delivery misdelivery,or misinformation unless you declare a higher value pay an additional charge document your actual loss and file a timely claim Limitations found in the current FedEx Service Guide apply Your right to recover from FedEx for any loss including intrinsic value of the package loss of sales income interest profit attorney's fees costs, and other forms of damage whether direct incidental consequential or special is limited to the greater of $100 or the authorized declared value Recovery cannot exceed actual documented loss Maximum for items of extraordinary value is $1 000 e g jewelry precious metals negotiable instruments and other items listed in our ServiceGuide Written claims must be filed within strict time limits see current FedEx Service Guide

CUSTODY SEAL

Cooler 2 of 2

Date 8/30/13
Signature

Nalge Nunc International

I-CHEM™ Brand Products

80009

APPENDIX III

RAW DATA – REFERENCE TOXICANT TEST

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-

ACUTE TOXICITY TEST (ALL SPECIES)

REVIEWED PAGES 1-7 -GJI

Test No. 999-3209 Client: QC Test Investigator

Test Type (rangefinding/definitive) Definitive Test Length (hr) 96

Species *Chironomus dilutus*

STUDY MANAGEMENT

Client: QC test

Client's Study Monitor: QC test

Testing Laboratory: Northwestern Aquatic Sciences

Test Location: Newport Laboratory

Laboratory's Study Personnel:

Proj. Man./Study Dir. G.J. IRISSARRI GJI

QA Officer L. K. Nemeth

1. GABuhler 2. S F Knowlton

3. Vivel Nakahama 4.

Study Schedule:

Test Beginning: 9-10-13 1420 Test Ending: 9-14-13 1410

TEST MATERIAL

Description: Potassium Chloride Crystals - Lot No.: FISHER 114689

NAS Sample No.

Date of Collection:

Date of Receipt:

Temperature (deg C):

Dissolved oxygen (mg/L):

pH:

Conductivity (umhos/cm):

Hardness (mg/L):

Alkalinity (mg/L):

Salinity (ppt):

Total chlorine (mg/L):

Total ammonia-N (mg/L):

DILUTION WATER

Description: Moderately hard synthetic water

Date of Preparation/Collection: 9-3-13

Water Quality: Cond. (umhos/cm): 282 Salinity (ppt) pH 7.6

Hardness (mg/L as CaCO₃): 86 Alkalinity (mg/L as CaCO₃): 70

Treatments: Aerated ≥ 24 hrs

TEST LOCATION

Test conducted in (circle one): room 1 room 2 trailer water bath other: Room#3

Randomization chart:

2.5	2.5	1.25	10	5	0	2.5	5	1.25	0
10	0	5	1.25	0	1.25	10	0.63	0	1.25
5	5	0.63	0.63	0.63	5	0	1.25	5	10
0.63	0.63	2.5	0	1.25	10	0.63	2.5	10	2.5
0	1.25	10	2.5	10	2.5	5	0	2.5	0.63
1.25	10	0	5	2.5	0.63	1.25	10	0.63	5

Error codes: 1) Correction of handwriting error

2) Written in wrong location; entry deleted

3) Wrong date deleted; replaced with correct date

4) Error found in measurement; measurement repeated

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-________

ACUTE TOXICITY TEST (ALL SPECIES)

Test No. 999-3209 Client QC Test Investigator ________

TEST ORGANISMS

Species: *Chironomus dilutus* Age: <24 HRS Size: 1st instar

Source: NAS cultures

Acclimation Data:

Date	Temp. (deg.C)	pH	DO (mg/L)	Cond umhos/cm	Feeding amount	Feeding description	Water changes	Hardness (mg/L)	Alkalinity (mg/L)
9-7-13	21.9	7.1	8.5	129		NONE	NONE	26	30
9-8-13	19.3	8.3	9.1	123		↓	↓	34	30
9-9-13	24.2	7.9	8.3	161		↓	↓	26	50
9-10-13	24.3	7.6	7.5	222		↓	↓	34	50
Mean	22.4	7.7	8.4	159				30	40
S.D.	2.4	0.5	0.7	45				5	12
(N)	4	4	4	4				4	4

Photoperiod during acclimation: 16:8, L:D

TEST PROCEDURES AND CONDITIONS

Test concentrations (50% series recommended): 10, 5, 2.5, 1.25, 0.63, 0 g/L

Test chamber: 30 ml plastic cups Test volume: 20 ml

Replicates/treatment: 10 Organisms/treatment: 10 (1/rep)

Test water changes: None Aeration during test: None

Feeding: 0.25 ml Tetra Fin (4g/L) suspension per cup on days 0 and 2

Duration: 24-hr, 48-hr, [✓ 96-hr] Test temperature (deg.C): 23 ± 1

Beaker placement: Stratified randomization Photoperiod: 16:8, L:D

MISCELLANEOUS NOTES

Test solution preparation:

Working stock: Dissolve 5g KCl crystals in dilution water and dilute to 500 mL. Final conc.: 10 g/L.

9-10-13
601

Test concentration (g/L)	KCl working stock (ml/200ml)	ml of dilution water per 200 ml
10	200	0
5	100	100
2.5	50	150
1.25	25	175
0.63	12.5	187.5
0	0	0

ACUTE TOXICITY TEST (ALL SPECIES)

Test No. 999-3209 Client QC Test

DAILY RECORD SHEET

Day 0 (9 /10 /13) ~~V~~ /SK/ GB Temp Beaker (°C): 23.2

Conc. (g/L)	Temp. (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	Comments
1. 10	23.8	8.3	12100	8.0	94	70	
2. 5	23.8	8.2	7780	7.9			
3. 2.5	23.9	8.2	4190	7.9			
4. 1.25	23.9	8.2	2350	7.8			
5. 0.63	23.8	8.2	1362	7.7			
6. 0	23.7	8.2	285	7.4	94	60	

Each replicate fed 0.25 ml Tetra Fin suspension. Initials: GB

Day 1 (9 /11 /13) SK Temp Beaker (°C): 23.0

Conc. (g/L)	Temp. (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	Comments
1. 10							
2. 5							
3. 2.5							
4. 1.25							
5. 0.63							
6. 0							

Day 2 (9 / 12 /13) GB Temp Beaker (°C): 23.3

Conc. (g/L)	Temp. (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	Comments
1. 10							
2. 5							
3. 2.5							
4. 1.25							
5. 0.63							
6. 0							

Each replicate fed 0.25 ml Tetra Fin suspension. Initials: GB

Day 3 (9 /13 /13) V Temp Beaker (°C): 23.0

Conc. (g/L)	Temp. (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	Comments
1. 10							
2. 5							
3. 2.5							
4. 1.25							
5. 0.63							
6. 0							

Day 4 (9 /14 /13) GB Temp Beaker (°C): 23.1

Conc. (g/L)	Temp. (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	Comments
1. 10	—	—	—	—	—	—	
2. 5	—	—	—	—			
3. 2.5	23.1	7.4	4320	~~7.3~~ 7.4			
4. 1.25	23.0	7.2	2640	~~7.2~~ 7.2			
5. 0.63	23.0	7.2	1460	~~7.0~~ 7.2			
6. 0	23.1	7.0	325	7.0	94	80	
Mean	23.5	7.8	10: 12400 0: 305	7.5	94	70	
SD	0.4	0.5	10: — 0: —	0.4	0	10	
n	(10)	(10)	10: (1) 0: (2)	(10)	(3)	(3)	

ACUTE TOXICITY TEST (ALL SPECIES)

Test No. 999-3209 Client QC Test Investigator

DAILY RECORD SHEET - Survivors

Day 0 (9/10/13) GSJ

Conc. (g/L)	Survivors in Replicate:										Total
	1	2	3	4	5	6	7	8	9	10	
1. 10	1	1	1	1	1	1	1	1	1	1	10
2. 5	1	1	1	1	1	1	1	1	1	1	10
3. 2.5	1	1	1	1	1	1	1	1	1	1	10
4. 1.25	1	1	1	1	1	1	1	1	1	1	10
5. 0.63	1	1	1	1	1	1	1	1	1	1	10
6. 0	1	1	1	1	1	1	1	1	1	1	10

Day 1 (9/11/13) GJI

Conc. (g/L)	Survivors in Replicate:										Total
	1	2	3	4	5	6	7	8	9	10	
1. 10	0	0	0	0	0	0	0	0	0	0	0 (10D)
2. 5	1	0	0	1	1	1	0	0	1	1	6 (4D)
3. 2.5	1	1	1	1	1	1	1	1	1	1	10
4. 1.25	1	1	1	1	1	1	1	1	1	1	10
5. 0.63	1	1	1	1	1	1	1	1	1	1	10
6. 0	1	1	1	1	1	1	1	1	1	1	10

Day 2 (9/12/13) GD

Conc. (g/L)	Survivors in Replicate:										Total
	1	2	3	4	5	6	7	8	9	10	
1. 10	0	0	0	0	0	0	0	0	0	0	0
2. 5	0	0	0	1	1	1	0	0	1	1	5(1D)
3. 2.5	1	1	1	1	1	1	1	1	1	0	9(1D)
4. 1.25	1	1	1	1	1	1	1	1	1	1	10
5. 0.63	1	1	1	1	1	1	1	1	1	1	10
6. 0	1	1	1	1	1	1	1	1	1	1	10

Day 3 (9/13/13) UD

Conc. (g/L)	Survivors in Replicate:										Total
	1	2	3	4	5	6	7	8	9	10	
1. 10	0	0	0	0	0	0	0	0	0	0	0
2. 5	0	0	0	0	0	0	0	0	0	0	0(5D)
3. 2.5	1	1	1	1	1	1	1	1	1	0	9
4. 1.25	1	1	1	1	1	1	1	1	1	1	10
5. 0.63	1	1	1	1	1	1	1	1	1	1	10
6. 0	1	1	1	1	1	1	1	1	1	1	10

Day 4 (9/14/13) MB

Conc. (g/L)	Survivors in Replicate:										Total
	1	2	3	4	5	6	7	8	9	10	
1. 10	0	0	0	0	0	0	0	0	0	0	0
2. 5	0	0	0	0	0	0	0	0	0	0	0
3. 2.5	1	1	1	1	1	1	1	1	1	0	9
4. 1.25	1	1	1	1	1	1	1	1	1	1	10
5. 0.63	1	1	1	1	1	1	1	1	1	1	10
6. 0	1	1	1	1	1	1	1	1	1	1	10

Acute 96-hr Toxicity Test-96 Hr Survival

Start Date:	9/10/2013 14:20	Test ID:	999-3209	Sample ID:	REF-Ref Toxicant
End Date:	9/14/2013 14:10	Lab ID:	ORNAS-Northwestern Aquati	Sample Type:	KCL-Potassium chloride
Sample Date:		Protocol:	EPAF 91-EPA Freshwater	Test Species:	CT-Chironomus dilutus
Comments:					

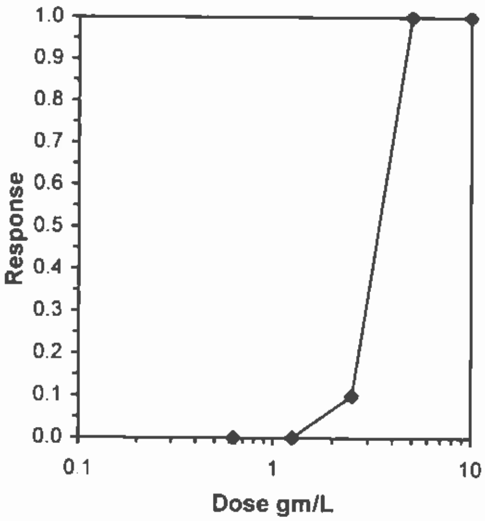
Conc-gm/L	1
D-Control	1.0000
0.63	1.0000
1.25	1.0000
2.5	0.9000
5	0.0000
10	0.0000

Conc-gm/L	**Mean**	**N-Mean**	Resp	Not Resp	**Total**	**N**	**Fisher's Exact P**	**1-Tailed Critical**	**Number Resp**	**Total Number**
D-Control	1.0000	1.0000	0	10	10	1			0	10
0.63	1.0000	1.0000	0	10	10	1	1.0000	0.0500	0	10
1.25	1.0000	1.0000	0	10	10	1	1.0000	0.0500	0	10
2.5	0.9000	0.9000	1	9	10	1	0.5000	0.0500	1	10
5	0.0000	0.0000	10	0	10	1			10	10
10	0.0000	0.0000	10	0	10	1			10	10

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Fisher's Exact Test	2.5	5	3.53553	

Trimmed Spearman-Karber

Trim Level	**EC50**	**95% CL**	
0.0%	3.2988	2.8922	3.7624
5.0%	3.3730	2.8623	3.9748
10.0%	3.4020	3.1367	3.6897
20.0%	3.4020	3.1367	3.6897
Auto-0.0%	3.2988	2.8922	3.7624

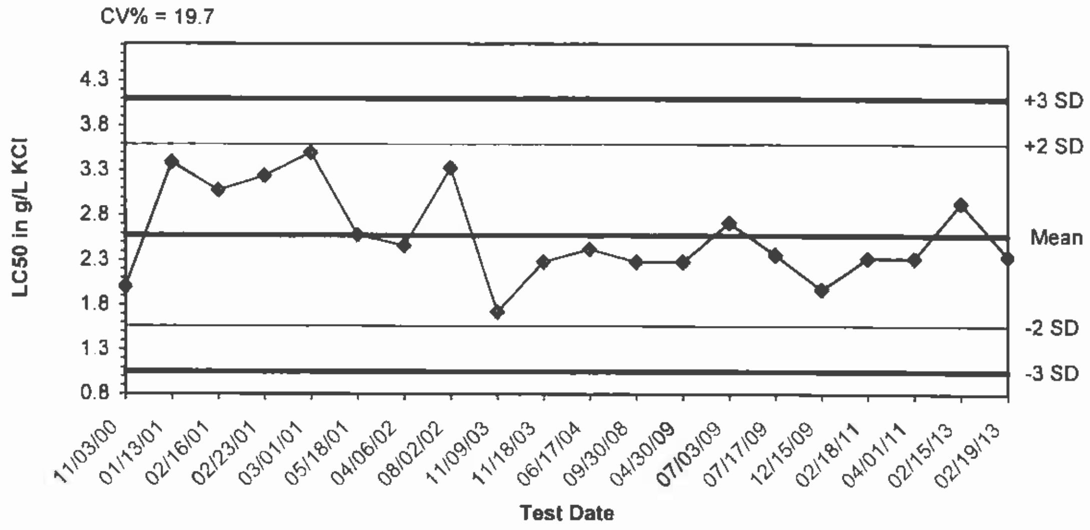


Test: AT-Acute 96-hr Toxicity Test
Test ID: 999-3209
Species: CT-Chironomus dilutus
Protocol: EPAF 91-EPA Freshwater
Sample ID: REF-Ref Toxicant
Sample Type: KCL-Potassium chloride
Start Date: 9/10/2013 14:20
End Date: 9/14/2013 14:1
Lab ID: ORNAS-Northwestern Aquatic Sciences

Pos	ID	Rep	Group	Start	24 Hr	48 Hr	72 Hr	96 Hr	Notes
	1	1	D-Control	10				10	
	2	1	0.630	10				10	
	3	1	1.250	10				10	
	4	1	2.500	10				9	
	5	1	5.000	10				0	
	6	1	10.000	10				0	

Comments: data entry verified against laboratory bench sheets 10-10-13 JRF

First instar midge larvae, Chironomus dilutus, acute reference toxicant test



Dates	Values	Mean	-2 SD	-3 SD	+2 SD	+3 SD
11/03/00	2.0000	2.5765	1.5610	1.0532	3.5920	4.0998
01/13/01	3.3900	2.5765	1.5610	1.0532	3.5920	4.0998
02/16/01	3.0800	2.5765	1.5610	1.0532	3.5920	4.0998
02/23/01	3.2400	2.5765	1.5610	1.0532	3.5920	4.0998
03/01/01	3.5000	2.5765	1.5610	1.0532	3.5920	4.0998
05/18/01	2.5800	2.5765	1.5610	1.0532	3.5920	4.0998
04/06/02	2.4600	2.5765	1.5610	1.0532	3.5920	4.0998
08/02/02	3.3300	2.5765	1.5610	1.0532	3.5920	4.0998
11/09/03	1.7200	2.5765	1.5610	1.0532	3.5920	4.0998
11/18/03	2.2800	2.5765	1.5610	1.0532	3.5920	4.0998
06/17/04	2.4200	2.5765	1.5610	1.0532	3.5920	4.0998
09/30/08	2.2800	2.5765	1.5610	1.0532	3.5920	4.0998
04/30/09	2.2800	2.5765	1.5610	1.0532	3.5920	4.0998
07/03/09	2.7200	2.5765	1.5610	1.0532	3.5920	4.0998
07/17/09	2.3600	2.5765	1.5610	1.0532	3.5920	4.0998
12/15/09	1.9700	2.5765	1.5610	1.0532	3.5920	4.0998
02/18/11	2.3200	2.5765	1.5610	1.0532	3.5920	4.0998
04/01/11	2.3200	2.5765	1.5610	1.0532	3.5920	4.0998
02/15/13	2.9400	2.5765	1.5610	1.0532	3.5920	4.0998
02/19/13	2.3400	2.5765	1.5610	1.0532	3.5920	4.0998

APPENDIX C
Chemical Data Quality Review and Laboratory Reports

(Provided on CD)

APPENDIX C
CHEMICAL DATA QUALITY REVIEW AND LABORATORY REPORTS

CHEMICAL DATA QUALITY REVIEW

Twenty-four surface water samples and fourteen sediment samples were collected in July and August 2013. The samples were submitted for chemical analysis to Analytical Resources Inc. (ARI), of Tukwila, Washington and Brooks Rand Labs (BRL), of Seattle, WA. A summary of the sample names, matrices, associated laboratory reports, and analytical tests are provided in Table C-1.

Quality assurance/quality control (QA/QC) reviews of laboratory procedures were performed on an ongoing basis by the laboratories. Hart Crowser reviewed the data, using laboratory quality control results summary sheets and raw data, as required, to ensure they met data quality objectives for the project. Data review followed the Monte Cristo Mining Area, Remediation Investigation Phase 3, Sampling and Analysis Plan/Quality Assurance Project Plan, dated May 31, 2013, and the format outlined in the National Functional Guidelines for Inorganic Data Review (EPA 2010) modified to include specific criteria of the individual analytical methods. The following elements were reviewed:

- Sampling documentation;
- Holding times and receiving temperatures;
- Reporting limits;
- Laboratory method blanks (metals only);
- Laboratory control sample/laboratory control sample duplicate (LCS/LCSD) recoveries (metals only);
- Matrix spike/matrix spike duplicate (MS/MSD) recoveries (metals only);
- Post-digestion spike (PS) recoveries (metals only);
- Certified reference material (CRM) recoveries and standard reference material (SRM) recoveries;
- Laboratory replicate relative standard deviations (RSDs); and
- Laboratory duplicate relative percent differences (RPDs).

The data were acceptable for use with qualification as described in the sections below. Full laboratory results are presented at the end of this appendix.

Sample Naming Conventions

Co-located surface water and sediment samples had identical names and collection date and times. ARI distinguished between the samples by entering them into the Laboratory Information Management System (LIMS) as separate job numbers (i.e. HC-76-02 (water) was reported in job number XD16, while HC-76-02 (sediment) was reported in XD13).

Sample Receiving Discrepancies

BRL 1328039: The sample containers were listed individually on the Chain of Custody (COC), and entered into the laboratory LIMS as separate samples. Two sample containers for sample HC-MCL-MAIN were mislabeled on the COC as HC-MCM-MAIN. The sample identification was hand-corrected on the laboratory reports.

ARI WX27: The sample matrix was not identified on the COC. Samples HC-MCL-MAIN-B and HC-MCL-MAIN-A were misidentified on the COC and bottles as HC-MCM-MAIN-B and HC-MCM-MAIN-A. The sample identification was hand-corrected on the laboratory reports.

ARI XD13 and XD16: Several sample collection times did not match between sample labels and the COC. At the time of sample collection, an Ecology representative on site requested that the time each individual bottle was filled be written on the sample label, so there were multiple collection times for each sample. When the COC was completed, a standard time for each sample was selected. Several analytical tests were not marked on the COC, and were added by the laboratory.

ARI XD 16: A portion of the total metals sample volume (100 mL) for HC-SFSR-07 was inadvertently field filtered. Results from this sample container are now J qualified because of a potential low bias in the results.

Holding Times, Preservation, and Receiving Temperatures

The sample coolers and samples were received intact at the laboratory and were within the required 0 to 6 degrees Celsius, with the following exceptions:

- ARI WX27: The temperature of the cooler was slightly above 6 degrees Celsius. As the samples were analyzed for metals only, sample results were not affected by the temperature exceedance, and no results were qualified.

Sample holding times were evaluated by comparing the sample collection dates to the sample extraction dates and analysis dates, with the following exceptions:

- BRL 1328039: Sample HC-MCL-MAIN was filtered past the 48 hour holding time. The laboratory qualified the results with H due to the holding time exceedance. The H qualifier was changed to J (estimated).

- ARI XD13: Sample HC-SFSR-07 was received at the laboratory past the seven day holding time for sulfide. Samples HC-GC-05, HC-GC-01, and HC-SFSR-03 were received with less than 48 hours before the holding time expired for sulfide. Samples HC-GC-05, HC-GC-01, HC-SFSR-03, and HC-SFSR-07 were analyzed past the holding time, and results were qualified as estimated (J) due to the holding time exceedances.

Sample preservation met method requirements.

Reporting Limits

Reporting limits were elevated in some samples because of sample dilution. Such increases in the reporting limits are an unavoidable but acceptable consequence of sample dilution that enables quantification of target analytes within the calibration range of the instrument, or that reduces the interferences, thereby enabling quantification of target analytes.

Analyte detections between the method detection limit (MDL) and method reporting limit (RL) were qualified by the laboratory with J (ARI) or B (BRL). The J or B qualifier was changed to T to be consistent with the Washington State Department of Ecology Environmental Information Management (EIM) database reporting requirements.

Surface Water Samples

EPA Method 1638 for Total Arsenic, Cadmium, and Silver

Laboratory Blanks

Method blanks were analyzed at the required frequency. Sample results were method-blank corrected.

- 1300525-ICB2: The initial calibration blank (ICB) for silver analyzed on 7/25/13 had a detection for silver above the low calibration standard. No samples were associated with that ICB, and no results were qualified.

- 1300632-ICB2: The ICB for silver analyzed on 09/13/13 had a detection for silver above the low calibration standard. No samples were associated with that ICB, and no results were qualified.

Laboratory Control Sample (LCS)

Laboratory control samples and laboratory control sample duplicates are analyzed by the laboratory to assess the accuracy of the analytical equipment. The LCS and LSCD samples are prepared from analyte-free matrix, which is then spiked with known levels of the analytes of concern. The concentrations are measured and the results are compared to the known spiked levels. All LCS and LCSD recoveries were within control limits. RPDs between the LCS and LCSD were also within control limits.

Matrix Spike/Matrix Spike Duplicate (MS/MSD)

The matrix spike and matrix spike duplicate samples are a portion of a field sample spiked with target analytes and are prepared with each analytical batch used to assess accuracy. Results from these analyses provide information on the extent of any signal suppression or enhancement due to matrix interference. The RPD between MS and MSD recoveries are used to assess precision. The QAPP control limits for MS and MSD recoveries are from 75 to 125 percent. All MS and MSD recoveries were within control limits. RPDs between the MS and MSD were also within control limits.

Laboratory Duplicate

Laboratory duplicates were prepared with each analytical batch by extracting a second separate aliquot of a sample. The laboratory duplicates were evaluated to assess analytical precision of the method and potential variability of the sample matrix. Laboratory duplicate RPDs were within control limits with the following exceptions:

- HC-SFSR-07 Dup: The RPD for silver exceeded the control limit. The sample and duplicate results were less than five times the MRL and no results were qualified.

Certified Reference Material

Certified reference materials (CRMs) were prepared with each analytical batch as an additional QC sample. All CRM recoveries were within control limits.

EPA Method 1638 for Dissolved Arsenic, Cadmium, and Silver

Laboratory Blanks

Method blanks were analyzed at the required frequency. Sample results were method-blank corrected.

- 1300525-ICB2: The initial calibration blank (ICB) for silver analyzed on 7/25/13 had a detection for silver above the low calibration standard. No samples were associated with that ICB, and no results were qualified.

- 1300632-ICB2: The ICB for silver analyzed on 09/13/13 had a detection for silver above the low calibration standard. No samples were associated with that ICB, and no results were qualified.

Laboratory Control Sample (LCS)

All LCS and LCSD recoveries were within control limits. RPDs between the LCS and LCSD were also within control limits.

Matrix Spike/Matrix Spike Duplicate (MS/MSD)

All MS and MSD recoveries were within control limits. RPDs between the MS and MSD were also within control limits.

Laboratory Duplicate

Laboratory duplicate RPDs were within control limits.

Certified Reference Material

All CRM recoveries were within control limits.

EPA Method 1631 for Total Mercury

Laboratory Blanks

Method blanks were analyzed at the required frequency. Sample results were method-blank corrected.

Matrix Spike/Matrix Spike Duplicate (MS/MSD)

All MS and MSD recoveries were within control limits. RPDs between the MS and MSD were also within control limits.

Certified Reference Material

All CRM recoveries were within control limits.

EPA Method 1631 for Dissolved Mercury

Laboratory Blanks

Method blanks were analyzed at the required frequency. Sample results were method-blank corrected.

Matrix Spike/Matrix Spike Duplicate (MS/MSD)

All MS and MSD recoveries were within control limits. RPDs between the MS and MSD were also within control limits.

Certified Reference Material

All CRM recoveries were within control limits.

Sample Notes

Samples HC-SFSR-07D, HC-GC-01D, HC-GC-05D, and HC-76-02D had dissolved Hg results much greater than the total Hg results for the samples. The laboratory confirmed the sample labels, but no discrepancies were observed.

EPA Method 6020A for Total Aluminum, Antimony, Barium, Beryllium, Calcium, Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Manganese, Nickel, Potassium, Selenium, Sodium, Thallium, Vanadium, and Zinc

Laboratory Blanks

There was no blank contamination.

Laboratory Control Sample (LCS)

All LCS and LCSD recoveries were within control limits. RPDs between the LCS and LCSD were also within control limits.

Matrix Spike/Matrix Spike Duplicate (MS/MSD)

All MS and MSD recoveries were within control limits. RPDs between the MS and MSD were also within control limits.

Laboratory Duplicate

Laboratory duplicate RPDs were within control limits or not applicable when sample and duplicate results were less than five times the MRL.

EPA Method 6020A for Dissolved Aluminum, Antimony, Barium, Beryllium, Calcium, Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Manganese, Nickel, Potassium, Selenium, Sodium, Thallium, Vanadium, and Zinc

Laboratory Blanks

There was no blank contamination with the following exception:

- MB-0900413: The method blank had detections for copper and sodium above the MRL. The laboratory did not reprepare the samples as the detections were below the action limit. The samples were evaluated and qualified thus:
    - Detections for copper or sodium that were less than three times the amount in the MB were qualified as non-detect (U) (HC-GC-05D [Cu], HC-GC-01D [Cu, Na], HC-SFSR-03D [Cu], HC-SFSR-07D [Cu], HC-SFSR-09D [Cu])
    - Detections for copper or sodium that were greater than three times the amount in the MB were not qualified (HC-GC-05D [Na], HC-SFSR-03D [Na], HC-76-02D [Cu, Na], HC-SFSR-07D [Na], HC-MCLD [Na], HC-SFSR-09D [Na])
    - Results for copper or sodium that were below the MRL were not qualified (HC-MCLD [Cu])

Laboratory Control Sample (LCS)

All LCS and LCSD recoveries were within control limits. RPDs between the LCS and LCSD were also within control limits.

Matrix Spike/Matrix Spike Duplicate (MS/MSD)

All MS and MSD recoveries were within control limits. RPDs between the MS and MSD were also within control limits.

Laboratory Duplicate

Laboratory duplicate RPDs were within control limits or not applicable when sample and duplicate results were less than five times the MRL.

EPA Method 200.8 for Dissolved Aluminum, Antimony, Barium, Beryllium, Calcium, Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Manganese, Nickel, Potassium, Selenium, Sodium, Thallium, Vanadium, and Zinc

Laboratory Blanks

No blank contamination was detected with the following exception:

- MB-071513: The method blank had a detection for iron above the MRL. Results for iron in the associated samples that were less than three times the amount in the method blank were qualified as non-detect (U) [HC-MCL-MAIN-B, HC-SFSR-03-B, and HC-GC-01-B].

Laboratory Control Sample (LCS)

All LCS and LCSD recoveries were within control limits. RPDs between the LCS and LCSD were also within control limits.

Matrix Spike/Matrix Spike Duplicate (MS/MSD)

RPDs between the MS and MSD were also within control limits.

Laboratory Duplicate

Laboratory duplicate RPDs were within control limits.

Conventional Analyses

Analytical Methods

Alkalinity was determined following SM 2320. Chloride, fluoride, and sulfate were prepared and analyzed following EPA Method 300.0.

Laboratory Blanks

No blank contamination was detected for chloride, fluoride, or sulfate.

Matrix Spike/Matrix Spike Duplicate (MS/MSD)

The MS and MSD recoveries and RPDs were within control limits for chloride, fluoride, and sulfate.

Laboratory Duplicate

Laboratory duplicate RPDs were within control limits or not applicable for alkalinity, chloride, fluoride, and sulfate.

Standard Reference Material

All SRM recoveries were within control limits for alkalinity, chloride, fluoride, and sulfate.

Sediment Samples

EPA Method 6010C for Total Aluminum, Antimony, Arsenic, Barium, Beryllium, Cadmium, Calcium, Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Manganese, Nickel, Sodium, Vanadium, and Zinc

Laboratory Blanks

No blank contamination was detected.

Laboratory Control Sample (LCS)

All LCS and LCSD recoveries were within control limits. RPDs between the LCS and LCSD were also within control limits.

Matrix Spike/Matrix Spike Duplicate (MS/MSD)

The MS and MSD recoveries and RPDs were within control limits with the following exceptions:

- HC-GC-05 MS/MSD: The recoveries for aluminum, calcium, iron, magnesium, manganese, and zinc fell outside the control limits. The recovery for antimony failed low. The amounts of aluminum, calcium, iron, magnesium, manganese, and zinc in the source sample were greater than the amount spiked, and sample results were not qualified. Antimony results in all associated samples were qualified as estimated (J) [HC-GC-05, HC-GC-01, HC-SFSR-03, HC-76-02, HC-SFSR-07, HC-MCL, and HC-SFSR-09].

Laboratory Duplicate

Laboratory duplicate RPDs were within control limits with the following exceptions:

- HC-GC-05 Dup: The RPDs for arsenic, cadmium, lead, manganese, and zinc exceeded the method control limits. The RPD for manganese fell within the QAPP control limits, and was not qualified. The result for cadmium in the duplicate was less than five times the MRL and cadmium was not qualified. The results for arsenic, lead, and zinc in HC-GC-05 were qualified as estimated (J) due to sample heterogeneity.

EPA Method 7471A for Total Mercury

Laboratory Blanks

No blank contamination was detected.

Laboratory Control Sample (LCS)

All LCS and LCSD recoveries were within control limits. RPDs between the LCS and LCSD were also within control limits.

Matrix Spike/Matrix Spike Duplicate (MS/MSD)

The MS and MSD recoveries and RPDs were within control limits.

Laboratory Duplicate

Laboratory duplicate RPDs were within control limits or not applicable when sample and duplicate results were less than five times the RL.

EPA Method 200.8 for Total Thallium

Laboratory Blanks

No blank contamination was detected.

Laboratory Control Sample (LCS)

All LCS and LCSD recoveries were within control limits. RPDs between the LCS and LCSD were also within control limits.

Matrix Spike/Matrix Spike Duplicate (MS/MSD)

The MS and MSD recoveries and RPDs were within control limits.

Laboratory Duplicate

Laboratory duplicate RPDs were within control limits or not applicable when sample and duplicate results were less than five times the RL.

Conventional Analyses

Analytical Methods

Total solids were prepared and analyzed following SM 2540B for samples analyzed at ARI. pH was analyzed following EPA Method 9045. Total Organic Carbon was prepared and analyzed by EPA Method 9060 Modified. Sulfide was prepared and analyzed following EPA Method 376.2. Acid volatile sulfide (AVS) was prepared and analyzed following EPA-821-R-91-100 draft method. Grain size was determined following PSEP Grain Size method.

Laboratory Blanks

No blank contamination was detected for TOC, sulfide, AVS, or total solids.

Laboratory Control Sample (LCS)

All LCS and LCSD recoveries were within control limits for pH, sulfide, AVS, and TOC.

Matrix Spike/Matrix Spike Duplicate (MS/MSD)

The MS and MSD recoveries and RPDs were within control limits for AVS, TOC, and sulfide.

Laboratory Duplicate

Laboratory duplicate RPDs were within control limits or not applicable for sulfide, AVS, and total solids.

Standard Reference Material

All SRM recoveries were within control limits for TOC.

Laboratory Replicate

Laboratory replicate RSDs were within control limits for TOC and grain size.

Sample Notes

- Samples HC-GC-01, HC-SFSR-03, HC-76-02, HC-SFSR-07, and HC-SFSR-09: Insufficient fines were available for the pipette analysis for grain size.

- Samples HC-SFSR-07 and HC-MCL: The samples contained woody or organic material, which was not removed prior to grain size analysis.

- Samples HC-GC-01, HC-SFSR-03, HC-76-02, and HC-SFSR-07: The moisture content portion of the grain size analysis was redone as it did not meet internal laboratory QA measurements. Sample results were not qualified.

Table C-1. Monte Cristo Sample Summary

Sample ID	Sample Date	Sample Time	Matrix	Total Metals	Total Hg by EPA 1631	Total Ag, As, Cd by EPA 1638	Methyl Hg by EPA 1630 modified	Selenium by EPA draft Method 1638, modifie	Dissolved metals	Dissolved Hg by EPA 1631	Dissolved Ag, As, Cd by EPA 1638	Alkalinity	Anions	Grain Size	Acid Volatile Sulfide	Total Organic Carbon	pH	Total solids by SM 2540G	Soil Fertility	Sulfide	Bioassay	Lab Report	DV	Notes
				Analyses																				
HC-GC-01-A	7/9/2013	1515	W	X																		WX27	X	
HC-GC-01	7/9/2013	1515	W		X	X				X	X											1328039	X	Filter at lab
HC-GC-01-B	7/9/2013	1515	W						x													WX27	X	Filter at lab
HC-GC-01	8/24/2013	1440	W	X	X	X						X										XD16, 1335046	X	
HC-GC-01D	8/24/2013	1440	W						X	X	X		X									XD16, 1335046	X	
HC-GC-01	8/24/2013	1440	SED	X										X	X	X	X	X		X		XD13	X	
HC-GC-01	8/24/2013	1330	SED																		X	P848		
HC-GC-05	8/25/2013	1445	W	X	X	X						x										XD16, 1335046	X	
HC-GC-05D	8/25/2013	1445	W						X	X	X		X									XD16, 1335046	X	
HC-GC-05	8/25/2013	1445	SED	x										x	x	x	x	x		x		XD13	X	
HC-GC-05	8/25/2013	1245	SED																		X	P848		
HC-76-02	8/26/2013	1200	W	X	X	X						X										XD16, 1335046	X	
HC-76-02D	8/26/2013	1200	W						X	X	X		X									XD16, 1335046	X	
HC-76-02	8/26/2013	1200	SED	X										X	X	X	X	X		X		XD13	X	
HC-76-02	8/26/2013	1015	SED																		X	P848		
HC-MCL-MAIN	7/8/2013	1610	W		X	X				X	X											1328039	X	Filter at lab, Sample mislabeled as HC-MCM-MAIN
HC-MCL-MAIN-A	7/8/2013	1610	W	X																		WX27	X	Sample mislabeled as HC-MCM-MAIN-A
HC-MCL-MAIN-B	7/8/2013	1610	W						x													WX27	X	Filter at lab, Sample mislabeled as HC-MCM-MAIN-B
HC-MCL	8/27/2013	1400	W	X	X	X						X										XD16, 1335046	X	
HC-MCL D	8/27/2013	1400	W						X	X	X		X									XD16, 1335046	X	
HC-MCL	8/27/2013	1400	SED	X										X	X	X	X	X		X		XD13	X	
HC-MCL	8/27/2013	1535	SED																		X	P848		
HC-SFSR-03	7/10/2013	1443	W		X	X				X	X											1328039	X	Filter at lab
HC-SFSR-03-A	7/10/2013	1443	W	X																		WX27	X	
HC-SFSR-03-B	7/10/2013	1443	W						x													WX27	X	Filter at lab
HC-SFSR-03	8/23/2013	1255	W	X	X	X						X										XD16, 1335046	X	
HC-SFSR-03D	8/23/2013	1255	W						X	X	X		X									XD16, 1335046	X	
HC-SFSR-03	8/23/2013	1255	SED	X										X	X	X	X	X		X		XD13	X	
HC-SFSR-03	8/23/2013	1530	SED																		X	P848		
HC-SFSR-07	8/22/2013	1330	W	X	X	X						X										XD16, 1335046	X	A portion (100 mL) of the total metals sample volume was field filtered
HC-SFSR-07D	8/22/2013	1330	W						X	X	X		X									XD16, 1335046	X	
HC-SFSR-07	8/22/2013	1330	SED	X										X	X	X	X	X		X		XD13	X	
HC-SFSR-07	8/22/2013	1730	SED																		X	P848		
HC-SFSR-09	8/28/2013	1210	W	X	X	X						X										XD16, 1335046	X	
HC-SFSR-09D	8/28/2013	1210	W						X	X	X		X									XD16, 1335046	X	
HC-SFSR-09	8/28/2013	1210	SED	X										X	X	X	X	X		X		XD13	X	
HC-SFSR-09	8/28/2013	1000	SED																		X	P848		
HC-SFSR-10	8/28/2013	1245	W							X	X											1335046	X	Filter blank
				16	**10**	**10**	**0**	**0**	**10**	**11**	**11**	**7**	**7**	**7**	**7**	**7**	**7**	**7**	**0**	**7**	**7**			