Final
SAMPLING ACTIVITIES REPORT

STANDARD MINE
GUNNISON COUNTY, COLORADO

Prepared for:
United Stated Environmental Protection Agency, Region 8
Ecosystem Protection and Remediation – Program Support

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Distribution List
Sampling Activities Report – Standard Mine – Gunnison County, Colorado

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Acronym List

bgs	Below Ground Surface
CSM	Conceptual Site Model
EPA	United States Environmental Protection Agency
ESAT	Environmental Services Assistance Team
GPS	Global Positioning System
NPL	National Priorities List
PDA	Personal Data Assistant
ROD	Record of Decision
RPD	Relative Percent Difference
SI	Site Inspection
USFWS	United States Fish and Wildlife Service

1.0 INTRODUCTION

This document is the Sampling Activities Report for a series of surface water, soil, and ecological investigations that were conducted in June, July, and September of 2006 at the Standard Mine Site (CERCLIS ID# CO0002378230) located in Gunnison County, Colorado. Sampling was performed in support of the Remedial Investigation/Feasibility Study of the Standard Mine. The following media were sampled during the investigations: surface water, pore water, sediment, soil (field screening and confirmatory sampling), macroinvertebrates (assemblage assessment), macroinvertebrate tissue, plant tissue, and fish tissue. In addition, aquatic habitat assessment, sediment toxicity testing, and surface water toxicity testing were also performed. Results of sediment and surface water toxicity testing, including analytical data collected in support of those activities, are included in separate toxicity testing reports and therefore will not be addressed in this document. Appendix D includes the Sediment Toxicity Testing report for Standard Mine and the Aquatic Toxicity Testing Report for Standard Mine.

Under United States Environmental Protection Agency (EPA) Contract Number EP-W-06-033, Techlaw, Inc. (Techlaw) was issued Technical Direction Forms DH002 and JS003 to prepare and implement a Sampling and Analysis Plan/Quality Assurance Project Plan for environmental media contaminated by metals at the Standard Mine site. These investigations were performed in accordance with the requirements outlined in the Final Quality Assurance Project Plan and Sampling and Analysis Plan for the Standard Mine Site (ESAT 2006).

During soil collection activities at the Standard Mine site, a Triad approach was employed for in-field decision making purposes. The Triad approach refers to three components of an ideal sampling and analysis program and includes the following: 1) systematic planning, 2) developing and maintaining dynamic work strategies, and 3) the use of rapid data collection technologies and measurement systems. In support of this approach, the Final Quality Assurance Project Plan and Sampling and Analysis Plan for the Standard Mine Site (ESAT 2006) was developed to serve as the systematic planning process and included the development and maintenance of dynamic work strategies. Dynamic work strategies incorporate the use of rapid data collection technologies and measurement systems as a feedback tool so that in-field decisions can be made. In-field decisions made include the determination of the site boundary for human health risk assessment purposes. Rapid data collection technologies and measurement systems that were used during this sampling event included the following: X-ray Fluorescence (XRF) instrumentation for soil screening and Trimble Personal Data Assistant (PDA)/Global Positioning System (GPS).

This summary report includes the following sections: Sampling Activities and Procedures (Section 2.0), Sample Quality Control (Section 3.0), Field Changes and/or Corrective Actions (Section 4.0), Analytical Results (Section 5.0), Triad Evaluation (Section 6.0) and References (Section 7.0).

1.1 Site Background and Description

The Standard Mine was a part of the Ruby Mining District located in Gunnison County, Colorado. Mining activity initially began at the Standard Mine in or around 1874, with the most significant operations beginning in 1931. Operations included the mining of lead, zinc, silver, and gold until 1966, when the mine was abandoned.

The mine consists of many open, unmarked adits and shafts, giving access to 8,400 feet of mine workings on 6 levels. The site also has a dilapidated mill and railroad tracks running 50 feet above the ground with rotting wooden support poles. The former mine is near a popular hiking trail and has no access restrictions. There is evidence of human activity at the site. Wastes at this mining site are estimated to be 53,560 cubic yards of waste rock and 29,340 cubic yards of mill tailings as well as seasonably variable amounts of water flowing out of the adits. Additionally, the site contains a non-engineered surface impoundment made entirely of highly mineralized waste rock. The unlined impoundment was built to collect metal-laden acid mine drainage containing cadmium, copper, lead, and zinc. There is evidence of overflow and seepage through the impoundment into Elk Creek, which runs directly adjacent to the mine. Elk Creek feeds into Coal Creek, which is a drinking water supply for the Town of Crested Butte four miles downstream from the former mine.

In 1999 a two-phase Site Inspection (SI) was conducted of the Ruby Mining District. Phase I was conducted in June 1999 to assess the environmental conditions during the high stream flow regime and Phase II was conducted September 1999 to assess the environmental conditions during the low stream flow regime (URS 2000). The 1999 SI was limited to surface water since, according to the United States Geological Survey; there are no extensive aquifer systems associated with the Ruby Mining District (USGS 1980).

SI results revealed elevated concentrations of the following metals: aluminum, antimony, arsenic, beryllium, cadmium, cobalt, copper, iron, lead, nickel, thallium, and zinc during total metals analyses of the surface waters from Coal Creek and its tributaries. In 2005 two additional sampling events were conducted in order to collect data for comparison to the 1999 SI results, evaluate changes in stream contaminant concentrations over differing flow conditions, assess sediment contaminant concentrations, and to evaluate previously unidentified watershed influences.

1.2 Objective

The 2006 investigations were conducted in order to obtain data that give current representative conditions of the quality of Coal Creek and associated tributaries, to address existing data gaps that were identified in the Screening Level Ecological Risk Assessment performed for the site (EPA 2006), and to address gaps in data identified by the EPA needed for Human Health Risk Assessment activities. Specific dates sampling activities were conducted include the following: First week, July 17-21 included ecological risk sampling, and second week July 24-28 for soil collection. The following data were collected during these investigations:

- Real-time field water quality parameters – pH, conductivity, dissolved oxygen, temperature, and GPS locations (if needed)
- Stream flows – using Marsh-McBirney flow meters, flumes (where necessary), and stream flow measurement instrumentation that is already in place
- Surface water – dissolved metals, total recoverable metals, dissolved organic carbon, anions, and alkalinity
- Pore water – dissolved metals
- Near real-time screening of soil and stream side sediment using XRF in support of soil sampling
- Soil – total recoverable metals and total mercury
- Sediment – total recoverable metals and total mercury
- Biological tissues – fish, macroinvertebrate, and plant tissue analyzed for total recoverable metals and total mercury for bird/wildlife exposure point concentrations
- Biological assessment – macroinvertebrate collection (species identification and count), and habitat assessment (using Rapid Bioassessment Protocols)
- Toxicity testing - surface water and sediment toxicity testing

2.0 SAMPLING ACTIVITIES AND PROCEDURES

Field activities at the Standard Mine site took place during June, July, and August of 2006. Specific activities included the following:

- June 19-23
  - real-time field water quality parameters
  - stream flow
  - surface water sampling
- July 5-8
  - soil sampling
- July 17-21
  - real-time field water quality parameters
  - stream flow
  - surface water
  - pore water
  - sediment
  - macroinvertebrate tissue
  - plant tissue
  - macroinvertebrate assemblage evaluation
  - habitat evaluation
  - site water and sediment collection for toxicity testing
- July 24-28
  - soil sampling
- September 11-15
  - real-time field water quality parameters
  - stream flow
  - surface water

- sediment
- macroinvertebrate assemblage evaluation
- habitat evaluation

In addition to these field activities, fish tissue sampling and assemblage assessment were performed by the Colorado Division of Wildlife during the July 17-21 event. This section outlines overall management of samples including sample identification methodology, sampling and analysis performed for each event, and sample documentation.

2.1 Sample Handling and Identification

Samples were collected, placed in containers, processed, and preserved in accordance with the EPA Region 8 Field Sampling Protocols (surface water and soil samples – note that pore water samples were processed as surface water samples), Bioassessment Protocols for Use in Streams and Wadeable Rivers (macroinvertebrate samples), EPA Environmental Response Team SOP #2016 (sediment samples), and as outlined in the Final Quality Assurance Project Plan and Sampling and Analysis Plan for the Standard Mine Site (ESAT 2006). Sample tags, labels, and chain of custody records were completed in accordance with the EPA Region 8 Field Sampling Protocols. Plant and fish tissue samples were collected and stored in a cooler with ice, transported to the Region 8 laboratory, and analyzed for total metals in accordance with protocols for soil sample analysis. Soil samples collected in the field and analyzed using XRF were submitted to a CLP laboratory for confirmatory purposes. Macroinvertebrate samples were submitted to a contract laboratory for identification.

Surface water, sediment, and pore water samples collected during these events were identified by the stream name followed by a station number. For example, locations in Coal Creek were identified as Coal – XX, with the station number corresponding to its location along the stream. Likewise, locations along Elk Creek, Splain's Gulch and the Standard Mine were identified as Elk-XX, SP-XX and SM-XX respectively.

Soil samples collected at the Standard Mine were identified using the following methodology (for example): 102-C-2-6.MM. The initial numeric value corresponds to the grid location assignment; the following letter indicates whether the sample was a grab sample (G) or a composite sample (C); the next value identifies the depth interval at which it was taken (2-6 inches or 6-18 inches); and the last two letters are the initials of the individual taking the sample. In the event the sample is a surface sample, the depth interval identifier was left blank. Duplicate samples were indicated with a lower case "d" immediately following the sampler's initials.

2.2 Surface Water Sampling

Surface water samples were collected during each event at locations along Coal Creek, Elk Creek, Slate River, Wildcat Creek, Splain's Gulch, the Copley Lake Outflow, and the Keystone Mine water treatment outflow. Note that not all water bodies were sampled during each field event. Discrete surface water samples were collected in 250 milliliter polyethylene bottles (total fractions) and 250 milliliter Nalgene filter bottles (dissolved fractions). Real-time water quality data (pH, temperature, dissolved oxygen, and specific conductivity) were also collected at each sampling location using a Hydrolab Multiprobe, results of which were recorded in a project-dedicated field notebook. In addition, stream flow measurements were made at select locations using a Marsh-McBirney flow meter, or determined from existing staff gauges or other semi-permanent flow measurement instruments. Sample location coordinates were also collected in the field using a GPS unit.

After collection surface water samples were filtered (if needed) and preserved with nitric acid (total and dissolved metals), phosphoric acid (dissolved organic carbon), or ice (alkalinity and anions). After preservation all samples were placed in a cooler with ice until transported to the EPA Region 8 Laboratory for analysis. Samples were analyzed at the EPA Region 8 Laboratory for the following: total and dissolved metals (EPA method 200.7 and 200.8), hardness (EPA method 2340B calculated from calcium and magnesium results), dissolved organic carbon (EPA method 415.1), alkalinity (EPA method 160.1), and anions (chloride, fluoride, and sulfate using EPA method 300.0). During the July event additional surface water was collected and transported to the Region8 laboratory for use in aquatic toxicity testing. Toxicity testing procedures and results are presented in a separate report and are include in Appendix D. Reports include Sediment Toxicity Testing report for Standard Mine and the Aquatic Toxicity Testing Report for Standard Mine.

2.3 Pore Water Sampling

During the July sampling event pore water samples were collected along Coal Creek, Elk Creek, Splain's Gulch, and the Copley Lake outflow for use in evaluating potential ecological impacts to the existing biological agents in the streambed. Samples were collected using a Push Point sampling device fitted with a syringe and flexible tubing, as discussed in the Final Quality Assurance Project Plan and Sampling and Analysis Plan for the Standard Mine Site (ESAT 2006). Once collected, samples were processed in the same manner as surface water samples. Pore water samples were analyzed for anions, alkalinity, dissolved organic carbon, and dissolved metals using the same analytical methods listed in Section 2.2.

2.4 Sediment Sampling

Sediment samples were collected during the July and September 2006 sampling events along Coal Creek, Elk Creek, Splain's Gulch, and the Slate River in order to determine contaminant loading in streambed sediments. Samples were collected in accordance with the protocols outlined in EPA Environmental Response Team SOP #2016, Sediment Sampling as described in the Final Quality Assurance Project Plan and Sampling and Analysis Plan for the Standard Mine Site (ESAT 2006). Samples were collected using a teflon scoop, placed in a 5 gallon bucket then split into two 150 milliliter polyethylene narrow mouth container. Sediment samples were placed on ice until transported to the EPA Region 8 laboratory and stored at 4°C until used for toxicity testing. Sediment samples were sent to CLP for analysis for total metals using EPA methods 200.7 and

200.8. During the July event additional sediment was collected and transported to the Region 8 laboratory for toxicity testing purposes. Toxicity testing procedures and results will be presented in a separate report and are included in appendix D, therefore will not be addressed in this document.

2.5 Biological Tissue Sampling

Biological tissues were sampled at several locations in the Coal Creek watershed during the July event in order to evaluate exposure point concentrations for various ecological receptors. Tissues sampled include fish (filet, carcass, and forage fish composite samples), vegetation, and macroinvertebrates. Fish tissues and vegetation samples were collected and placed in small-volume zip-lock baggies, while macroinvertebrate samples were collected and placed in 150 ml polyethylene sample bottles. Samples were stored on ice until transported to the EPA Region 8 laboratory for analysis. Vegetation and macroinvertebrate samples were collected by EPA and ESAT representatives in the field, and fish samples were collected by representatives from the Colorado Division of Wildlife. All biological tissues samples were analyzed for total metals at the Region 8 laboratory using EPA methods 200.7 and 200.8.

2.6 Macroinvertebrate Assemblage Sampling

Semi-quantitative benthic macroinvertebrate assemblage sampling was performed at locations along Coal Creek, Elk Creek, Splain's Gulch, and the Copley Lake outfall during the July and September events. Samples were collected using a D-frame dip net in accordance with the provisions outlined in the Final Quality Assurance Project Plan and Sampling and Analysis Plan for the Standard Mine Site (ESAT 2006). After collection samples were containerized in wide-mouth Nalgene containers and preserved with 70% ethanol. Samples were then placed in a cooler and shipped to a contract laboratory for macroinvertebrate identification.

2.7 Habitat Assessment

Habitat assessments were conducted during the July and September sampling events in order to evaluate the structure of the physical habitat that might influence the quality of the watershed and, as a result, the condition of the aquatic community. The habitat assessments were conducted by ESAT personnel at locations along Elk Creek, Coal Creek, the Copley Lake outfall, and Splain's Gulch in accordance with the Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers (EPA 1999), Section 5.2 – A Visual-Based Habitat Assessment.

2.8 Soil Sampling

Soil sampling was performed in July (over two events) in the vicinity of the Standard Mine following a Triad approach using XRF and GPS/PDA instrumentation as well as laboratory confirmation analysis. The purpose of this portion of the sampling effort was to define the boundaries of the Standard Mine site and evaluate soil contaminant levels for ecological and human health risk assessment use. Boundary determination will be used for the assessment of impacts related to ecological risk as well as human health pathways. Refer to figure 2.8-1 for boundary determination for soil. For all soil screening activities an Innov-X Systems Alpha Series™ XRF Spectrometer was used to measure total metals concentrations in soil in accordance with the provisions outlined in the Innov-X Systems User Manual, Version 2.1 (August 2005) and the Standard Operating Procedure titled Analytical Determination of Trace Metals in Soil and Sediment by Field Portable X-Ray Fluorescence Spectrometry (ESAT 2006).

An initial site boundary estimate was made based on data collected during previous field investigations (visual observations) and served as the basis for establishing sampling locations. Figures 2.8-1 and 2.8-2 include the site boundaries for the areas involved in the study. A triangular grid pattern (with nodes spaced approximately 50 feet apart) was established along the perimeter of and within the site boundary, and extended approximately two sampling points outside of the estimated boundary. Based on the estimated site boundary, sampling took place within the site boundary and along the boundary in order to establish an accurate boundary location. Both sampling activities are further discussed below.

Sampling Within the Site Boundary

Five grab soil samples were collected from a depth of 0-2 inches below ground surface (bgs) at and around each grid node using a Teflon scoop in accordance with the Final Quality Assurance Project Plan and Sampling and Analysis Plan for the Standard Mine Site (ESAT 2006). When possible, individual samples were processed and analyzed in the field. However, when samples could not be processed in the field they were stored in a cooler with ice and transported to the EPA Region 8 laboratory for sample processing and XRF analysis (as described in the following section).

Boundary Verification Sampling

In order to accurately delineate the site boundary, soil samples were collected in the vicinity of the estimated boundary and processed/analyzed in the field. Boundary verification was conducted using the processes discussed in the Final Quality Assurance Project Plan and Sampling and Analysis Plan for the Standard Mine Site (ESAT 2006). Soil samples were collected, dried, sieved, and placed in a plastic sample cup with a Mylar cover. Soil screening continued out from the estimated site boundary (at 50 foot intervals along the established grid transect) until lead and arsenic concentrations fell below 400 and 100 parts per million, respectively.

Subsurface Profile Sampling

Subsurface profile samples were collected at 10 discrete locations along the perimeter of the site at depths of 2-6 inches and 6-18 inches. Samples were containerized, homogenized, and placed in a cooler with ice for transport to the Region 8 laboratory for XRF analysis. As stated above, all samples not processed in the field were transported to the Region 8 laboratory, processed as described in the Boundary Verification Sampling section, and analyzed using the XRF.

Overall, 129 soil samples were submitted for confirmatory analysis of total metals and mercury to Chemtech Consulting Group located in Mountainside, New Jersey using EPA methods 200.7, 200.8, and 7071 (cold vapor method for mercury analysis).

2.9 Sample Documentation

During sampling activities (surface water, pore water, sediment, plant tissue sampling, macroinvertebrate assemblage sampling, and macroinvertebrate tissue sampling) logbooks were maintained by individuals in the field. During sampling at each sampling location, the logbook was filled out with information such as sampling date, time, location, weather conditions, personnel, real-time stream data (pH, dissolved oxygen, specific conductivity, and temperature), and/or other pertinent observations. Where applicable, a stream flow calculation form was filled out by individuals conducting stream flow measurements. Habitat assessment forms were filled out in the field by individuals performing the assessment and included information such as personnel, date, time, location, and specific habitat assessment scores. Documentation from the current study regarding fish collected and processed by the Colorado Division of Wildlife is currently held by EPA in electronic format. In addition, historical fish shocking data collected by Colorado Division of Wildlife from Coal Creek has been provided to EPA in electronic format. Soil samples collected at the Standard Mine were transported to an on-site staging area where information such as sample identification, date, time, and XRF analytical results were entered into a logbook and electronic spreadsheet. Additional information included in the logbook and electronic spreadsheet included results for XRF QA/QC samples as well as oven temperatures. Due to time constraints in the field, only information such as sample identification, date, and time were reported in the field. Soil samples were transported to the Region 8 laboratory for XRF analysis. Surface water, pore water, sediment, biological tissue, and soil samples submitted for laboratory analysis were entered into a chain of custody system using Forms II Lite.

3.0 SAMPLE QUALITY CONTROL

This section details the quality control methods used in the field for activities performed during the sampling effort. These include decontamination methods, field instrument calibration, duplicate sample collection, and confirmatory sampling.

3.1 Decontamination Methods

In general, all non-dedicated disposable equipment involved in field sampling activities was decontaminated prior to sampling. For soil sampling activities teflon scoops, sampling spatulas, and sieve pans were decontaminated between sampling locations using deioninzed water and a 10% Liquinox solution. Sieves were decontaminated first by dumping out coarse material, then by brushing visible material from the base of the sieve using a chip brush. Remaining material will be removed using high pressure air (small compressed air canisters) using a backwashing approach (i.e., air was directed from the bottom of the sieve to the top). The XRF screening window was decontaminated using a dry laboratory wipe between each sample. For stream sampling, disposable items were used when possible to minimize the potential for cross contamination. Water quality meters were rinsed between sampling locations with deionized water.

3.2 Field Instrument Calibration

Field instruments requiring calibration or routine function checks included water quality meters and XRF instrumentation. In accordance with field sampling protocols, the water quality meter, consisting of a pH probe, dissolved oxygen meter, conductivity meter, thermometer, and barometer was calibrated daily and compared to established pH and conductivity standards. Dissolved oxygen was calibrated using the saturated air approach on a daily basis and as needed in the field due to substantial changes in barometric pressure. The water quality meter thermometer and barometer are calibrated on an annual basis in accordance with the manufacturer's recommendations. XRF instrumentation function checks were performed routinely during use in accordance with the provisions outlined in the XRF standard operating procedures (ESAT 2006). XRF sample standards (NIST standards) were analyzed at a rate of 1 standard per 20 soil samples analyzed. XRF blank samples were analyzed at a rate of 1 blank per 20 soil samples. XRF function check information was recorded in the mobile laboratory field notebook.

3.3 Duplicate Sample Collection

Duplicate samples were collected during these events in order to determine sampling precision and correlation between samples. Per the USEPA SW-846 guidance, the relative percent difference (RPD) for split samples should, in general, be below 50% for low level constituents and below 30% for high level constituents. These are laboratory guidelines and may not apply to all field situations. However, for this evaluation as well as the XRF evaluation presented in Section 5.0, an average RPD value less than 35% is considered indicative of a good correlation between samples based on methods 6010 and methods 6020. Although, each analyte will have its own specific criteria for RPD. RPD was evaluated for total and dissolved metals (arsenic, cadmium, copper, lead, and zinc), alkalinity, anions, and dissolved organic carbon for surface water and pore water samples for each event. RPD was also calculated for total recoverable metals (arsenic, cadmium, copper, lead, and zinc) for sediment samples collected in September and soil samples collected in July. Results of the RPD evaluation are included in Tables 3.0-1 through 3.0-5. RPD values were calculated using the following equation:

RPD = [ABS(Sample Result – Duplicate Result)]/[(0.5 * (Sample Result + Duplicate Result)]

Average RPD values for total and dissolved metals in water samples were consistently low (less than 25%), indicating acceptable reproducibility. The same was true for alkalinity, anions, and dissolved oxygen RPD values which were all below 26%, with the exception of chloride (56% in June) and fluoride (50% in July). The relative high RPD values for chloride and fluoride are due to the low levels of these anions in the samples, where small variations in concentration can have a substantial impact on RPD. Average RPD values for sediment duplicates (total metals) collected during the September event were all below 9%, indicating acceptable reproducibility.

Average RPD values for total metals (arsenic, cadmium, copper, lead, and zinc) in soil samples analyzed with XRF were all below 17% with the exception of arsenic. Arsenic had an average RPD of 41.5%, indicating less than desirable reproducibility. Individual

RPD values for arsenic ranged from 0% to 134%, with 6 pairs having an individual RPD in excess of 100%. This may have been due to general heterogeneity in geospatial distribution of soil contaminants, inadequate soil homogenization, or a combination of the two.

Average RPD values for total metals (arsenic, cadmium, copper, lead, and zinc) in soil samples analyzed by the laboratory were all below 8% with the exception of cadmium. Cadmium had an average RPD of 49.3%, with two pairs having individual RPDs in excess of 70%. Upon review of analytical results, it appears the high RPDs are due primarily to low cadmium detections in the soil (similar to the anion results discussed above), rather than a fundamental problem with reproducibility.

3.4 Blanks

In order to evaluate the potential of sample contamination during collection and/or transport to the laboratory, as well as contaminants introduced at the laboratory, aqueous blanks were collected in the field during the June and September events. Blank samples were analyzed for total recoverable metals, dissolved metals, alkalinity, anions, and dissolved organic carbon. All blank results were either below, or just above the method detection limit for each analyte, indicating no substantial contamination issue associated with the collection and/or laboratory analysis process.

3.5 Confirmatory Sampling

Confirmatory sampling was performed to verify XRF total metals results for samples collected from the Standard Mine Site. As discussed in Section 2.0, approximately 129 samples were submitted to Chemtech Consulting Group for analysis. Results of the confirmatory sampling (using an RPD approach) showed general agreement between the XRF and laboratory data for lead and zinc, with weaker agreement for arsenic and cadmium. Confirmatory sampling results are further discussed in Section 5.0 (Analytical Results).

4.0 FIELD CHANGES AND/OR CORRECTIVE ACTIONS

Changes to the Sampling and Analysis Plan implemented during field activities were minor in nature. It was anticipated that a maximum of 25% of soil samples analyzed by XRF would be submitted for confirmatory analysis. In actuality 29% of the samples were submitted for confirmatory analysis. In addition, total recoverable metals samples were not collected from three locations during the June event. The sample locations included Coal-10, Coal-15, and Coal-20. These locations were sampled for the remaining planned constituents. For the months of May, August, and October, the Coal Creek Coalition Watershed group collected the monthly surface water samples.

5.0 ANALYTICAL RESULTS

Analytical results are presented in Tables 5.0-1 through 5.0-19 and include analytical data from the EPA Region 8 laboratory as well as data provided by contract laboratories. In addition, macroinvertebrate assemblage results, results of the habitat assessments performed by ESAT personnel, and results of the Colorado Division of Wildlife fish survey are included in Appendices A, B, and C respectively. The following sections give a general breakdown of analytical results.

5.1 Surface Water and Pore Water

Results for anions, alkalinity, and dissolved organic carbon are included in Tables 5.0-1 (surface water for June), 5.0-2 (pore water for July), 5.0-3 (surface water for July), and 5.0-4 (surface water for September). Results for dissolved metals and hardness are included in Tables 5.0-5 (surface water for June), 5.0-6 (pore water for July), 5.0-7 (surface water for July), and 5.0-8 (surface water for September). Results for total recoverable metals are included in Tables 5.0-9 (surface water for June), 5.0-10 (surface water for July), and 5.0-11 (surface water for September).

5.2 Sediment and Biological Tissues

Sediment samples collected during the July and September events were analyzed for total recoverable metals. Results are included in Tables 5.0-12 (July) and 5.0-13 (September). Total recoverable metals results for biological tissue sampling conducted in July are included in Tables 5.0-14 (fish), 5.0-15 (macroinvertebrates), and 5.0-16 (vegetation). Vegetation, identified as possible food sources for wildlife, were collected from potentially contaminated areas and were given an identification at the site. The reference locations were given an identification number in the field at the time of collection, not assigned prior to the field event. Macroinvertebrate samples were assigned identification numbers prior to sampling event. Fish tissue samples were initially designated by their composition. Samples were designated as a carcass (carc), composite (comp), or filet (fil). In order to clarify the location from which the samples originated the nearest stream sampling location was added to the sample information, and is included in the "Location" column in Table 5.0-14.

5.3 Macroinvertebrate Assemblage Sampling

Macroinvertebrate samples collected during the September event were submitted to Chadwick and Associates, Inc., located in Littleton, Colorado in order to assess the assemblage makeup. Macroinvertebrate identification results are included in Appendix A and were performed to the species level where possible. In addition, results also include summary statistics and indices evaluations for each sample.

5.4 Habitat Assessment

Results of the habitat assessments performed during the July and September events are included in Appendix B. Habitat assessment results include a basic narrative describing each site, individual field data sheets, habitat score summaries, and site photographs.

5.5 Soil Metals

Soil samples collected from the Standard Mine site were analyzed for total metals using XRF (Table 5.0-17) as well as by an analytical laboratory (Table 5.0-18) for confirmation purposes as described in Section 2.0. In order to evaluate differences in XRF and confirmatory analytical results, metals concentrations for arsenic, cadmium, copper, lead, and zinc were compared using RPD and single linear regression approaches.

Relative percent difference was calculated using the following equation:

RPD = [ABS(XRF Result – Laboratory Result)]/[0.5 * (XRF Result + Laboratory Result)]

As discussed in Section 3.0, for this evaluation an RPD value less than 35% is considered indicative of a good correlation between samples. Results of this RPD evaluation are included in Table 5.0-19. Average RPD values (using only detections) showed acceptable correlation (RPD <35%) between XRF and confirmatory results for copper (25%), lead (13%), and zinc (35%). Correlation between XRF and confirmatory results for arsenic were marginal (41%) and poor for cadmium (63%). The relatively high RPD value for cadmium may be due to the limited number of XRF analytical detections (only 16 in the dataset). The XRF detection limit for cadmium is approximately 30 ppm, where laboratory detection limits are typically less than 1 ppm. Therefore it is difficult to assess the actual agreement between the two analytical techniques. However, it should be noted that of the XRF samples where cadmium was not detected, the corresponding laboratory result was less than the XRF detection limit in all but three cases.

Single linear regression analysis was also performed to determine the existence and degree of correlation between XRF and confirmatory total metals results (Table 5.0-19). Results indicated strong linear relationships between XRF and confirmatory total metals results, with p values less than 0.001, and associated R-squared values ranging between 0.82 (lead) and 0.94 (zinc). Coupled with the RPD results, it appears that the XRF was generally successful in estimating total metals concentrations in the field for the analytes of interest specific to this project. However, additional investigation may need to be performed to further evaluate XRF performance in the field depending on detection limit requirements and differing analytes of interest.

6.0 TRIAD EVALUATION

As discussed in the introduction to this document, the Triad approach was employed during soil sampling activities at the Standard Mine site. Soil metals data, evaluated using XRF, were collected on a real-time basis and used to determine the site boundary for human health and ecological risk assessment purposes. Surface water, sediment, and biological tissue sampling followed a static sampling protocol rather than the Triad approach, and therefore will not be evaluated in this section.

The goal of the Triad approach is to manage decision uncertainty in order to increase confidence that project decisions are made correctly and cost effectively (EPA 2004). The Triad approach is composed of three fundamental elements: systematic project planning, dynamic work strategies, and real-time measurement technologies. This section will evaluate how each of these elements was incorporated prior to and during field activities as well as an evaluation of how the Triad approach was implemented overall.

6.1 Systematic Project Planning

Systematic project planning is considered the most important element of the Triad approach (EPA 2004) and was a key concern for development of the SAP for this project. Systematic project planning consists of three primary sub-elements:

- **Framing the Problem:** identifying project objectives, constraints, stakeholders, the regulatory framework, and primary/secondary decisions.

- **Developing a Conceptual Site Model:** constructing and maintaining a conceptual site model (CSM) that captures information pertinent to the primary/secondary decisions that must be made.

- **Evaluating and Managing Uncertainty:** evaluating and managing the uncertainty associated with decision-making in the context of the CSM so that decisions can be made with acceptable levels of confidence (EPA 2004).

The systematic planning framework employed for this project was the Data Quality Objective (DQO) process (EPA 1994), and was included as an appendix to the SAP. The DQO process addresses the planning cycle for a project from the problem statement through data collection. The following sections describe the systematic planning framework sub-elements and how they were addressed during project planning.

6.1.1 Framing the Problem

The first step in the systematic planning framework is to frame the problem. This includes identifying project objectives, constraints, stakeholders, the regulatory framework, and primary/secondary decisions that need to be made. As a part of this step, the Triad approach depends on open communication between involved parties so that there is a clear, consensus-based understanding of the project goals. In an effort to gain consensus of interested parties and allow for transparency of planning, development of the SAP for this project involved multiple regulatory agency representatives (EPA, Colorado Department of Public Health and Environment, Colorado Division of Wildlife, and the United States Fish and Wildlife Service [USFWS]) as well as other interested parties and professional technical experts (in Triad terms referred to as a team of allied environmental professionals). Each of these groups was involved in the development, review, finalization, and implementation of the SAP.

As a part of the DQO development process, several components of this systematic planning frame work step were addressed. For example, the purpose of step 1 of the DQO process (State the Problem) is to describe the problem to be studied so that the focus of the investigation is unambiguous. Attributes of this step of the DQO process include the site introduction and history, listing interested parties as well as primary decision makers, and the identification of decision drivers. During the SAP review process, consensus was gained regarding each of these attributes from the identified interested parties.

Also related to this attribute of the systematic planning framework are steps 2, 3, and 4 of the DQO process (Identify the Decision, Identify Inputs to the Decision, and Identify the Boundaries of the Study). These steps are intended to define the decision statements that the investigation will attempt to resolve, establish the data that will be required to do so, and evaluate the temporal and spatial boundaries over which the decision statements apply. Involvement of multiple interested parties at this stage was critical during SAP development. Government agency, local interested parties, and a team of allied environmental professionals were consulted to insure the following: appropriate regulatory, scientific, and engineering decisions were made; appropriate data (including number of points as well as data types) were collected; applicable spatial and temporal boundaries for the site were identified; local interests were addressed; and each of these items was appropriately captured in the SAP. Government agency and private consulting experts involved with SAP development included individuals with a historical knowledge of the study site, experts with substantial academic and in-field experience regarding the contaminants associated with the study site, experts with experience in statistical approaches to sampling design, as well as experts with experience in SAP implementation.

6.1.2 Developing a CSM

The second step in the systematic planning process is the construction and maintenance of a CSM that captures information pertinent to the decisions that must be made. The CSM was addressed in the SAP via the first step of the DQO process. This included an evaluation of contaminant sources, identification of COCs, primary release mechanisms, COC fate and transport, exposure routes, and potential receptors. For this project the CSM was developed with input from technical experts and agency representatives familiar with historical investigations performed at the site. An analysis of the CSM in the DQO document resulted in what is called the "Problem Statement" (per the DQO naming convention), and was intended to provide a mutually agreed upon, unambiguous focus for the Standard Mine project. The development of such a focus is one of the fundamental goals of the systematic planning process. The CSM was also the basis for addressing other DQO requirements (i.e., development of the decision statements, data requirements, and project boundaries) in the SAP.

As a part of the Triad approach, the CSM should be a living document that can be changed or adapted based on conditions observed in the field. This was necessary for the CSM prepared for the Standard Mine, since it did not initially include specific project boundaries. As such, the CSM was able to be adapted in the field and the project boundaries evaluated using real-time XRF data (specifically arsenic and lead results) as discussed in the SAP and Section 2.8 of this document.

6.1.3 Evaluating and Managing Uncertainty

The Triad approach emphasizes evaluating and managing the uncertainty associated with decision-making in the context of the CSM so that decisions can be made with acceptable levels of confidence. This pertains to identifying and developing strategies to eliminate, reduce, or manage unknowns as well as exercising proactive control over the greatest sources of uncertainty (i.e., sample density, orientation, and/or subsampling) during the planning process. The SAP for this project was specifically designed to identify and address areas of uncertainty (per step 6 of the DQO process). The primary areas of uncertainty identified in the DQO portion of the SAP (applicable to the soil investigation) were sampling density, soil homogeneity, and specific project boundaries. Based on these identified uncertainties the SAP addressed what sort of sampling approach would allow for accurate assessment of the geospatial distribution of contaminants across the site in a cost effective manner. In order to address this issue as well as assert proactive control over this area of uncertainty, the SAP was developed to incorporate a statistically-based sampling grid (using FIELDS software) that also incorporated transect sampling at specific locations to evaluate the effectiveness of the established grid (see Section 5.0 for a discussion). Since real-time instrumentation was going to be used in the field for sample analysis, the sampling grid was relatively dense (50 foot node spacing), allowing for high contaminant distribution resolution. The increased resolution made it possible to address the second area of concern (soil homogeneity) as well as project boundary uncertainty. In conjunction with use of the XRF, this sampling approach also allowed team members to identify areas appropriate for further analysis (i.e., areas where depth sampling would occur) on a near- real time basis.

Based on the approach used to develop the SAP, each of the Systematic Project Planning Triad elements was successfully addressed during the planning stage.

6.2 Dynamic Work Strategies

The dynamic work strategies element of the Triad approach is intended to allow a project to adapt in the field as real-time information becomes available. The intent of the dynamic aspect of work strategies is to allow projects to be completed faster and cheaper, while maintaining quality control over all data collection activities. For this reason the project SAP was written so that in-field decisions could be made as information became available. The dynamic work strategy employed during this investigation applied primarily to what is referred to as adaptive data collection. Data collection strategies can be adaptive in two ways: adaptive location selection and adaptive analytics selection (EPA 2004). For this project the main strategy employed was adaptive location selection. For example, real-time instrumentation (XRF) was used in the field to generate data used as a basis for selection of additional sample locations along the perimeter. Results of the perimeter sampling were used to determine if sampling should continue outward from the site (based on established arsenic and lead criteria), or not. In addition, real time XRF data were used to identify locations where depth profile samples should be collected from within the site boundary.

6.3 Real-time Measurement Technologies

The third element to the Triad Method is real-time measurement technologies, the use of which makes dynamic work strategies possible. For this project real-time measurement technologies included the following: XRF (to determine soil metals concentrations); GPS units used for sample location data collection; and computer systems used for data management, data manipulation, and location/results mapping. Surface maps of soil concentrations of lead and arsenic were generated in the field using GPS location data. The surface maps were then used to select additional sampling locations along the perimeter, as well as locations where depth profile samples would be collected. During the first soil investigation event, all XRF samples were sent to the laboratory for confirmatory analysis. However, after the initial XRF results and laboratory analytical results were compared, team members were confident that the goals of the investigation could be met relying solely on XRF results. Therefore no additional XRF samples were submitted for confirmatory analysis after the first soil investigation field event. As a result, only 29% of the XRF samples were submitted for laboratory analysis, a substantial analytical cost savings.

6.4 Conclusions

An ideal Triad project would incorporate and strongly rely on each of the three Triad elements described above. However, each field project is distinct and therefore may not be equally strong in every element. The following fundamental aspects of a Triad project are imperative for success and therefore may provide a basis for evaluation (EPA 2004):

- Consensus on clearly worded project goals and decisions,
- A CSM that anticipates site-specific heterogeneities and contaminant distributions,
- Strategies to refine the CSM over the course of the project, and
- Discussions about the mechanisms to manage sampling and analytical uncertainties in data collection.

Using these aspects as criteria, the Standard Mine project should be considered successful in each of these areas. As discussed above, the SAP was developed with systematic project planning as its basis. This included utilization of an open communication strategy with cooperation of a group of allied environmental professionals. The resulting SAP included consensus-based project goals and decisions, as well as discussions about the mechanisms to manage sampling and analytical uncertainties in data collection. Dynamic work strategies were also employed so that cost-effective and time-saving field decisions could be made. For example, XRF metals results were mapped in the field in order to facilitate selection of additional sampling locations on a timely basis. In addition, use of the XRF in the field resulted in fewer samples submitted for laboratory analysis and, hence, a lower overall analytical cost. Finally, the CSM was developed in such a way that it could be successfully refined in the field, specifically relating to the location of the project boundary.

7.0 REFERENCES

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Tables

Table 3.0-1 Relative Percent Difference Evaluation for June 2006 Duplicates

Surface Water

Location	Dissolved Arsenic	Dissolved Cadmium	Dissolved Copper	Dissolved Lead	Dissolved Zinc	Hardness (mg/L)	Chloride (mg/L)	Fluoride (mg/L)	Sulfate as SO4 (mg/L)	Total Alkalinity (mg CaCO3 / L)	Dissolved Organic Carbon (mg/L)
Elk-00	2.6	2.54	5.28	2.74	517	53	0.2	<0.05U	21	28.9	1.6
Elk-00D	2.78	2.5	5.05	2.68	513	53	0.7	<0.05U	21.6	30	1.5
RPD	6.7%	1.6%	4.5%	2.2%	0.8%	0.0%	111.1%	0.0%	2.8%	3.7%	6.5%
SP-00	<0.400UD	<0.400UD	<1.00U	<0.400UD	<5.00U	21	0.7	<0.05U	2.8	19.8	2.2
SP-00D	<0.200U	<0.200U	<1.00U	<0.200U	<5.00U	20	0.7	<0.05U	2.7	20.4	3.5
RPD	NA	NA	0.0%	NA	0.0%	4.9%	0.0%	0.0%	3.6%	3.0%	45.6%
Average RPD:	6.7%	1.6%	2.2%	2.2%	0.4%	2.4%	55.6%	0.0%	3.2%	3.4%	26.0%

Location	Total Arsenic	Total Cadmium	Total Copper	Total Lead	Total Zinc
Elk-00	<5.00UD	2.62	5.98	4.74	498
Elk-00D	<5.00UD	2.88	6.57	7.73	486
RPD	0.0%	9.5%	9.4%	48.0%	2.4%
SP-00	<5.00UD	<1.00UD	1	<1.50UD	<5.00U
SP-00D	<5.00UD	<1.00UD	1.2	<1.50UD	<5.00U
RPD	0.0%	0.0%	18.2%	0.0%	0.0%
Average RPD:	0.0%	4.7%	13.8%	24.0%	1.2%

Notes:

NA - Not evaluated since results had different detection limits.

For comparative purposes flags were removed from analytical results, except in instances where both samples were nondetect with the same detection limit.

Table 3.0-2 Relative Percent Difference Evaluation for July 2006 Duplicates

Porewater

Location	Dissolved Arsenic	Dissolved Cadmium	Dissolved Copper	Dissolved Lead	Dissolved Zinc	Hardness (mg/L)	Chloride (mg/L)	Fluoride (mg/L)	Sulfate as SO4 (mg/L)	Total Alkalinity (mg CaCO3 / L)	Dissolved Organic Carbon (mg/L)
Coal-10	1.71	<0.200U	<1.00U	<0.200U	65	45	1.6	0.3	13.6	30.3	1.9
Coal-10D	1.73	<0.200U	<1.00U	<0.200U	66.1	45	1.7	0.1	13	30.5	1.8
RPD	1.2%	0.0%	0.0%	0.0%	1.7%	0.0%	6.1%	100%	4.5%	0.7%	5.4%
Elk-00	2.81	2.09	2.37	0.22	323	66	<0.2U	<0.1U	28.2	35.2	1.4
Elk-00D	2.89	2.07	2.25	0.215	301	66	<0.2U	<0.1U	28.3	34.5	1.2
RPD	2.8%	1.0%	5.2%	2.3%	7.1%	0.0%	0.0%	0.0%	0.4%	2.0%	15.4%
Average RPD:	2.0%	0.5%	2.6%	1.1%	4.4%	0.0%	3.0%	50.0%	2.4%	1.3%	10.4%

Surface Water

Location	Total Arsenic	Total Cadmium	Total Copper	Total Lead	Total Zinc
Coal-10	4.13	<1.00UD	<5.00UD	<5.00UD	102
Coal-10D	4.16	<1.00UD	<5.00UD	<5.00UD	102
RPD	0.7%	0.0%	0.0%	0.0%	0.0%
Elk-00	3.67	2.2	<5.00UD	<5.00UD	410
Elk-00D	2.82	2.24	<5.00UD	<5.00UD	398
RPD	26.2%	1.8%	0.0%	0.0%	3.0%
Average RPD:	13.5%	0.9%	0.0%	0.0%	1.5%

Location	Dissolved Arsenic	Dissolved Cadmium	Dissolved Copper	Dissolved Lead	Dissolved Zinc	Hardness (mg/L)	Chloride (mg/L)	Fluoride (mg/L)	Sulfate as SO4 (mg/L)	Total Alkalinity (mg CaCO3 / L)	Dissolved Organic Carbon (mg/L)
Coal-10	3.93	0.59	<1.00U	<0.200U	122	46	1.4	0.1	13.9	32.5	1.9
Coal-10D	3.92	0.584	<1.00U	<0.200U	116	46	1.4	0.1	13.9	31.8	1.9
RPD	0.3%	1.0%	0.0%	0.0%	5.0%	0.0%	0.0%	0.0%	0.0%	2.2%	0.0%
Elk-00	2.9	2.24	2	0.287	364	66	<0.2U	<0.1U	31.1	35	1.3
Elk-00D	2.86	2.32	1.99	0.292	366	67	<0.2U	<0.1U	28.3	34.6	1.2
RPD	1.4%	3.5%	0.5%	1.7%	0.5%	1.5%	0.0%	0.0%	9.4%	1.1%	8.0%
Average RPD:	0.8%	2.3%	0.3%	0.9%	2.8%	0.8%	0.0%	0.0%	4.7%	1.7%	4.0%

Notes:

For comparative purposes flags were removed from analytical results, except in instances where both samples were nondetect with the same detection limit.

Table 3.0-3 Relative Percent Difference Evaluation for September 2006 Duplicates

Surface Water

Location	Dissolved Arsenic	Dissolved Cadmium	Dissolved Copper	Dissolved Lead	Dissolved Zinc	Hardness	Chloride (mg/L)	Fluoride (mg/L)	Sulfate as SO4 (mg/L)	Total Alkalinity (mg CaCO3 / L)	Dissolved Organic Carbon (mg/L)
Coal-10	2.85	0.785	1.1	<0.200U	227	56	3.1	0.2	18.6	32.9	1.6
Coal-10D	2.85	0.757	1.28	<0.200U	229	56	3.1	0.2	19.9	33.3	1.6
RPD	0.0%	3.6%	15.1%	0.0%	0.9%	0.0%	0.0%	0.0%	6.8%	1.2%	0.0%
Elk-10	0.266	42.5	46.7	44.4	8230	98	0.6	<0.1U	100	8.21	1.0
Elk-10D	0.236	42.9	46.3	43.5	8270	98	0.6	<0.1U	99.6	8.39	1.0
RPD	12.0%	0.9%	0.9%	2.0%	0.5%	0.0%	0.0%	0.0%	0.4%	2.2%	0.0%
Average RPD:	6.0%	2.3%	8.0%	1.0%	0.7%	0.0%	0.0%	0.0%	3.6%	1.7%	0.0%

Location	Total Arsenic	Total Cadmium	Total Copper	Total Lead	Total Zinc
Coal-10	4.36	<1.00UD	1.2	<1.00UD	214
Coal-10D	4.49	<1.00UD	1.47	<1.00UD	219
RPD	2.9%	0.0%	20.2%	0.0%	2.3%
Elk-10	1.00	41	59.6	73.2	7520
Elk-10D	1.26	43	60.9	75.1	7700
RPD	23.0%	4.8%	2.2%	2.6%	2.4%
Average RPD:	13.0%	2.4%	11.2%	1.3%	2.3%

Sediment

Location	Arsenic	Cadmium	Copper	Lead	Zinc
Coal-10	49.7	7.37	12.7	50.3	1350
Coal-10D	52.7	7.67	14.9	55.7	1440
RPD	5.9%	4.0%	15.9%	10.2%	6.5%
Elk-10	157	31.2	896	5670	4430
Elk-10D	159	35.1	913	5530	4840
RPD	1.3%	11.8%	1.9%	2.5%	8.8%
Average RPD:	3.6%	7.9%	8.9%	6.3%	7.6%

Notes:

For comparative purposes flags were removed from analytical results, except in instances where both samples were nondetect with the same detection limit.

Table 3.0-4 Relative Percent Difference Evaluation for Laboratory Analyzed Soil Samples

Location	Arsenic	Cadmium	Copper	Lead	Zinc
14-C-2-6-MB	19.1	0.24	24.4	315	254
14-C-2-6-MBD	19.4	0.5	25.1	328	248
RPD	1.6%	70.3%	2.8%	4.0%	2.4%
152-C-JC	13	1.2	13.6	81.5	185
152-C-JCD	12.5	0.5	12.9	90.7	188
RPD	3.9%	82.4%	5.3%	10.7%	1.6%
170-C-2-6-JC	14.6	0.36	11.4	48	94.9
170-C-2-6-JCD	15	0.5	11.5	45.8	100
RPD	2.7%	32.6%	0.9%	4.7%	5.2%
30-C-MB	12.1	7	64.5	1440	759
30-C-MBD	12.2	6.2	80.5	1350	745
RPD	0.8%	12.1%	22.1%	6.5%	1.9%
Average RPD:	2.3%	49.3%	7.8%	6.5%	2.8%

Table 3.0-5 Relative Percent Difference Evaluation for XRF Analyzed Soil Samples

Sample ID	Arsenic	Cadmium	Copper	Lead	Zinc
13-G-MB	<6	<30	116.0	3716.0	973.0
13-G-MB-D	<6	<30	88.0	3920.0	960.0
RPD	0.0%	0.0%	27.5%	5.3%	1.3%
152-C-JC	17.3	<30	<15	82.7	282.9
152-C-JC-D	14.0	<30	<15	91.2	305.5
RPD	20.9%	0.0%	0.0%	9.8%	7.7%
169-C-DG	30.4	<30	66.7	802.1	339.0
169-C-DG-D	6.0	<30	42.7	455.6	355.5
RPD	134.1%	0.0%	43.8%	55.1%	4.7%
175-G-MB	29.0	<30	32.0	302.0	387.0
175-G-MB-D	34.0	<30	35.0	277.0	357.0
RPD	15.9%	0.0%	9.0%	8.6%	8.1%
355-G-MB	13.0	<30	<15	80.1	449.4
355-G-MB-D	6.0	<30	<15	82.6	457.4
RPD	73.6%	0.0%	0.0%	3.1%	1.8%
372-G-DG	<6	<30	42.7	321.6	410.2
372-G-DG-D	<6	<30	20.2	316.6	387.2
RPD	0.0%	0.0%	71.7%	1.6%	5.8%
3-G-MB	47.0	<30	<15	262.0	193.0
3-G-MB-D	52.0	<30	<15	208.0	199.0
RPD	10.1%	0.0%	0.0%	23.0%	3.1%
556-G-MM	227.8	<30	159.1	4713.3	694.8
556-G-MM-D	264.1	<30	145.8	5113.3	777.9
RPD	14.8%	0.0%	8.7%	8.1%	11.3%
568-G-MM	20.0	<30	<15	209.5	640.6
568-G-MM-D	6.0	<30	<15	224.1	684.8
RPD	107.9%	0.0%	0.0%	6.7%	6.7%
575-G-MB	6.0	<30	23.8	438.5	403.9
575-G-MB-D	20.0	<30	15.0	441.5	415.1
RPD	107.9%	0.0%	45.2%	0.7%	2.7%
602-G-MB	31.4	<30	37.6	955.8	314.2
602-G-MB-D	30.0	<30	38.5	921.5	277.5
RPD	4.8%	0.0%	2.5%	3.6%	12.4%
625-G-MM	<6	<30	40.4	710.8	982.0
625-G-MM-D	<6	<30	26.7	691.4	946.0
RPD	0.0%	0.0%	40.8%	2.8%	3.7%
632-G-MM	<6	<30	23.6	1418.8	860.8
632-G-MM-D	<6	<30	28.4	1443.0	839.2
RPD	0.0%	0.0%	18.8%	1.7%	2.5%
635-G-MM	<6	<30	38.7	1592.0	809.2
635-G-MM-D	<6	<30	27.5	1489.7	781.5
RPD	0.0%	0.0%	33.8%	6.6%	3.5%
640-G-MM	13.6	<30	<15	184.3	590.1
640-G-MM-D	22.3	<30	<15	174.0	628.0
RPD	48.5%	0.0%	0.0%	5.8%	6.2%
650-G-MM	<6	<30	<15	144.1	392.9
650-G-MM-D	<6	<30	<15	136.4	389.7
RPD	0.0%	0.0%	0.0%	5.5%	0.8%
654-G-MM	<6	<30	<15	467.7	406.5
654-G-MM-D	<6	<30	<15	436.8	391.6
RPD	0.0%	0.0%	0.0%	6.8%	3.8%

Table 3.0-5 Relative Percent Difference Evaluation for XRF Analyzed Soil Samples

Sample ID	Arsenic	Cadmium	Copper	Lead	Zinc
77-G-DG	27.0	<30	15.0	128.0	264.0
77-G-DG-D	23.0	<30	18.0	149.0	265.0
RPD	16.0%	0.0%	18.2%	15.2%	0.4%
222-G-DG	6.0	<30	<15	189.4	613.2
222-G-DG-D	19.6	<30	<15	167.3	606.5
RPD	106.1%	0.0%	0.0%	12.4%	1.1%
224-G-DG	6.0	<30	38.9	710.9	668.6
224-G-DG-D	45.8	<30	25.4	761.8	729.6
RPD	153.7%	0.0%	41.9%	6.9%	8.7%
289-G-MB	17.1	<30	<15	137.3	232.3
289-G-MB-D	12.7	<30	<15	160.6	239.7
RPD	29.7%	0.0%	0.0%	15.6%	3.1%
569-G-MM	6.0	<30	19.5	398.5	552.7
569-G-MM-D	20.7	<30	15.0	389.5	528.1
RPD	110.1%	0.0%	26.3%	2.3%	4.5%
642-G-MM	<6	42.3	593.1	4662.7	3234.5
642-G-MM-D	<6	31.9	602.7	4773.1	3270.1
RPD	0.0%	28.0%	1.6%	2.3%	1.1%
Average RPD:	41.5%	1.2%	16.9%	9.1%	4.6%

Notes:

RPD - Relative Percent Difference

For comparative purposes flags were removed from anlaytical results, except in instances where both samples were nondetect with the same detection limit.

Table 5.0-1 Alkalinity, Anions, and Dissolved Organic Carbon - June 2006 Surface Water

Location	Chloride (mg/L)	Fluoride (mg/L)	Sulfate as SO4 (mg/L)	Total Alkalinity (mg CaCO3 / L)	Dissolved Organic Carbon (mg/L)
Bog-01	<0.2U	5.01	75.9	<2.00U	<1.0U
Coal-00	1.2	1.16	37.7	24.3	2.6J
Coal-02	1.2	0.65	32.2	25.3	2.6J
Coal-05	0.9J	<0.05U	11.2	23.9	2.7J
Coal-10	1	<0.05U	10.1	24.3	2.8J
Coal-15	0.8J	<0.05U	11.1	24.4	3.0J
Coal-20	0.9J	<0.05U	3.9J	19.9	4.2J
Coal-25	1.1	<0.05U	5.2	20.8	3.1J
Coal-Opp1	1.4	<0.05U	10.5	24.6	4.2J
Coal-Opp2	1.5	<0.05U	12.1	23.8	3.1J
Cop-00	0.7J	<0.05U	3.2J	10.4	7.8
Elk-00	<0.2U	<0.05U	21	28.9	1.6J
Elk-00D	0.7J	<0.05U	21.6	30	1.5J
Elk-05	<0.2U	<0.05U	21	28.8	1.5J
Elk-06	0.7J	<0.05U	24.7	19.3	2.2J
Elk-08	<0.2U	<0.05U	26.8	19.7	1.9J
Elk-10	<0.2U	<0.05U	37.6	11.6	1.1J
Elk-29	0.7J	<0.05U	7.8	10.4	1.6J
Key-00	3.6	2	97.6	7.02J	1.4J
Key-01	5.6	14.94	502	4.45J	1.4J
Key-02	1.4	<0.05U	16.4	7.77J	1.5J
Slate-01	0.7J	<0.05U	10.2	22.4	<1.0U
Slate-02	0.8J	<0.05U	13.3	24.7	1.0J
SM-00	<0.2U	<0.05U	186	<2.00U	3.8J
SM-02	0.7J	<0.05U	54.5	<2.00U	3.7J
SP-00	0.7J	<0.05U	2.8J	19.8	2.2J
SP-00D	0.7J	<0.05U	2.7J	20.4	3.5J
SP-01	<0.2U	<0.05U	4.3J	18.8	1.4J
Wild-00	0.8J	<0.05U	6.7	24.4	1.5J
FB-01	<0.2U	<0.05U	<1.0U	<2.00U	<1.0U
FB-02	<0.2U	<0.05U	<1.0U	<2.00U	<1.0U

Notes:

J - Estimated value due to anlayte detection between the Method Reporting Limit and Detection Limit.

U - Analyte not detected. Reported value is less than (<) the detection limit.

mg/L - milligrams per liter

Table 5.0-2 Alkalinity, Anions, and Dissolved Organic Carbon - July 2006 Pore Water

Location	Chloride (mg/L)	Fluoride (mg/L)	Sulfate as SO4 (mg/L)	Total Alkalinity (mg CaCO3 / L)	Dissolved Organic Carbon (mg/L)
Coal-00	3	0.9	42.7	42	1.6J
Coal-02	1.7	0.8	113	36.4	1.9J
Coal-05	102	<0.1U	72.1	40.6	1.6J
Coal-10	1.6	0.3J	13.6	30.3	1.9J
Coal-10D	1.7	0.1J	13	30.5	1.8J
Coal-15	1.3	<0.1U	12.8	29.7	2.3J
Coal-20	2.6	<0.1U	22.9	25.2	1.5J
Coal-25	1.5	<0.1U	10.1	25.9	2.7J
Coal-Opp 1	1.3	<0.1U	13.2	36	2.0J
Coal-Opp 2	1	0.2J	8.3	41.6	<1.0U
Cop-01	0.9J	<0.1U	8.1	36.7	3.0J
Elk-00	<0.2U	<0.1U	28.2	35.2	1.4J
Elk-00D	<0.2U	<0.1U	28.3	34.5	1.2J
Elk-05	0.6J	<0.1U	28.2	32	1.5J
Elk-06	0.6J	<0.1U	41.2	20.1	2.1J
Elk-08	0.6J	<0.1U	44.1	20.8	1.9J
SP-00	<0.2U	<0.1U	2.3J	28.4	2.4J
SP-01	<0.2U	<0.1U	2.2J	25.1	2.7J

Notes:

J - Estimated value due to anlayte detection between the Method Reporting Limit and Detection Limit.

U - Analyte not detected. Reported value is less than (<) the detection limit.

mg/L - milligrams per liter

Table 5.0-3 Alkalinity, Anions, and Dissolved Organic Carbon - July 2006 Surface Water

Location	Chloride (mg/L)	Fluoride (mg/L)	Sulfate as SO4 (mg/L)	Total Alkalinity (mg CaCO3 / L)	Dissolved Organic Carbon (mg/L)
Coal-00	1.7	0.8	68.2	40.6	1.9J
Coal-02	1.7	1.2	129	38.5	1.7J
Coal-05	1.4	0.2J	17.6	31.9	1.8J
Coal-10	1.4	0.1J	13.9	32.5	1.9J
Coal-10D	1.4	<0.1U	13.9	31.8	1.9J
Coal-15	1.2	<0.1U	12.9	29.4	2.3J
Coal-20	1.4	<0.1U	6.3	27.3	2.6J
Coal-25	1	<0.1U	9	26	3.5J
Coal-Opp 1	1.3	<0.1U	14.1	33.2	1.9J
Coal-Opp 2	1.3	0.1J	14	33.1	1.8J
Cop-01	<0.2U	<0.1U	2.5J	13.7	8.3
Elk-00	<0.2U	<0.1U	31.1	35	1.3J
Elk-00D	<0.2U	<0.1U	28.3	34.6	1.2J
Elk-05	0.6J	<0.1U	27.4	33.4	1.2J
Elk-06	0.6J	0.1J	41.2	21.6	2.0J
Elk-08	0.6J	<0.1U	44.4	21.7	2.2J
Elk-10	0.6J	<0.1U	61.2	12.2	1.2J
Elk-29	0.6J	0.1J	10.1	13.6	2.1J
Key-00	3.3	1.5	90.7	8.60J	1.6J
Slate-01	0.6J	<0.1U	14.2	31.3	1.0J
Slate-02	0.9J	<0.1U	16.1	33	1.1J
SP-00	<0.2U	<0.1U	2.2J	27.2	2.4J
SP-01	<0.2U	<0.1U	2.1J	24.9	2.5J
Wild-00	1.0	<0.1U	7.9	32.3	2.0J

Notes:

J - Estimated value due to anlayte detection between the Method Reporting Limit and Detection Limit.

U - Analyte not detected. Reported value is less than (<) the detection limit.

mg/L - milligrams per liter

Table 5.0-4 Alkalinity, Anions, and Dissolved Organic Carbon - September 2006 Surface Water

Location	Chloride (mg/L)	Fluoride (mg/L)	Sulfate as SO4 (mg/L)	Total Alkalinity (mg CaCO3 / L)	Dissolved Organic Carbon (mg/L)
Coal-00	3.7	1	82.4	50.4	2.0J
Coal-02	3.4	1.7	129	46.3	1.8J
Coal-05	2.9	2.8	174	26.4	2.0J
Coal-10	3.1	0.2J	18.6	32.9	1.6J
Coal-10D	3.1	0.2J	19.9	33.3	1.6J
Coal-15	2.3	<0.1U	17.6	30.3	2.1J
Coal-20	2.9	<0.1U	10	28.5	2.4J
Coal-25	1	<0.1U	13.6	26.7	2.3J
Coal-Opp 1	2.6	<0.1U	17.7	34.7	1.8J
Coal-Opp 2	2.7	0.2J	18.4	33.8	1.7J
Cop-01	0.5J	<0.1U	4.6J	19.4	4.2J
Elk-00	0.6J	<0.1U	41.8	34.9	<1.0U
Elk-05	0.5J	<0.1U	41.8	33.6	<1.0U
Elk-06	0.6J	<0.1U	74.8	19.8	1.1J
Elk-08	0.6J	<0.1U	77.8	21.2	1.0J
Elk-10	0.6J	<0.1U	100	8.21J	1.0J
Elk-10D	0.6J	<0.1U	99.6	8.39J	1.0J
Elk-29	0.7J	<0.1U	15	14.6	1.3J
Key-00	5.5	10.5	692	7.20J	1.7J
Key-Opp 1	6.5	11.9	694	9.73J	1.6J
Slate-01	1	<0.1U	23.6	43.7	1.3J
Slate-02	1	<0.1U	24.2	43.6	1.3J
SP-00	0.8J	<0.1U	3.0J	31.2	2.0J
SP-01	0.8J	<0.1U	2.8J	26.9	2.3J
Wild-00	1.7	<0.1U	12	39.2	2.0J
FB-01	0.5J	<0.1U	<1.0U	2.00J	<1.0U
FB-02	<0.2U	<0.1U	<1.0U	<2.00U	<1.0U

Notes:

J - Estimated value due to anlayte detection between the Method Reporting Limit and Detection Limit.

U - Analyte not detected. Reported value is less than (<) the detection limit.

mg/L - milligrams per liter

Table 5.0-5 Dissolved Metals and Hardness - June 2006 Surface Water

Location	Aluminum	Antimony	Arsenic	Beryllium	Cadmium	Calcium	Chromium	Copper	Iron	Lead	Magnesium	Manganese	Nickel	Selenium	Silica (SiO2)	Silver	Strontium	Thallium	Zinc	Hardness (mg/L)
Bog-01	6850	<2.50UD	<1.00UD	1.09J	18.7D	11800	<1.00U	3.77J	2030	<1.00UD	2560	1220	16.2D	<2.50UD	32300	<1.00UD	50.7	<1.00UD	5680	40
Coal-00	57.9J	<1.00UD	1.72JD	<1.00U	0.538JD	24300	<1.00U	1.61J	<50.0U	<0.400UD	1890	29.5	1.08JD	<1.00UD	7310	<0.400UD	136	<0.400UD	114	69
Coal-02	55.5J	<1.00UD	1.72JD	<1.00U	0.472JD	21100	<1.00U	1.38J	<50.0U	<0.400UD	1820	25.1	1.07JD	<1.00UD	7210	<0.400UD	122	<0.400UD	101	60
Coal-05	77.6J	<1.00UD	2.68D	<1.00U	0.488JD	11200	<1.00U	1.98J	<50.0U	<0.400UD	1410	29.8	0.687JD	<1.00UD	7390	<0.400UD	106	<0.400UD	121	34
Coal-10	70.7J	<1.00UD	2.54D	<1.00U	0.555JD	11500	<1.00U	1.18J	55.1J	<0.400UD	1500	30.5	0.703JD	<1.00UD	7380	<0.400UD	109	<0.400UD	129	35
Coal-15	<50.0U	<1.00UD	3.45D	<1.00U	1.02JD	12600	<1.00U	2.88J	<50.0U	1.27JD	1180	18.3	0.678JD	<1.00UD	7140	<0.400UD	103	<0.400UD	206	36
Coal-20	54.9J	<1.00UD	3.73D	<1.00U	<0.400UD	7250	<1.00U	<1.00U	64.9J	<0.400UD	1050	4.25J	<0.400UD	<1.00UD	6690	<0.400UD	78.9	<0.400UD	<5.00U	22
Coal-25	<50.0U	<1.00UD	7.69D	<1.00U	<0.400UD	8620	<1.00U	<1.00U	93.7J	<0.400UD	1010	15.3	0.413JD	<1.00UD	5610	<0.400UD	86.8	<0.400UD	<5.00U	26
Coal-Opp1	<50.0U	<1.00UD	3.27D	<1.00U	<0.400UD	11500	<1.00U	1.25J	54.9J	0.503JD	1280	20.3	0.477JD	<1.00UD	7120	<0.400UD	107	<0.400UD	87.8	34
Coal-Opp2	58.6J	<1.00UD	3.29D	<1.00U	0.456JD	11400	<1.00U	<1.00U	55.8J	0.500JD	1290	26.2	0.575JD	<1.00UD	7270	<0.400UD	105	<0.400UD	101	34
Cop-00	55.1J	<1.00UD	2.25D	<1.00U	<0.400UD	4440	<1.00U	<1.00U	217	<0.400UD	499J	13.5	<0.400UD	<1.00UD	2300	<0.400UD	30.4	<0.400UD	<5.00U	13
Elk-00	<50.0U	<1.00UD	2.60D	<1.00U	2.54D	19300	<1.00U	5.28	<50.0U	2.74D	1290	45.8	0.840JD	<1.00UD	7220	<0.400UD	130	<0.400UD	517	53
Elk-00D	<50.0U	<1.00UD	2.78D	<1.00U	2.50D	19000	<1.00U	5.05	<50.0U	2.68D	1310	46.8	1.56JD	<1.00UD	7150	<0.400UD	131	<0.400UD	513	53
Elk-05	<50.0U	<1.00UD	4.24D	<1.00U	2.64D	19100	<1.00U	6.39	<50.0U	5.11D	1320	86.4	0.892JD	<1.00UD	7570	<0.400UD	104	<0.400UD	515	53
Elk-06	65.6J	<1.00UD	1.68JD	<1.00U	5.71D	16300	<1.00U	13.9	<50.0U	11.9D	1360	198	1.28JD	<1.00UD	6750	<0.400UD	92.7	<0.400UD	1090	46
Elk-08	64.1J	<1.00UD	2.07D	<1.00U	6.40D	17400	<1.00U	14.5	<50.0U	16.7D	1410	259	1.34JD	<1.00UD	6690	<0.400UD	96.5	<0.400UD	1140	49
Elk-10	153J	<2.50UD	<1.00UD	<1.00U	16.5D	17600	<1.00U	43.9	78.1J	66.0D	1560	807	2.19JD	<2.50UD	6490	<1.00UD	98.4	<1.00UD	3070	50
Elk-29	<50.0U	<0.500U	<0.200U	<1.00U	0.750J	6030	<1.00U	1.10J	<50.0U	4.6	511J	<1.00U	0.336J	<0.500U	4360	<0.200U	37.2	<0.200U	145	17
Key-00	304	<1.00UD	<0.400UD	<1.00U	2.30D	54500	<1.00U	10.9	<50.0U	<0.400UD	1620	447	2.74D	<1.00UD	10800	<0.400UD	91.8	<0.400UD	480	143
Key-01	1610D	<5.00UD	<2.00UD	<2.00UD	7.03JD	242000D	<2.00UD	19.4D	<100UD	<2.00UD	2670D	1760D	10.2D	<5.00UD	4760D	<2.00UD	315D	<2.00UD	1510D	615D
Key-02	95.0J	<1.00UD	<0.400UD	<1.00U	1.64JD	6130	<1.00U	10.3	<50.0U	<0.400UD	1470	258	1.11JD	<1.00UD	12300	<0.400UD	37	<0.400UD	331	21
Slate-01	52.5J	<1.00UD	<0.400UD	<1.00U	<0.400UD	11900	<1.00U	1.20J	<50.0U	1.45JD	1280	11.7	0.484JD	<1.00UD	4050	<0.400UD	96.6	<0.400UD	35.4	35
Slate-02	<50.0U	<1.00UD	0.773JD	<1.00U	<0.400UD	13200	<1.00U	1.22J	<50.0U	1.25JD	1520	21.7	0.516JD	<1.00UD	5080	<0.400UD	101	<0.400UD	54.3	39
SM-00	1200D	<10.0UD	<4.00UD	<2.00UD	142D	53700D	<2.00UD	733D	1070D	1290D	6180D	8450D	12.8JD	<10.0UD	10700D	<4.00UD	414D	<4.00UD	25100D	159D
SM-02	618	<2.50UD	<1.00UD	<1.00U	27.3D	17600	<1.00U	162	694	176D	2160	1560	3.62JD	<2.50UD	8620	<1.00UD	89.3	<1.00UD	5280	53
SP-00	<50.0U	<1.00UD	<0.400UD	<1.00U	<0.400UD	6310	<1.00U	<1.00U	<50.0U	<0.400UD	1240	<1.00U	<0.400UD	<1.00UD	8960	<0.400UD	71.1	<0.400UD	<5.00U	21
SP-00D	<50.0U	<0.500U	<0.200U	<1.00U	<0.200U	6150	<1.00U	<1.00U	<50.0U	<0.200U	1240	<1.00U	0.236J	<0.500U	8560	<0.200U	74.3	<0.200U	<5.00U	20
SP-01	<50.0U	<1.00UD	<0.400UD	<1.00U	<0.400UD	5890	<1.00U	<1.00U	<50.0U	<0.400UD	1260	<1.00U	<0.400UD	<1.00UD	9300	<0.400UD	67.6	<0.400UD	<5.00U	20
Wild-00	<50.0U	<1.00UD	<0.400UD	<1.00U	<0.400UD	8060	<1.00U	<1.00U	<50.0U	<0.400UD	2140	<1.00U	<0.400UD	<1.00UD	7140	<0.400UD	83.5	<0.400UD	<5.00U	29
FB-01	<50.0U	<0.500U	<0.200U	<1.00U	<0.200U	<50.0U	<1.00U	<1.00U	<50.0U	<0.200U	<200U	<1.00U	<0.200U	<0.500U	<50.0U	<0.200U	<2.00U	<0.200U	<5.00U	<0.3U
FB-02	<50.0U	<0.500U	<0.200U	<1.00U	<0.200U	52.6J	<1.00U	<1.00U	<50.0U	<0.200U	<200U	<1.00U	<0.200U	<0.500U	<50.0U	<0.200U	<2.00U	<0.200U	7.20J	<0.3U

Notes:

J - Estimated value due to anlayte detection between the Method Reporting Limit and Detection Limit.

U - Analyte not detected. Reported value is less than (<) the detection limit.

D - Sample was diluted prior to analysis.

All units are micrograms per liter, unless otherwise indicated.

mg/L - milligrams per liter

Table 5.0-6 Dissolved Metals and Hardness - July 2006 Porewater

Location	Aluminum	Antimony	Arsenic	Beryllium	Cadmium	Calcium	Chromium	Copper	Iron	Lead	Magnesium	Manganese	Nickel	Selenium	Silica (SiO_2)	Silver	Strontium	Thallium	Zinc	Hardness (mg/L)
Coal-00	<20.0U	<0.500U	0.766J	<0.200U	0.915J	35000J	0.718J	1.19J	<50.0UJ	<0.200U	3380	1.54	1.33	<0.500U	10600	<0.200U	214	<0.200U	188	101
Coal-02	<20.0U	<0.500U	1.16	<0.200U	1.21	63800	0.612J	1.70J	<50.0U	<0.200U	4540	15.3	2.82	<0.500U	8310	<0.200U	284	<0.200U	195	178
Coal-05	<20.0U	<0.500U	1.59	<0.200U	1.1	85700	0.711J	1.14J	<50.0U	<0.200U	16600	7.19	3.44	2.96	14000	<0.200U	696	<0.200U	163	282
Coal-10	<20.0U	<0.500U	1.71	<0.200U	<0.200U	14400	0.573J	<1.00U	<50.0U	<0.200U	2190	0.578J	0.772J	<0.500U	8040	<0.200U	111	<0.200U	65	45
Coal-10D	<20.0U	<0.500U	1.73	<0.200U	<0.200U	14500	0.523J	<1.00U	<50.0U	<0.200U	2220	0.520J	0.851J	<0.500U	8100	<0.200U	112	<0.200U	66.1	45
Coal-15	<20.0U	<0.500U	6.06	<0.200U	0.647J	14500	<0.500U	<1.00U	<50.0U	<0.200U	1620	6.88	0.686J	<0.500U	6690	<0.200U	137	<0.200U	121	43
Coal-20	<20.0U	<0.500U	1.78	<0.200U	<0.200U	18400	<0.500U	<1.00U	<50.0U	<0.200U	1570	1.19	0.882J	<0.500U	6750	<0.200U	161	<0.200U	37.2	52
Coal-25	<20.0U	<0.500U	6.96	<0.200U	<0.200U	10700	0.579J	<1.00U	<50.0U	<0.200U	1630	1080	1.77	<0.500U	6030	<0.200U	124	<0.200U	32.2	33
Coal-Opp 1	<20.0U	<0.500U	2.65	<0.200U	0.414J	16800	4.26	<1.00U	<50.0U	<0.200U	2190	2.93	0.877J	<0.500U	7280	<0.200U	161	<0.200U	78	51
Coal-Opp 2	<20.0U	<0.500U	1.08	<0.200U	<0.200U	14400	0.617J	12.5	<50.0U	2.18	2790	0.531J	0.812J	<0.500U	11200	<0.200U	137	<0.200U	17.9	47
Cop-01	<20.0U	<0.500U	3.36	<0.200U	<0.200U	15000	0.653J	<1.00U	50.7J	<0.200U	1410	101	0.833J	<0.500U	7700	<0.200U	103	<0.200U	3.61J	43
Elk-00	<20.0U	<0.500U	2.81	<0.200U	2.09	24000	<0.500U	2.37J	<50.0U	0.220J	1590	5.84	1.48	<0.500U	7680	<0.200U	169	<0.200U	323	66
Elk-00D	<20.0U	<0.500U	2.89	<0.200U	2.07	23800	<0.500U	2.25J	<50.0U	0.215J	1600	5.92	1.36	<0.500U	7660	<0.200U	168	<0.200U	301	66
Elk-05	<20.0U	<0.500U	2.15	<0.200U	3.6	22400	<0.500U	3.37J	<50.0U	0.482J	1610	4.07	1.55	<0.500U	7390	<0.200U	117	<0.200U	662	63
Elk-06	<20.0U	<0.500U	0.807J	<0.200U	7.58	22400	<0.500U	7.39	<50.0U	2.73	1910	95.8	2.34	<0.500U	6570	<0.200U	127	<0.200U	1290	64
Elk-08	<20.0U	<0.500U	0.974J	<0.200U	8.58	23800	<0.500U	7.37	228	3.86	2020	111	2.82	<0.500U	6790	<0.200U	132	<0.200U	1450	68
SP-00	<20.0U	<0.500U	<0.200U	<0.200U	<0.200U	7990	<0.500U	<1.00U	<50.0U	<0.200U	1560	0.298J	0.452J	<0.500U	9280	<0.200U	90.2	<0.200U	<2.00U	26
SP-01	<20.0U	<0.500U	<0.200U	<0.200U	<0.200U	6560	<0.500U	<1.00U	<50.0U	<0.200U	1390	0.616J	0.370J	<0.500U	9490	<0.200U	77.7	<0.200U	<2.00U	22

Notes:

J - Estimated value due to anlayte detection between the Method Reporting Limit and Detection Limit.

U - Analyte not detected. Reported value is less than (<) the detection limit.

D - Sample was diluted prior to analysis.

All units are micrograms per liter, unless otherwise indicated.

mg/L - milligrams per liter

Table 5.0-7 Dissolved Metals and Hardness - July 2006 Surface Water

Location	Aluminum	Antimony	Arsenic	Beryllium	Cadmium	Calcium	Chromium	Copper	Iron	Lead	Magnesium	Manganese	Nickel	Selenium	Silica (SiO_2)	Silver	Strontium	Thallium	Zinc	Hardness (mg/L)
Coal-00	37.5J	<0.500U	1.61	<0.200U	0.535J	44700	0.750J	1.09J	<50.0U	<0.200U	3680	18.1	1.54	<0.500U	8560	<0.200U	217	<0.200U	82.6	127
Coal-02	44.2J	<0.500U	1.51	<0.200U	0.752J	63000	0.715J	1.23J	<50.0U	<0.200U	3410	35.4	2.54	<0.500U	7230	<0.200U	260	<0.200U	122	171
Coal-05	72.9	<0.500U	3.64	<0.200U	0.641J	19000	0.512J	12.1	54.3J	0.383J	2170	40.6	2.46	<0.500U	7780	<0.200U	146	<0.200U	154	56
Coal-10	53.5	<0.500U	3.93	<0.200U	0.590J	15100	<0.500U	<1.00U	50.5J	<0.200U	2060	37.7	0.929J	<0.500U	7770	<0.200U	146	<0.200U	122	46
Coal-10D	53.1	<0.500U	3.92	<0.200U	0.584J	15100	<0.500U	<1.00U	<50.0U	<0.200U	2060	36.8	0.851J	<0.500U	7750	<0.200U	145	<0.200U	116	46
Coal-15	<20.0U	<0.500U	6.1	<0.200U	0.732J	14500	<0.500U	<1.00U	<50.0U	<0.200U	1610	7.58	0.682J	<0.500U	6690	<0.200U	136	<0.200U	127	43
Coal-20	<20.0U	<0.500U	7.48	<0.200U	<0.200U	10400	<0.500U	<1.00U	58.3J	<0.200U	1630	5.6	0.482J	<0.500U	6180	<0.200U	116	<0.200U	<2.00U	33
Coal-25	<20.0U	<0.500U	15.3	<0.200U	<0.200U	11900	<0.500U	<1.00U	113J	<0.200U	1430	25	0.472J	<0.500U	4490	<0.200U	134	<0.200U	2.71J	36
Coal-Opp 1	<20.0U	<0.500U	5.08	<0.200U	0.394J	16300	<0.500U	<1.00U	76.3J	<0.200U	1890	45.5	0.744J	<0.500U	6960	<0.200U	150	<0.200U	75.2	49
Coal-Opp 2	36.6J	<0.500U	4.59	<0.200U	0.478J	16000	<0.500U	<1.00U	71.5J	<0.200U	1910	51	0.826J	<0.500U	7280	<0.200U	146	<0.200U	100	48
Cop-01	31.2J	<0.500U	2.69	<0.200U	<0.200U	5320	<0.500U	<1.00U	346	<0.200U	604J	14.1	0.328J	<0.500U	2010	<0.200U	34.9	<0.200U	<2.00U	16
Elk-00	<20.0U	<0.500U	2.9	<0.200U	2.24	24000	<0.500U	2.00J	<50.0U	0.287J	1610	11.2	1.28	<0.500U	7630	<0.200U	168	<0.200U	364	66
Elk-00D	<20.0U	<0.500U	2.86	<0.200U	2.32	24000	<0.500U	1.99J	<50.0U	0.292J	1610	11.3	1.28	<0.500U	7580	<0.200U	167	<0.200U	366	67
Elk-05	<20.0U	<0.500U	4.65	<0.200U	3.58	22800	<0.500U	2.69J	<50.0U	1.38	1610	86.7	1.49	<0.500U	7520	<0.200U	119	<0.200U	570	64
Elk-06	<20.0U	<0.500U	0.929J	<0.200U	8.89	22600	<0.500U	6.74	<50.0U	3.84	1940	240	2.26	<0.500U	6620	<0.200U	127	<0.200U	1480	65
Elk-08	20.5J	<0.500U	1.38	<0.200U	10.6	23700	<0.500U	8.4	<50.0U	6.76	2040	413	2.18	0.543J	6740	<0.200U	131	<0.200U	1660	68
Elk-10	<20.0U	<0.500U	0.254J	<0.200U	28.4	23400	<0.500U	28.5	53.2J	33.5	2390	1320	4.7	0.771J	6860	<0.200U	136	<0.200U	4600	68
Elk-29	<20.0U	<0.500U	0.200J	<0.200U	1.01	8040	<0.500U	2.75J	<50.0U	2.33	709J	2.48	0.898J	<0.500U	4620	<0.200U	45.4	<0.200U	154	23
Key-00	99.5	<0.500U	0.220J	<0.200U	3.16	37700	<0.500U	8.59	<50.0U	<0.200U	2720	366	3.29	<0.500U	12700	<0.200U	85.5	<0.200U	522	105
Slate-01	<20.0U	<0.500U	0.402J	<0.200U	0.222J	15900	0.525J	<1.00U	<50.0U	0.871J	1750	12.3	0.674J	<0.500U	4400	<0.200U	126	<0.200U	21.3	47
Slate-02	<20.0U	<0.500U	0.513J	<0.200U	0.214J	20300	0.510J	<1.00U	75.2J	0.840J	2130	32.9	0.758J	<0.500U	5260	<0.200U	153	<0.200U	28.7	59
SM-00	455JD	<10.0UD	<4.00UD	<4.00UD	161D	86600	<10.0UD	454D	1140	913D	9410	10000D	19.3JD	<10.0UD	12400	<4.00UD	560	<4.00UD	25000D	255
SP-00	<20.0U	<0.500U	<0.200U	<0.200U	<0.200U	9180	<0.500U	<1.00U	<50.0U	<0.200U	1610	<0.200U	0.319J	<0.500U	10100	<0.200U	101	<0.200U	<2.00U	30
SP-01	<20.0U	<0.500U	<0.200U	<0.200U	<0.200U	8030	<0.500U	<1.00U	<50.0U	<0.200U	1550	0.518J	0.290J	<0.500U	10600	<0.200U	90.2	<0.200U	<2.00U	26
Wild-00	<20.0U	<0.500U	<0.200U	<0.200U	<0.200U	12700	<0.500U	<1.00U	<50.0U	<0.200U	3310	<0.200U	0.430J	<0.500U	7760	<0.200U	130	<0.200U	<2.00U	45

Notes:

J - Estimated value due to anlayte detection between the Method Reporting Limit and Detection Limit.

U - Analyte not detected. Reported value is less than (<) the detection limit.

D - Sample was diluted prior to analysis.

All units are micrograms per liter, unless otherwise indicated.

mg/L - milligrams per liter

Table 5.0-8 Dissolved Metals and Hardness - September 2006 Surface Water

Location	Aluminum	Antimony	Arsenic	Beryllium	Cadmium	Calcium	Chromium	Copper	Iron	Lead	Magnesium	Manganese	Nickel	Selenium	Silica (SiO2	Silver	Strontium	Thallium	Zinc	Hardness
Coal-00	<50.0U	<0.500U	1.21	<1.00U	0.420J	44700	<1.00U	1.44J	<50.0U	<0.200U	4650	24.3	2.23	<0.500U	7250	<0.200U	311	<0.200U	82.8	131
Coal-02	61.9J	<0.500U	1.01	<1.00U	0.534J	65300	<1.00U	1.50J	<50.0U	<0.200U	4540	43.1	3.36	<0.500U	6980	<0.200U	315	<0.200U	128	182
Coal-05	188J	<0.500U	1.58	<1.00U	0.634J	89900	<1.00U	1.65J	<50.0U	<0.200U	2590	97.2	4.04	<0.500U	6290	<0.200U	220	<0.200U	161	235
Coal-10	78.1J	<0.500U	2.85	<1.00U	0.785J	17900	<1.00U	1.10J	75.5J	<0.200U	2650	97.6	1.31	<0.500U	7580	<0.200U	174	<0.200U	227	56
Coal-10D	77.6J	<0.500U	2.85	<1.00U	0.757J	17900	<1.00U	1.28J	84.0J	<0.200U	2660	97.9	1.32	<0.500U	7610	<0.200U	175	<0.200U	229	56
Coal-15	<50.0U	<0.500U	6.61	<1.00U	0.798J	17200	<1.00U	<1.00U	84.4J	<0.200U	2060	12.1	0.980J	<0.500U	5670	<0.200U	179	<0.200U	164	51
Coal-20	<50.0U	<0.500U	8.55	<1.00U	<0.200U	13200	<1.00U	<1.00U	121J	<0.200U	2060	9.05	0.756J	<0.500U	5010	<0.200U	162	<0.200U	<5.00U	41
Coal-25	<50.0U	<0.500U	13.6	<1.00U	<0.200U	13900	<1.00U	<1.00U	134J	<0.200U	1640	36.1	0.720J	<0.500U	3280	<0.200U	177	<0.200U	5.01J	41
Coal-Opp 1	<50.0U	<0.500U	4.98	<1.00U	0.367J	18500	<1.00U	1.04J	148J	<0.200U	2340	76.4	0.948J	<0.500U	6300	<0.200U	184	<0.200U	87.3	56
Coal-Opp 2	64.1J	<0.500U	4.02	<1.00U	0.495J	18200	<1.00U	<1.00U	134J	<0.200U	2420	92.7	1.09	<0.500U	7000	<0.200U	181	<0.200U	137	55
Cop-01	<50.0U	<0.500U	2.01	<1.00U	<0.200U	7590	<1.00U	<1.00U	209	<0.200U	822J	33.8	0.521J	<0.500U	3780	<0.200U	49.7	<0.200U	<5.00U	22
Elk-00	<50.0U	<0.500U	1.99	<1.00U	3.19	28500	<1.00U	1.92J	<50.0U	0.208J	1980	22	1.53	<0.500U	7760	<0.200U	222	<0.200U	643	79
Elk-05	<50.0U	<0.500U	4.91	<1.00U	5.38	27400	<1.00U	1.98J	<50.0U	0.472J	2020	139	1.8	<0.500U	8050	<0.200U	152	<0.200U	1140	77
Elk-06	<50.0U	<0.500U	0.513J	<1.00U	15.1	33000	<1.00U	5.21	<50.0U	1.26	2970	453	3.51	<0.500U	7550	<0.200U	194	<0.200U	3250	95
Elk-08	<50.0U	<0.500U	0.867J	<1.00U	18.7	33800	<1.00U	7.75	<50.0U	2.45	3060	795	3.99	<0.500U	7660	<0.200U	198	<0.200U	3770	97
Elk-10	<50.0U	<0.500U	0.266J	<1.00U	42.5	33100	<1.00U	46.7	155J	44.4	3710	2250	7.18	0.696J	8000	<0.200U	197	<0.200U	8230	98
Elk-10D	<50.0U	<0.500U	0.236J	<1.00U	42.9	33100	<1.00U	46.3	168J	43.5	3700	2270	7.34	0.842J	8000	<0.200U	199	<0.200U	8270	98
Elk-29	<50.0U	<0.500U	<0.200U	<1.00U	1.12	9900	<1.00U	1.38J	<50.0U	1.01	847J	<1.00U	0.773J	<0.500U	5010	<0.200U	60	<0.200U	210	28
Key-00	831JD	<10.0UD	<4.00UD	<10.0UD	<4.00UD	305000D	<10.0UD	<10.0UD	<500UD	<4.00UD	2340JD	129D	13.4JD	<10.0UD	1150JD	<4.00UD	392D	<4.00UD	86.6JD	771D
Key-Opp 1	812JD	<10.0UD	<4.00UD	<10.0UD	<4.00UD	299000D	<10.0UD	<10.0UD	<500UD	<4.00UD	2170JD	273D	13.9JD	<10.0UD	1830JD	<4.00UD	390D	<4.00UD	178JD	756D
Slate-01	<50.0U	<0.500U	0.333J	<1.00U	0.328J	21900	<1.00U	1.44J	54.7J	0.851J	2620	27.8	1.35	<0.500U	5730	<0.200U	194	<0.200U	38.1	65
Slate-02	<50.0U	<0.500U	0.308J	<1.00U	0.330J	22400	<1.00U	1.15J	53.0J	0.842J	2690	29.8	1.13	<0.500U	5740	<0.200U	195	<0.200U	37.3	67
SM-00	200	<0.500U	0.596J	<1.00U	154	76900	<1.00U	212	446	546	8670	11100	20	2.1	10400	0.520J	606	<0.200U	26500	228
SM-00-EF	60.7J	<0.500U	0.533J	<1.00U	159	76000	<1.00U	179	258	397	8570	11100	20.4	2.01	10300	0.389J	599	<0.200U	26400	225
SP-00	<50.0U	<0.500U	<0.200U	<1.00U	<0.200U	8640	<1.00U	<1.00U	<50.0U	<0.200U	1690	<1.00U	0.415J	<0.500U	9040	<0.200U	112	<0.200U	6.51J	29
SP-01	<50.0U	<0.500U	<0.200U	<1.00U	<0.200U	7150	<1.00U	<1.00U	<50.0U	<0.200U	1560	<1.00U	0.407J	<0.500U	10200	<0.200U	95	<0.200U	<5.00U	24
Wild-00	<50.0U	<0.500U	<0.200U	<1.00U	<0.200U	12700	<1.00U	<1.00U	<50.0U	<0.200U	3880	<1.00U	0.884J	<0.500U	7140	<0.200U	158	<0.200U	6.69J	48
FB-01	<50.0U	<0.500U	<0.200U	<1.00U	<0.200U	60.8J	<1.00U	<1.00U	<50.0U	<0.200U	<200U	<1.00U	<0.200U	<0.500U	<50.0U	<0.200U	<2.00U	<0.200U	<5.00U	<0.3U
FB-02	<50.0U	<0.500U	<0.200U	<1.00U	<0.200U	<50.0U	<1.00U	<1.00U	<50.0U	<0.200U	<200U	<1.00U	<0.200U	<0.500U	<50.0U	<0.200U	<2.00U	<0.200U	<5.00U	<0.3U

Notes:

J - Estimated value due to anlayte detection between the Method Reporting Limit and Detection Limit.

U - Analyte not detected. Reported value is less than (<) the detection limit.

D - Sample was diluted prior to analysis.

All units are micrograms per liter, unless otherwise indicated.

mg/L - milligrams per liter

Table 5.0-9 Total Recoverable Metals - June 2006 Surface Water

Location	Aluminum	Antimony	Arsenic	Beryllium	Cadmium	Calcium	Chromium	Copper	Iron	Lead	Magnesium	Manganese	Nickel	Selenium	Silica (SiO2)	Silver	Strontium	Thallium	Zinc
Bog-01	6340	<2.50UD	<5.00UD	1.15J	20.5D	11200	<1.00U	4.07J	1910	6.90JD	2340	1200	16.4D	<5.00UD	30100	<1.00UD	48.8	<1.00UD	5520
Coal-00	124J	<2.50UD	<5.00UD	<1.00U	<1.00UD	23200	<1.00U	3.01J	82.8J	<1.50UD	1790	32.6	<2.50UD	<5.00UD	6710	<1.00UD	128	<1.00UD	113
Coal-02	130J	<2.50UD	<5.00UD	<1.00U	<1.00UD	20000	<1.00U	2.12J	88.3J	<1.50UD	1730	31	<2.50UD	<5.00UD	7010	<1.00UD	120	<1.00UD	103
Coal-05	130J	<2.50UD	<5.00UD	<1.00U	<1.00UD	10900	<1.00U	2.11J	112J	<1.50UD	1390	36.9	<2.50UD	<5.00UD	7090	<1.00UD	103	<1.00UD	124
Coal-10	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Coal-15	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Coal-20	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Coal-25	128J	<2.50UD	8.52JD	<1.00U	<1.00UD	8230	<1.00U	<1.00U	185J	<1.50UD	987J	22	<2.50UD	<5.00UD	5330	<1.00UD	84.6	<1.00UD	<5.00U
Coal-Opp1	86.7J	<2.50UD	<5.00UD	<1.00U	<1.00UD	11000	<1.00U	2.51J	133J	<1.50UD	1220	27	<2.50UD	<5.00UD	6700	<1.00UD	103	<1.00UD	83.7
Coal-Opp2	94.3J	<2.50UD	<5.00UD	<1.00U	<1.00UD	10800	<1.00U	2.03J	115J	<1.50UD	1190	28.9	<2.50UD	<5.00UD	6530	<1.00UD	101	<1.00UD	106
Cop-00	114J	<2.50UD	<5.00UD	<1.00U	<1.00UD	4120	<1.00U	<1.00U	440	<1.50UD	456J	54.9	<2.50UD	<5.00UD	2070	<1.00UD	29.2	<1.00UD	<5.00U
Elk-00	<50.0U	<2.50UD	<5.00UD	<1.00U	2.62JD	18200	<1.00U	5.98	<50.0U	4.74JD	1270	53	<2.50UD	<5.00UD	6650	<1.00UD	126	<1.00UD	498
Elk-00D	56.7J	<2.50UD	<5.00UD	<1.00U	2.88JD	18500	<1.00U	6.57	<50.0U	7.73D	1200	47.7	<2.50UD	<5.00UD	6570	<1.00UD	128	1.31JD	486
Elk-05	<50.0U	<2.50UD	<5.00UD	<1.00U	2.74JD	17700	<1.00U	7.08	<50.0U	7.20JD	1320	87.7	<2.50UD	<5.00UD	6750	<1.00UD	99.4	<1.00UD	477
Elk-06	99.5J	<2.50UD	<5.00UD	<1.00U	5.71D	15100	<1.00U	14.6	95.3J	16.6D	1300	191	<2.50UD	<5.00UD	5880	<1.00UD	88.9	<1.00UD	993
Elk-08	101J	<2.50UD	<5.00UD	<1.00U	6.50D	16100	<1.00U	17.2	104J	23.3D	1290	254	<2.50UD	<5.00UD	6010	<1.00UD	93	<1.00UD	1070
Elk-10	190J	<2.50UD	<5.00UD	<1.00U	17.5D	17200	<1.00U	51.1	171J	95.4D	1630	799	2.72JD	<5.00UD	6340	<1.00UD	99.1	<1.00UD	3030
Elk-29	<50.0U	<2.50UD	<5.00UD	<1.00U	<1.00UD	5990	<1.00U	1.24J	<50.0U	8.70D	491J	3.28J	<2.50UD	<5.00UD	4270	<1.00UD	37.3	1.37JD	157
Key-00	449	<2.50UD	<5.00UD	<1.00U	2.45JD	51100	<1.00U	15.8	103J	2.16JD	1590	441	3.10JD	<5.00UD	10800	<1.00UD	91.3	<1.00UD	476
Key-01	1650D	<5.00UD	<10.0UD	<2.00UD	7.58JD	241000D	<2.00UD	21.0D	146JD	<3.00UD	2780D	1840D	12.2JD	<10.0UD	4900D	<2.00UD	328D	<2.00UD	1590D
Key-02	311	<2.50UD	<5.00UD	<1.00U	1.79JD	6060	<1.00U	14.5	104J	2.89JD	1460	254	<2.50UD	<5.00UD	12100	<1.00UD	37.4	<1.00UD	343
Slate-01	131J	<2.50UD	<5.00UD	<1.00U	<1.00UD	11600	<1.00U	<1.00U	158J	3.93JD	1320	16.4	<2.50UD	<5.00UD	4040	<1.00UD	96.3	<1.00UD	42.3
Slate-02	394	<2.50UD	<5.00UD	<1.00U	<1.00UD	13600	<1.00U	1.56J	472	3.75JD	1590	34.5	<2.50UD	<5.00UD	6320	<1.00UD	106	<1.00UD	65.8
SM-00	1170D	<25.0UD	<50.0UD	<2.00UD	142D	55000D	<2.00UD	730D	2130D	1320D	5890D	8550D	<25.0UD	<50.0UD	10800D	<10.0UD	428D	<10.0UD	26100D
SM-02	657	<2.50UD	<5.00UD	<1.00U	29.0D	17000	<1.00U	157	1050	195D	2000	1530	4.41JD	<5.00UD	8440	<1.00UD	88.8	<1.00UD	5220
SP-00	53.7J	<2.50UD	<5.00UD	<1.00U	<1.00UD	6200	<1.00U	<1.00U	<50.0U	<1.50UD	1170	1.08J	<2.50UD	<5.00UD	8360	<1.00UD	71	<1.00UD	<5.00U
SP-00D	53.7J	<2.50UD	<5.00UD	<1.00U	<1.00UD	5890	<1.00U	1.20J	<50.0U	<1.50UD	1140	<1.00U	<2.50UD	<5.00UD	7890	<1.00UD	71.2	<1.00UD	<5.00U
SP-01	55.8J	<2.50UD	<5.00UD	<1.00U	<1.00UD	5860	<1.00U	<1.00U	73.8J	<1.50UD	1170	3.07J	<2.50UD	<5.00UD	8950	<1.00UD	68.7	<1.00UD	<5.00U
Wild-00	58.5J	<2.50UD	<5.00UD	<1.00U	<1.00UD	7950	<1.00U	<1.00U	<50.0U	<1.50UD	2040	2.19J	<2.50UD	<5.00UD	6750	<1.00UD	84.9	<1.00UD	7.98J
FB-01	<50.0U	<2.50UD	<5.00UD	<1.00U	<1.00UD	<50.0U	<1.00U	<1.00U	<50.0U	<1.50UD	<200U	<1.00U	<2.50UD	<5.00UD	<50.0U	<1.00UD	<2.00U	<1.00UD	<5.00U
FB-02	<50.0U	<2.50UD	<5.00UD	<1.00U	<1.00UD	<50.0U	<1.00U	<1.00U	<50.0U	<1.50UD	<200U	<1.00U	<2.50UD	<5.00UD	<50.0U	<1.00UD	<2.00U	<1.00UD	<5.00U

Notes:

J - Estimated value due to anlayte detection between the Method Reporting Limit and Detection Limit.

U - Analyte not detected. Reported value is less than (<) the detection limit.

D - Sample was diluted prior to analysis.

NA - No data available since analysis was not performed at the Region 8 Laboratory.

All units are micrograms per liter, unless otherwise indicated.

Table 5.0-10 Total Recoverable Metals - July 2006 Surface Water

Location	Aluminum	Antimony	Arsenic	Beryllium	Cadmium	Calcium	Chromium	Copper	Iron	Lead	Magnesium	Manganese	Nickel	Selenium	Silica (SiO_2)	Silver	Strontium	Thallium	Zinc
Coal-00	<100UD	<2.50UD	1.54JD	<1.00UD	<1.00UD	37800	<2.50UD	<5.00UD	68.0J	<5.00UD	3280	24.4D	1.78JD	<2.50UD	7770	<1.00UD	233	<1.00UD	72.1D
Coal-02	<100UD	<2.50UD	2.15JD	<1.00UD	<1.00UD	61600	<2.50UD	<5.00UD	79.3J	<5.00UD	3410	43.7D	2.40JD	<2.50UD	7330	<1.00UD	274	<1.00UD	114D
Coal-05	<100UD	<2.50UD	4.24JD	<1.00UD	<1.00UD	16600	<2.50UD	<5.00UD	140J	<5.00UD	2100	46.7D	<1.00UD	<2.50UD	7970	<1.00UD	156	<1.00UD	106D
Coal-10	<100UD	<2.50UD	4.13JD	<1.00UD	<1.00UD	14500	<2.50UD	<5.00UD	134J	<5.00UD	2040	42.8D	<1.00UD	<2.50UD	7770	<1.00UD	154	<1.00UD	102D
Coal-10D	<100UD	<2.50UD	4.16JD	<1.00UD	<1.00UD	14600	<2.50UD	<5.00UD	133J	<5.00UD	2050	41.9D	<1.00UD	<2.50UD	7730	<1.00UD	154	<1.00UD	102D
Coal-15	<100UD	<2.50UD	7.38D	<1.00UD	<1.00UD	13600	<2.50UD	<5.00UD	110J	<5.00UD	1570	11.2D	<1.00UD	<2.50UD	6620	<1.00UD	142	<1.00UD	107D
Coal-20	<100UD	<2.50UD	8.12D	<1.00UD	<1.00UD	9850	<2.50UD	<5.00UD	157J	<5.00UD	1620	9.87D	<1.00UD	<2.50UD	6220	<1.00UD	125	<1.00UD	<10.0UD
Coal-25	<100UD	<2.50UD	17.8D	<1.00UD	<1.00UD	11100	<2.50UD	<5.00UD	248	<5.00UD	1400	31.6D	<1.00UD	<2.50UD	4440	<1.00UD	141	<1.00UD	<10.0UD
Coal-Opp 1	<100UD	<2.50UD	5.58D	<1.00UD	<1.00UD	15600	<2.50UD	<5.00UD	176J	<5.00UD	1850	53.1D	<1.00UD	<2.50UD	7100	<1.00UD	164	<1.00UD	46.0JD
Coal-Opp 2	<100UD	<2.50UD	5.12D	<1.00UD	<1.00UD	15600	<2.50UD	<5.00UD	171J	<5.00UD	1900	59.7D	<1.00UD	<2.50UD	7480	<1.00UD	163	<1.00UD	72.9D
Cop-01	<100UD	<2.50UD	3.63JD	<1.00UD	<1.00UD	4990	<2.50UD	<5.00UD	610	<5.00UD	580J	51.5D	<1.00UD	<2.50UD	2070	<1.00UD	37.3	<1.00UD	<10.0UD
Elk-00	<100UD	<2.50UD	3.67JD	<1.00UD	2.20JD	22600	<2.50UD	<5.00UD	<50.0U	<5.00UD	1550	15.5D	<1.00UD	<2.50UD	7780	<1.00UD	183	<1.00UD	410D
Elk-00D	<100UD	<2.50UD	2.82JD	<1.00UD	2.24JD	21900	<2.50UD	<5.00UD	<50.0U	<5.00UD	1510	13.9D	<1.00UD	<2.50UD	7680	<1.00UD	179	<1.00UD	398D
Elk-05	<100UD	<2.50UD	4.44JD	<1.00UD	3.53JD	21000	<2.50UD	<5.00UD	<50.0U	<5.00UD	1510	96.3D	1.02JD	<2.50UD	7570	<1.00UD	128	<1.00UD	640D
Elk-06	<100UD	<2.50UD	<1.00UD	<1.00UD	9.28D	21300	<2.50UD	8.29JD	94.4J	11.2JD	1850	267D	1.65JD	<2.50UD	6780	<1.00UD	140	<1.00UD	1730D
Elk-08	<100UD	<2.50UD	1.31JD	<1.00UD	10.2D	21900	<2.50UD	11.0JD	130J	16.8JD	1890	403D	2.18JD	<2.50UD	6880	<1.00UD	144	<1.00UD	1790D
Elk-10	413D	<2.50UD	1.68JD	<1.00UD	28.8D	21100	<2.50UD	70.7D	936	196D	2220	1330D	3.79JD	<2.50UD	7250	<1.00UD	144	<1.00UD	5050D
Elk-29	<100UD	<2.50UD	<1.00UD	<1.00UD	<1.00UD	7520	<2.50UD	<5.00UD	<50.0U	<5.00UD	682J	1.93JD	<1.00UD	<2.50UD	4730	<1.00UD	50.1	<1.00UD	162D
Key-00	227JD	<2.50UD	<1.00UD	<1.00UD	3.22JD	34600	<2.50UD	10.8JD	52.1J	<5.00UD	2550	393D	3.55JD	<2.50UD	13000	<1.00UD	92.5	<1.00UD	552D
Slate-01	<100UD	<2.50UD	<1.00UD	<1.00UD	<1.00UD	14600	<2.50UD	<5.00UD	75.5J	<5.00UD	1650	12.3D	<1.00UD	<2.50UD	4420	<1.00UD	136	<1.00UD	<10.0UD
Slate-02	<100UD	<2.50UD	<1.00UD	<1.00UD	<1.00UD	16400	<2.50UD	<5.00UD	117J	<5.00UD	1880	35.7D	<1.00UD	<2.50UD	4820	<1.00UD	138	<1.00UD	<10.0UD
SM-00	1010D	<2.50UD	2.38JD	1.23JD	157D	63500	<2.50UD	488D	2590	1270D	7170	9350D	20.2D	<2.50UD	10600	<1.00UD	489	<1.00UD	26700D
SP-00	<100UD	<2.50UD	<1.00UD	<1.00UD	<1.00UD	7510	<2.50UD	<5.00UD	<50.0U	<5.00UD	1460	<1.00UD	<1.00UD	<2.50UD	8960	<1.00UD	92.4	<1.00UD	<10.0UD
SP-01	<100UD	<2.50UD	<1.00UD	<1.00UD	<1.00UD	6530	<2.50UD	<5.00UD	53.2J	<5.00UD	1360	1.18JD	<1.00UD	<2.50UD	9380	<1.00UD	81.6	<1.00UD	<10.0UD
Wild-00	<100UD	<2.50UD	<1.00UD	<1.00UD	<1.00UD	9860	<2.50UD	<5.00UD	<50.0U	<5.00UD	2810	<1.00UD	<1.00UD	<2.50UD	6800	<1.00UD	116	<1.00UD	<10.0UD

Notes:

J - Estimated value due to anlayte detection between the Method Reporting Limit and Detection Limit.

U - Analyte not detected. Reported value is less than (<) the detection limit.

D - Sample was diluted prior to analysis.

NA - No data available since analysis was not performed at the Region 8 Laboratory.

All units are micrograms per liter, unless otherwise indicated.

Table 5.0-11 Total Recoverable Metals - September 2006 Surface Water

Location	Aluminum	Antimony	Arsenic	Beryllium	Cadmium	Calcium	Chromium	Copper	Iron	Lead	Magnesium	Manganese	Nickel	Selenium	Silica (SiO2)	Silver	Strontium	Thallium	Zinc
Coal-00	59.5D	<2.50UD	1.98JD	<1.00D	<1.00UD	40000D	<1.00JD	1.54D	51.2D	<1.00UD	4250D	27.6D	1.36JD	<2.50UD	7190D	<1.00UD	306D	<1.00UD	78.0D
Coal-02	114U	<2.50UD	2.67JD	<1.00U	<1.00UD	60600	<1.00J	1.58	71.7U	<1.00UD	4180	51	2.22JD	<2.50UD	6830U	<1.00UD	309	<1.00UD	124
Coal-05	279D	<2.50UD	2.95JD	<1.00D	<1.00UD	70000D	<1.00D	1.82D	125D	<1.00UD	2400D	97.6D	2.68JD	<2.50UD	6480JD	<1.00UD	208D	<1.00UD	160JD
Coal-10	128U	<2.50UD	4.36JD	<1.00U	<1.00UD	16000	<1.00U	1.20J	159U	<1.00UD	2420	98	<1.00UD	<2.50UD	7310	<1.00UD	169	<1.00UD	214
Coal-10D	127D	<2.50UD	4.49JD	<1.00D	<1.00UD	16300D	<1.00D	1.47UD	174D	<1.00UD	2450D	99.3D	<1.00UD	<2.50UD	7410UD	<1.00UD	174D	<1.00UD	219D
Coal-15	<50.0D	<2.50UD	8.20D	<1.00D	<1.00UD	15500D	<1.00JD	1.59D	159D	<1.00UD	1870D	14.8D	<1.00UD	<2.50UD	5510D	<1.00UD	174D	<1.00UD	155UD
Coal-20	<50.0U	<2.50UD	10.7D	<1.00U	<1.00UD	11800	<1.00	<1.00	197U	<1.00UD	1870	11.4U	<1.00UD	<2.50UD	4820	<1.00UD	157	<1.00UD	<5.00
Coal-25	51.0D	<2.50UD	17.8D	<1.00D	<1.00UD	12500D	<1.00D	<1.00D	255D	<1.00UD	1490D	45.2D	<1.00UD	<2.50UD	3220JD	<1.00UD	171D	<1.00UD	5.16UD
Coal-Opp 1	<50.0J	<2.50UD	6.79D	<1.00U	<1.00UD	16700	<1.00	<1.00	227J	<1.00UD	2130	77.7	<1.00UD	<2.50UD	6090	<1.00UD	179	<1.00UD	81.7U
Coal-Opp 2	89.3D	<2.50UD	5.24D	<1.00D	<1.00UD	16400D	<1.00JD	<1.00D	225D	<1.00UD	2190D	93.7D	<1.00UD	<2.50UD	6740D	<1.00UD	175D	<1.00UD	128D
Cop-01	<50.0	<2.50UD	3.51JD	<1.00	<1.00UD	6880	<1.00	<1.00	413	<1.00UD	750	108U	<1.00UD	<2.50UD	3660	<1.00UD	48.1	<1.00UD	<5.00U
Elk-00	<50.0D	<2.50UD	2.57JD	<1.00D	2.91JD	25400D	<1.00D	2.24D	<50.0D	<1.00UD	1770D	22.4UD	<1.00UD	<2.50UD	7400JD	<1.00UD	212D	<1.00UD	581D
Elk-05	<50.0U	<2.50UD	5.93D	<1.00U	5.33D	24000	<1.00J	2.36J	<50.0U	1.97JD	1790J	131	1.18JD	<2.50UD	7340U	<1.00UD	139	<1.00UD	999
Elk-06	<50.0U	<2.50UD	1.86JD	<1.00U	14.5D	29500U	<1.00U	7.41U	<50.0U	5.89D	2650U	441U	2.74JD	<2.50UD	7160U	<1.00UD	185U	<1.00UD	2980U
Elk-08	80.3U	<2.50UD	1.81JD	<1.00U	17.7D	30300U	<1.00J	13.7U	89.2U	13.8D	2740U	772U	3.39JD	<2.50UD	7290U	<1.00UD	188U	<1.00UD	3450U
Elk-10	350JD	<2.50UD	<1.00UD	<1.00UD	41.0D	29800D	<1.00JD	59.6JD	256JD	73.2D	3330D	2200D	6.47D	<2.50UD	7650D	<1.00UD	188UD	<1.00UD	7520D
Elk-10D	361	<2.50UD	1.26JD	<1.00U	43.0D	30300	<1.00U	60.9	269J	75.1D	3410U	2250U	7.06D	<2.50UD	7890	<1.00UD	199	<1.00UD	7700U
Elk-29	<50.0UD	<2.50UD	<1.00UD	<1.00UD	1.08JD	9050D	<1.00UD	3.15JD	<50.0JD	3.11JD	780D	2.63D	<1.00UD	<2.50UD	4800D	<1.00UD	57.7D	<1.00UD	199D
Key-00	1060D	<5.00UD	2.29JD	<5.00D	<2.00UD	313000D	<5.00D	6.97D	300D	<2.00UD	2380D	117JD	10.8D	<5.00UD	1270D	<2.00UD	387D	<2.00UD	87.2D
Key-Opp 1	1080	<5.00UD	<2.00UD	<5.00U	<2.00UD	310000	<5.00U	6.07J	<250U	<2.00UD	2200J	286	12.0D	<5.00UD	1990	<2.00UD	384	<2.00UD	185
Slate-01	<50.0	<2.50UD	1.56JD	<1.00	<1.00UD	21000	<1.00	1.41	114	1.68JD	2490	28.7	<1.00UD	<2.50UD	5470U	<1.00UD	185	<1.00UD	36.7U
Slate-02	<50.0U	<2.50UD	<1.00UD	<1.00U	<1.00UD	21100	<1.00U	1.41U	106U	1.51JD	2510	30.4U	<1.00UD	<2.50UD	5480	<1.00UD	185	<1.00UD	37.8U
SM-00	745	<2.50UD	2.04JD	<1.00U	147D	73700	<1.00U	251	1230	846D	8210	11200	20.7D	<2.50UD	10400	<1.00UD	587	<1.00UD	25700
SM-00-EF	712D	<2.50UD	1.12JD	<1.00UD	148D	72900D	<1.00D	245D	1070D	821D	8070D	11200D	21.2D	<2.50UD	10400D	<1.00UD	582JD	<1.00UD	25900JD
SP-00	<50.0U	<2.50UD	1.06JD	<1.00U	<1.00UD	8290	<1.00U	<1.00U	<50.0U	1.66JD	1600	3.39J	<1.00UD	<2.50UD	8790	<1.00UD	107	<1.00UD	10.3J
SP-01	<50.0D	<2.50UD	1.49JD	<1.00D	<1.00UD	6880D	<1.00D	<1.00D	50.4D	<1.00UD	1480D	1.40JD	<1.00UD	<2.50UD	9880UD	<1.00UD	91.5D	<1.00UD	<5.00D
Wild-00	<50.0U	<2.50UD	<1.00UD	<1.00U	<1.00UD	12300	<1.00U	<1.00U	<50.0J	<1.00UD	3730	<1.00J	<1.00UD	<2.50UD	7060	<1.00UD	154	<1.00UD	<5.00U
FB-01	<50.0D	<2.50UD	<1.00UD	<1.00D	<1.00UD	<50.0D	<1.00D	<1.00D	<50.0D	<1.00UD	<200D	<1.00JD	<1.00UD	<2.50UD	<50.0D	<1.00UD	<2.00D	<1.00UD	<5.00D
FB-02	<50.0	<2.50UD	1.21JD	<1.00	<1.00UD	<50.0	<1.00	<1.00U	<50.0U	<1.00UD	<200J	<1.00J	<1.00UD	<2.50UD	<50.0	<1.00UD	<2.00U	<1.00UD	6.33

Notes:

J - Estimated value due to anlayte detection between the Method Reporting Limit and Detection Limit.

U - Analyte not detected. Reported value is less than (<) the detection limit.

D - Sample was diluted prior to analysis.

All units are micrograms per liter, unless otherwise indicated.

Table 5.0-12 Total Recoverable Metals - July 2006 Sediment

Location	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc
Coal-00	5030	8.5	29.7	79.8	0.48	6.4	1710	3.3	10.3	32.9	10900	50	1550	1830	0.13	6.8	669	5	0.6	69.9	3.5	8	1120
Coal-02	4920	8.3	39.6	78	0.47	7.8	1660	5.6	12.6	34.7	12800	44.9	1700	2160	0.13	8.4	529	4.8	0.74	51	3.5	8.9	1130
Coal-05	5990	8.3	84.7	79	0.57	8.8	1980	2.2	14.9	17	15700	88.3	1990	2300	0.14	7.3	670	4.9	1.7	64.5	3.5	10.5	1230
Coal-10	6540	8.2	87.8	71.6	0.55	6.3	2260	3.3	14.4	17.8	15300	44.6	1970	1840	0.14	7.7	613	4.8	2.1	68.7	1.8	9.2	1140
Coal-10D	6810	10.2	91.3	76.5	0.53	5.9	1970	6.1	9.8	20	16300	61.3	1890	767	0.17	8.2	836	5.9	2.6	68.9	2.1	11.8	1030
Coal-15	4940	7.5	31.8	75.5	0.28	3.3	2580	5.7	6.9	14.9	13500	35.4	2540	1060	0.047	5.4	576	4.4	0.46	97.2	3.1	10.4	505
Coal-20	8530	8	49	91.3	0.36	0.22	2890	2.8	6.3	7.5	18900	18.5	3190	857	0.04	3.9	557	4.7	3.9	522	12.1	19.4	116
Coal-25	5160	7.8	148	68.6	0.31	0.24	1920	2.4	4.4	5.9	17200	38.4	2000	604	0.092	3.4	453	4.6	3.1	55.9	2.5	11.5	131
Coal-Opp 1	4540	8.1	50.5	73.8	0.29	2.4	1820	2.1	5.6	9.8	13200	51.3	1930	892	0.12	3.2	560	4.7	0.62	60.4	1.1	9.2	405
Coal-Opp 2	4540	8.6	46.8	56.7	0.28	3.3	1660	3.7	5.8	10.5	11300	47.1	1640	859	0.14	4.3	656	5	1	56.1	3.6	8.3	503
Cop-01	8690	11.9	75.7	116	0.49	0.57	2890	3.7	9.8	8.6	26800	38	2870	1990	0.2	5.5	911	6.9	0.78	69.3	2.3	14.7	139
Elk-00	7280	7.5	34	88.5	0.7	21.1	2170	1.8	18.6	107	17900	286	2920	3490	0.13	8.9	904	4.4	0.37	55.9	1.2	7.8	2720
Elk-00D	7960	9.2	51.9	98.7	0.71	22.8	2770	1.7	19.7	106	21300	257	3450	3720	0.14	8.8	791	5.3	0.56	84.9	1.9	16.5	2850
Elk-05	6390	7.6	32	84.9	0.77	22.8	1970	1.8	20.3	169	21000	437	2480	3860	0.13	9	933	4.4	0.72	47.9	0.95	7.2	2610
Elk-06	8100	8.1	16.2	92.8	0.43	2.6	2590	2.5	8.2	18.6	20000	29	3970	560	0.14	7.4	1130	4.7	0.71	55.9	2.5	9.5	619
Elk-08	6660	8	13.2	64.6	0.92	25.8	2180	1.6	24.2	253	19500	632	2430	4360	0.14	7.8	736	4.7	0.57	43.1	1.3	4.8	2630
Elk-29	2660	9	11.9	47.7	0.6	3.8	1220	2.1	5.3	13.8	7820	838	467	1580	0.15	4	554	5.3	0.47	40.4	3.8	5	512
Slate-01	14300	8.3	11.2	45.7	0.57	2.2	4630	18.7	6	19.7	18200	76.6	6350	432	0.14	18.9	1170	4.8	0.51	691	2	33.5	385
Slate-02	13000	8.7	16.3	54.5	0.58	2.2	4050	16.4	6.4	21.9	20100	95	5670	461	0.15	19.6	1040	5.1	0.95	516	2.1	29	464
SP-00	4610	8	1.3	85.4	0.16	0.19	2510	2.3	4.9	5.7	11800	6.9	1960	615	0.13	2.4	635	4.6	1.3	128	3.3	12.5	39.8
SP-01	3450	8.3	1.1	72	0.1	0.22	2340	2.4	4.8	5.2	12400	15.9	1310	607	0.083	2.5	301	4.8	1.4	86.2	3.4	15.7	39.5

Notes:

All units are milligrams per kilogram dry weight, unless otherwise indicated.

Due to discrepancies in the CLP electronic deliverable laboratory flag fields, only the reported result is included above. No laboratory flags were included.

Table 5.0-13 Total Recoverable Metals - September 2006 Sediment

Location	% Solids	Aluminum	Antimony	Arsenic	Beryllium	Cadmium	Calcium	Chromium	Copper	Iron	Lead	Magnesium	Manganese	Nickel	Selenium	Silica (SiO2)	Silver	Strontium	Thallium	Zinc	Mercury
Coal-00	61.2	9550D	<0.997UD	27.9D	0.597D	9.78JD	3870D	2.07D	51.1D	17000D	81.5D	3900D	2840D	7.57D	<0.997UD	13500D	0.570JD	44.5D	<0.399UD	2080JD	0.037D
Coal-02	27.8	17500	<2.50UD	75.7D	1.93	29.0JD	6670	3.24U	122	28200	250D	4250	6200	17.3D	<2.50UD	20200	1.97JD	67.7	<0.999UD	5240U	0.077D
Coal-05	19.7	26400D	<0.997UD	89.8D	1.44JD	6.78JD	6200D	6.64JD	212D	36700D	411D	5520D	2400D	9.73D	1.38JD	19200D	2.81JD	45.2D	0.720JD	2660D	0.048D
Coal-10	73.8	9690	<0.986UD	49.7D	<0.493U	7.37JD	3130	0.58	12.7J	18400J	50.3D	3890J	2230	5.57D	<0.986UD	12900U	0.524JD	27	<0.394UD	1350	0.013D
Coal-10D	72.6	8760D	<0.985UD	52.7JD	0.603JD	7.67JD	2760D	0.835JD	14.9D	18100D	55.7D	3170D	2220D	5.60D	<0.985UD	13100D	0.655JD	25.5D	0.471JD	1440D	0.058D
Coal-15	41.3	9520D	<0.998UD	82.9D	0.559JD	7.23JD	3880D	2.77D	31.3D	16800D	112D	3130D	1670D	4.60D	<0.998UD	16200D	1.73JD	44.0D	<0.399UD	1420D	0.052D
Coal-20	52.1	10800	<0.249UD	83.2D	0.605	0.515JD	4810	3.55J	8.88U	17700J	53.1D	3610J	673	3.36D	0.958JD	16300	0.902JD	64.7U	0.135JD	136	0.042D
Coal-25	38.2	12100D	<0.498UD	299D	<0.498JD	0.492JD	3910D	2.41D	8.14D	24600D	56.5D	3930D	1930D	4.75D	0.668JD	16200D	8.13JD	43.8D	<0.199UD	197D	0.520D
Coal-Opp 1	27	11800J	<0.998UD	178D	0.722J	13.2JD	6130	1.67	36.5U	25700	123D	3950	4060	5.34D	1.36JD	19600U	2.88JD	68.9	<0.399UD	1930	0.156D
Coal-Opp 2	56.8	7070D	<0.989UD	70.4D	<0.494UD	3.66JD	2470D	0.831JD	12.7D	14600D	61.6D	2580D	1630D	3.18D	<0.989UD	12000D	1.43JD	26.4D	<0.395UD	645D	0.043D
Cop-01	23.2	9530	<2.49UD	130D	<0.498	1.11JD	7550J	<0.498J	7.24U	36700	35.0JD	2590J	7860	4.74JD	<2.49UD	15100U	<0.997UD	51	<0.997UD	157	0.056D
Elk-00	40.2	12400D	<2.49UD	50.7D	1.05JD	24.5JD	5560D	3.81D	133D	17900D	377D	3300D	2780D	8.67D	<2.49UD	20800D	<0.994UD	53.3D	<0.994UD	5140D	0.040D
Elk-05	36.1	11000	<2.47UD	66.5D	1.35U	31.9JD	4260U	0.516	272J	23500	809D	3660J	4900	10.4D	<2.47UD	15700U	1.19JD	30.8	<0.986UD	5870	0.029D
Elk-06	47.9	11700D	<2.49UD	55.8D	1.59JD	41.6JD	3740D	<0.498D	353D	26700D	1170D	3740D	5990D	11.8D	<2.49UD	15400D	2.21JD	28.0D	<0.996UD	6700D	0.035D
Elk-08	43.9	10300	<2.49UD	80.6D	1.72U	46.3JD	3030U	<0.498U	413U	28000	1430D	2770J	7320	11.0D	<2.49UD	14200U	2.39JD	23.2	<0.996UD	7180	0.034D
Elk-10	35.1	11200D	<2.49UD	157D	2.21D	31.2JD	1730D	2.85D	896D	82300D	5670D	1830D	7590D	9.03D	6.35JD	16900D	17.9JD	15.1UD	<0.996UD	4430JD	0.098D
Elk-10D	36.7	11200	<2.50UD	159D	2.28J	35.1JD	1850J	2.87	913U	86100	5530D	1850J	7810	9.33D	6.13JD	17200	17.8JD	16.1	<0.999UD	4840U	0.096D
Elk-29	67.5	3910	<0.994UD	9.54D	0.785	8.52JD	1040J	<0.497U	20.1	9110	1190D	629	2930	5.14D	<0.994UD	7190U	<0.398UD	9.42U	<0.398UD	899J	0.007D
Slate-01	35.3	22700D	<0.990UD	24.1D	0.994D	8.06JD	8160D	23.5JD	56.5D	30000D	204D	8780D	1250D	26.1D	1.38JD	18100D	0.727JD	79.9D	<0.396UD	989JD	0.024D
Slate-02	68.8	24000	<0.499UD	18.1D	0.741U	3.81JD	9710	20.3U	29.3	23400	156D	7910U	730	18.9D	0.689JD	17900	0.444JD	97.1U	0.232JD	579	0.011D
SP-00	74.4	4970D	<0.482UD	1.43D	<0.482D	<0.193UD	2530D	0.683D	3.95UD	12200D	8.59JD	2010D	683D	1.29D	<0.482UD	6710D	<0.193UD	34.1D	0.228JD	36.5JD	0.011D
SP-01	73	4620	<0.492UD	1.12D	<0.492	<0.197UD	2570	0.976U	3.92	12900J	6.33JD	2040	605	1.54D	<0.492UD	6850U	<0.197UD	37.7U	<0.197UD	36.5	0.026D

Notes:

J - Estimated value due to anlayte detection between the Method Reporting Limit and Detection Limit.

U - Analyte not detected. Reported value is less than (<) the detection limit.

D - Sample was diluted prior to analysis.

All units are milligrams per kilogram dry weight, unless otherwise indicated.

Table 5.0-14 Total Metals - July 2006 Fish

Designation	Location	% Solids	Aluminum	Antimony	Arsenic	Beryllium	Cadmium	Calcium	Chromium	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Nickel	Selenium	Silica (SiO2)	Silver	Strontium	Thallium	Zinc
Carc-1	Coal-25	26.4	109D	<0.06UD	12.7D	<0.25UD	0.4D	20000D	9.5D	7.1JD	406D	0.4D	1330D	24.9D	0.24D	5.9D	4.5D	300D	0.4D	58.9JD	<0.03UD	123D
Carc-1	Elk-00	26.1	16.4D	<0.06UD	1.7D	<0.13UD	3.1D	14800D	3.8D	11.5D	91.9D	1.8D	1230D	13.6D	0.09D	1.7D	3.9D	84.3D	0.03JD	40.0D	0.05JD	267JD
Carc-1	SP-01	27.4	34.4D	<0.07UD	0.3D	<0.27UD	0.1D	18800D	5.2D	6.1JD	120D	<0.03UD	1200D	11.8D	0.16D	2.7D	1.8D	125D	<0.03UD	61.8JD	<0.03UD	97.1D
Carc-2	Coal-25	26.8	233D	<0.06UD	16.0D	<0.26UD	0.3D	19800D	6.5D	7.9JD	530D	0.9D	1360D	37.7D	0.21D	3.7D	4.0D	632D	0.4D	62.8JD	<0.03UD	148D
Carc-2	Elk-00	25.9	15.6D	<0.06UD	3.6D	<0.24UD	1.6D	18300D	2.8D	4.7D	99.3D	0.6D	1400D	8.4D	0.12D	1.1D	3.5D	50.8JD	0.02JD	48.7D	<0.02UD	195JD
Carc-2	SP-01	25.4	30.6D	<0.06UD	0.4D	<0.24UD	0.1D	14800D	2.8D	10.2JD	104D	<0.02UD	1260D	14.9D	0.15D	1.0D	1.8D	114D	<0.02UD	48.5JD	<0.02UD	90.7D
Carc-3	Coal-25	25.6	11.9JD	<0.06UD	9.8D	<0.25UD	1.4D	17600D	3.2D	6.8JD	85.5D	0.1D	1170D	9.2D	0.20D	1.3D	3.2D	17.4JD	0.1D	55.0JD	<0.02UD	109D
Carc-3	Elk-00	25.8	38.6D	<0.06UD	1.3D	<0.25UD	2.3D	10700D	3.1D	11.5JD	118D	1.4D	1180D	12.4D	0.08D	1.0D	3.6D	129D	<0.02UD	31.7JD	0.02JD	230D
Carc-3	SP-01	25.5	32.3D	<0.06UD	0.2D	<0.25UD	3.1D	21300D	3.4D	10.2JD	110D	<0.02UD	1360D	10.5D	0.16D	1.5D	2.4D	95.6D	<0.02UD	65.5JD	<0.02UD	132D
Comp-4	Coal-10	22.6	17.3D	<0.05UD	1.9D	<0.21UD	2.6D	19200D	2.8D	6.2D	74.1D	0.2D	1360D	27.1D	0.08D	1.3D	4.5D	45.5JD	<0.02UD	48.0D	<0.02UD	343JD
Comp-4	Coal-15	23.7	31.7D	<0.05UD	2.1D	<0.22UD	2.2D	17200D	3.5D	10.4JD	129D	0.6D	1350D	19.9D	0.13D	1.5D	3.3D	88.0D	0.02JD	53.4JD	<0.02UD	284D
Comp-7	Coal-02	24.6	21.9D	<0.06UD	0.4D	<0.24UD	2.2D	19000D	2.6D	6.7D	73.7D	0.1D	1310D	15.0D	0.06D	1.0D	4.4D	42.8JD	<0.02UD	37.4D	<0.02UD	291JD
Fil-1	Coal-02	24.9	3.6JD	<0.06UD	1.1D	<0.25UD	0.1D	2580D	3.2D	3.5D	17.9JD	<0.02UD	1380D	2.8D	0.11D	0.4D	2.6D	44.3JD	<0.02UD	5.90D	<0.02UD	124JD
Fil-1	Coal-10	23.7	4.8JD	<0.06UD	4.3D	<0.23UD	0.2D	2220D	3.1D	8.3D	25.1JD	0.02JD	1490D	2.4D	0.20D	0.4D	3.2D	47.1JD	<0.02UD	6.54D	<0.02UD	145JD
Fil-1	Coal-15	23.7	7.6JD	<0.06UD	13.5D	<0.23UD	0.2D	2300D	3.2D	3.9JD	27.1JD	<0.02UD	1450D	2.4D	0.32D	0.3D	2.8D	35.5JD	<0.02UD	7.16JD	<0.02UD	152D
Fil-1	Coal-25	23.4	4.0JD	<0.06UD	17.6D	<0.23UD	0.03JD	1880D	3.2D	4.8JD	<11.6UD	<0.02UD	1430D	1.4D	0.34D	0.2D	2.8D	28.7JD	<0.02UD	5.99JD	<0.02UD	43.5D
Fil-1	Elk-00	23.7	5.9JD	<0.06UD	1.8D	<0.23UD	0.5D	4320D	2.8D	2.8JD	16.0JD	0.03JD	1380D	2.7D	0.10D	0.4D	3.2D	52.1JD	<0.02UD	14.6JD	0.02JD	132D
Fil-1	SP-00	23.6	7.8JD	<0.06UD	5.2D	<0.23UD	0.03JD	3100D	3.3D	5.2JD	61.3D	<0.02UD	1400D	1.9D	0.29D	0.5D	3.1D	44.6JD	<0.02UD	10.8JD	<0.02UD	72.0D
Fil-1	SP-01	24.9	7.3JD	<0.06UD	0.6D	<0.24UD	0.06JD	5640D	4.0D	3.3JD	30.0JD	<0.02UD	1290D	3.1D	0.17D	1.3D	1.6D	49.5JD	<0.02UD	19.8JD	<0.02UD	71.0D
Fil-2	Coal-02	24	5.7JD	<0.06UD	2.3D	<0.23UD	0.2D	9540D	2.9D	3.1D	23.9JD	0.08JD	1430D	4.7D	0.16D	0.7D	3.0D	25.2JD	<0.02UD	16.9D	<0.02UD	119JD
Fil-2	Coal-10	23.4	4.7JD	<0.06UD	1.6D	<0.23UD	0.3D	2770D	2.9D	3.7D	30.8JD	0.07JD	1410D	3.1D	0.10D	0.3D	2.1D	27.4JD	<0.02UD	6.15D	0.04JD	115JD
Fil-2	Coal-15	24.7	7.5JD	<0.06UD	9.4D	<0.24UD	0.2D	5890D	3.1D	4.9JD	20.5JD	<0.02UD	1300D	2.2D	0.24D	0.6D	2.9D	30.1JD	<0.02UD	18.8JD	<0.02UD	131D
Fil-2	Coal-25	25	3.6JD	<0.06UD	18.6D	<0.24UD	0.03JD	4310D	3.1D	3.8D	15.9JD	<0.02UD	1380D	2.3D	0.28D	0.5D	2.9D	32.2JD	<0.02UD	11.0D	<0.02UD	63.8JD
Fil-2	Elk-00	22.5	<2.2UD	<0.05UD	4.2D	<0.22UD	0.2D	4020D	2.8D	2.5D	32.7JD	0.05JD	1550D	2.2D	0.16D	0.3D	3.3D	50.4JD	<0.02UD	11.2D	<0.02UD	129JD
Fil-2	SP-01	22.7	5.8JD	<0.06UD	0.4D	<0.22UD	0.05JD	2470D	3.2D	6.0JD	17.3JD	<0.02UD	1380D	1.8D	0.18D	0.3D	1.7D	49.0JD	<0.02UD	8.32JD	<0.02UD	67.5D
Fil-3	Coal-02	24	6.1JD	<0.06UD	0.9D	<0.23UD	0.1D	2010D	3.1D	2.7D	15.6JD	<0.02UD	1410D	2.1D	0.12D	0.3D	2.5D	41.9JD	<0.02UD	3.92D	<0.02UD	132JD
Fil-3	Coal-10	22.1	4.5JD	<0.05UD	1.5D	<0.21UD	0.3D	3720D	3.0D	7.2D	18.3JD	<0.02UD	1400D	3.0D	0.18D	0.3D	3.2D	44.9JD	<0.02UD	10.1D	<0.02UD	184JD
Fil-3	Coal-15	23.7	6.7JD	<0.06UD	12.3D	<0.23UD	0.4D	4180D	3.3D	5.8JD	35.8JD	0.09JD	1400D	2.5D	0.34D	0.5D	2.8D	23.6JD	<0.02UD	11.9JD	<0.02UD	124D
Fil-3	Coal-25	24.1	3.7JD	<0.06UD	14.2D	<0.24UD	0.08JD	4020D	3.3D	13.7JD	13.5JD	<0.02UD	1310D	2.4D	0.25D	0.4D	2.9D	25.1JD	<0.02UD	13.4JD	<0.02UD	92.5D
Fil-3	Elk-00	22.9	5.0JD	<0.05UD	1.3D	<0.22UD	0.1D	2850D	3.1D	3.1JD	16.3JD	0.03JD	1430D	1.7D	0.13D	0.2D	3.0D	45.2JD	<0.02UD	9.11JD	<0.02UD	129D
Fil-3	SP-01	23	6.2JD	<0.06UD	0.2D	<0.23UD	0.06JD	2610D	3.5D	3.5JD	19.9JD	<0.02UD	1390D	1.8D	0.20D	0.4D	1.6D	48.7JD	<0.02UD	8.72JD	<0.02UD	88.4D
Fil-4	Coal-02	23.7	2.4JD	<0.06UD	0.7D	<0.24UD	0.3D	5830D	2.8D	3.0D	<11.8UD	<0.02UD	1440D	3.3D	0.08D	0.4D	2.8D	53.7JD	<0.02UD	10.6D	<0.02UD	110JD
Fil-5	Coal-02	24.1	3.6JD	<0.06UD	0.7D	<0.23UD	0.2D	6390D	2.8D	3.9D	16.8JD	<0.02UD	1420D	4.4D	0.09D	0.5D	2.6D	32.8JD	<0.02UD	10.7D	<0.02UD	97.9JD
Fil-5	Coal-10	22.2	7.1JD	<0.05UD	0.9D	<0.22UD	0.3D	5700D	3.0D	4.8D	25.3JD	<0.02UD	1460D	4.3D	0.11D	0.4D	3.3D	55.8D	<0.02UD	12.4D	<0.02UD	157JD
Fil-6	Coal-02	23	6.3JD	<0.06UD	0.7D	<0.23UD	0.2D	7720D	3.0D	4.7JD	25.2JD	0.3D	1590JD	10.9D	0.10D	0.4D	2.5D	30.3JD	<0.02UD	13.3D	0.1D	146D

Notes:

J - Estimated value due to anlayte detection between the Method Reporting Limit and Detection Limit.

U - Analyte not detected. Reported value is less than (<) the detection limit.

D - Sample was diluted prior to analysis.

All units are milligrams per kilogram dry weight, unless otherwise indicated.

Table 5.0-15 Total Metals - July 2006 Macroinvertebrates

Location	% Solids	Aluminum	Antimony	Arsenic	Beryllium	Cadmium	Calcium	Chromium	Copper	Iron	Lead	Magnesium	Manganese	Nickel	Selenium	Silica (SiO2)	Silver	Strontium	Thallium	Zinc
Coal-05	100	1610D	<0.715UD	13.7D	<0.572UD	16.6D	1700D	2.89D	52.5D	2110D	8.59JD	1350D	355D	1.71D	6.79JD	1810D	<0.286UD	10.3D	<0.286UD	2230D
Coal-10	100	1570D	<0.787UD	19.1D	<0.629UD	22.3D	3960D	3.04JD	34.4D	3640D	10.0JD	1750D	609D	2.91D	6.72JD	2470D	<0.315UD	28.7D	<0.315UD	3290D
Coal-15	100	754D	<0.392UD	11.8D	<0.314UD	19.0D	2660D	2.96D	44.3D	2420D	8.23D	1670D	257D	1.23D	4.57JD	1430D	0.392JD	18.4D	<0.157UD	1980D
Coal-20	100	583D	<0.974UD	11.4D	<0.779UD	2.52JD	3110D	3.29JD	25.7D	1340D	0.702JD	1510D	318D	1.75JD	2.64JD	1360D	<0.390UD	23.5D	<0.390UD	514D
Coal-25	100	1640D	<0.520UD	47.9D	<0.416UD	2.11JD	2520D	2.76D	20.4D	3560D	7.37JD	1870D	769D	1.65D	5.44JD	2420D	0.622JD	22.9D	<0.208UD	439D
Coal-Opp 2	100	754D	<0.485UD	18.1D	<0.388UD	9.90D	2510D	3.56D	25.7D	2070D	8.23JD	1640D	267D	1.94D	4.30JD	1700D	<0.194UD	19.9D	<0.194UD	1460D
Cop-01	100	764D	<1.55UD	26.1D	<1.24UD	3.95JD	2730D	3.60JD	19.3D	5960D	5.80JD	1540D	1540D	2.18JD	1.94JD	1470D	<0.620UD	18.2D	<0.620UD	435D
Elk-00	100	420D	<0.559UD	4.98D	<0.447UD	32.9D	1530D	3.19D	149D	892D	60.6D	1790D	370D	1.27D	6.29JD	659D	<0.224UD	8.98D	<0.224UD	3530D
Elk-05	100	1470D	<0.444UD	21.2D	<0.355UD	21.4D	1540D	2.69D	124D	8690D	157D	1590D	1300D	3.00D	3.09JD	1750D	<0.178UD	9.86D	<0.178UD	2740D
SP-00	100	566D	<1.17UD	0.767JD	<0.935UD	2.29JD	2100D	3.35JD	19.1D	1440D	5.36JD	1350D	143D	1.41JD	1.65JD	1360D	<0.468UD	19.3D	<0.468UD	398D
SP-01	100	363D	<0.679UD	0.424JD	<0.543UD	1.28JD	2950D	2.87D	20.4D	899D	<0.272UD	1770D	75.3D	0.863JD	1.49JD	1040D	<0.272UD	23.0D	<0.272UD	341D

Notes:

J - Estimated value due to anlayte detection between the Method Reporting Limit and Detection Limit.

U - Analyte not detected. Reported value is less than (<) the detection limit.

D - Sample was diluted prior to analysis.

All units are milligrams per kilogram dry weight, unless otherwise indicated.

Table 5.0-16 Total Metals - July 2006 Vegetation

Location	% Solids	Aluminum	Antimony	Arsenic	Beryllium	Cadmium	Calcium	Chromium	Copper	Iron	Lead	Magnesium	Manganese	Nickel	Selenium	Silica (SiO2)	Silver	Strontium	Thallium	Zinc
Elk-29	100	160JD	<0.5UD	0.3JD	<0.2UD	0.4JD	10700D	2.2D	7.7D	142D	1.3D	2610D	537D	1.7D	<0.5UD	484JD	<0.2UD	39.1D	<0.2UD	61.2D
SM-00	100	220JD	<0.5UD	0.5JD	<0.2UD	2.9D	12300D	2.6D	10.6D	253D	41.2D	2870D	184D	2.5D	<0.5UD	647JD	<0.2UD	59.8D	<0.2UD	217D
SP-01 N	100	543JD	<0.5UD	0.3JD	<0.2UD	<0.2UD	11900D	3.6D	7.8D	699D	1.4D	2570D	103D	1.8D	<0.5UD	1170JD	<0.2UD	72.2D	<0.2UD	45.7D
SP-01 S	100	858JD	<0.5UD	0.4JD	<0.2UD	0.2JD	11300D	3.5D	8.0D	1450D	1.9D	3060D	186D	2.1D	<0.5UD	1330JD	<0.2UD	101D	<0.2UD	54.6D

Notes:

J - Estimated value due to anlayte detection between the Method Reporting Limit and Detection Limit.

U - Analyte not detected. Reported value is less than (<) the detection limit.

D - Sample was diluted prior to analysis.

All units are milligrams per kilogram dry weight, unless otherwise indicated.

Table 5.0-17 Total Metals - July 2006 Soil Analyzed by XRF

Sample ID	Arsenic	Barium	Cadmium	Cobalt	Chromium	Copper	Iron	Mercury	Manganese	Nickel	Lead	Selenium	Zinc
100-G-JC	36.0	535.0	<30	375.0	<94	42.0	34789.0	<9	822.0	<35	72.0	<5	154.0
101-G-MB	21.0	<375	<30	292.0	<94	18.0	37131.0	<9	536.0	<35	37.0	<5	121.0
102-G-MB	30.0	493.0	<30	167.0	<94	22.0	26283.0	<9	473.0	<35	80.0	<5	142.0
103-G-MB	36.0	486.0	<30	214.0	<94	50.0	26044.0	<9	236.0	<35	66.0	<5	114.0
104-G-MB	30.0	<375	<30	<105	<94	<15	25659.0	<9	993.0	<35	95.0	<5	469.0
105-G-MB	11.0	527.0	<30	<105	<94	22.0	22657.0	<9	804.0		138.0	<5	953.0
106-G-MB	99.0	<375	<30	248.0	<94	139.0	36823.0	<9	775.0	<35	4144.0	<5	292.0
107-G-MB	<6	<375	<30	308.0	<94	143.0	43400.0	<9	982.0	<35	1070.0	<5	696.0
108-G-MB	20.0	<375	<30	<105	<94	<15	18118.0	<9	1346.0	<35	172.0	<5	262.0
10-G-MB	12.0	<375	<30	148.0	<94	<15	22249.0	<9	697.0	<35	134.0	<5	445.0
110-G-JC	12.0	489.0	<30	150.0	<94	25.0	24339.0	<9	1167.0	<35	55.0	<5	224.0
111-G-DG	14.0	<375	<30	<105	<94	<15	20853.0	11.0	1326.0	<35	144.0	<5	252.0
112-C-DG	167.9	<375	43.1	<105	<94	382.5	97492.2	<9	8694.3	<35	7755.2	<5	4212.2
112-G-JC	99.0	<375	<30	<105	<94	241.0	68191.0	<9	2466.0	<35	3116.0	<5	1038.0
113-C-DG	270.4	<375	<30	<105	<94	477.7	95496.5	<9	1867.2	<35	9866.9	<5	1940.7
113-G-MB	395.0	<375	<30	550.0	<94	626.0	91604.0	<9	1160.0	<35	12733.0	<5	3324.0
114-G-JC	47.0	446.0	<30	120.0	<94	17.0	22311.0	<9	434.0	<35	127.0	<5	129.0
115-C-DG	317.0	912.0	<30	<105	<94	579.9	109368.4	<9	1117.5	<35	12693.9	32.0	1115.7
115-G-DG	<6	<375	<30	<105	<94	685.0	143025.0	<9	730.0	<35	14674.0	<5	968.0
116-G-JS	61.0	<375	<30	180.0	<94	149.0	36676.0	<9	2527.0	<35	2029.0	<5	1135.0
117-G-MB	39.0	<375	<30	<105	<94	86.0	30223.0	<9	1648.0	<35	851.0	<5	583.0
118-G-MB	<6	669.0	<30	<105	<94	96.0	29193.0	<9	2863.0	<35	2206.0	<5	1529.0
119-G-DG	<6	459.0	<30	129.0	<94	<15	24432.0	<9	656.0	<35	271.0	<5	247.0
11-G-MB	24.0	421.0	<30	<105	<94	21.0	22477.0	<9	863.0	<35	507.0	<5	296.0
120-C-DG	78.4	<375	<30	<105	<94	155.8	47677.0	<9	3310.7	<35	3961.2	<5	669.4
120-G-JC	47.0	<375	<30	<105	<94	143.0	53712.0	<9	1405.0	<35	1229.0	<5	567.0
121-C-MB	51.9	<375	<30	<105	<94	152.7	50349.0	<9	1145.8	<35	1277.0	<5	620.7
121-G-JS	47.0	<375	<30	<105	<94	171.0	53410.0	<9	1551.0	<35	1290.0	<5	544.0
122-G-JS	<6	606.0	<30	<105	<94	27.0	21982.0	<9	1594.0	<35	1013.0	<5	536.0
123-G-JC	<6	<375	43.0	142.0	<94	194.0	24984.0	<9	7036.0	<35	1239.0	<5	1373.0
124-G-JC	<6	<375	<30	<105	<94	140.0	24372.0	<9	3320.0	<35	1939.0	<5	1022.0
126-G-JC	26.0	<375	<30	210.0	<94	23.0	27268.0	<9	859.0	<35	220.0	<5	438.0
127-G-DG	<6	<375	<30	226.0	<94	91.0	41441.0	<9	866.0	<35	743.0	<5	425.0
129-C-JC	287.0	<375	<30	<105	<94	534.7	99689.6	<9	957.2	<35	6359.1	<5	1386.9
12-G-MB	<6	<375	<30	<105	<94	28.0	23778.0	<9	812.0	<35	602.0	<5	489.0
130-C-JC	231.4	<375	<30	<105	<94	465.7	87424.7	<9	952.4	<35	5872.3	<5	2472.7
131-C-JC	517.7	<375	57.7	757.2	<94	906.5	189168.8	<9	1529.1	<35	9796.5	20.2	4404.6
132-C-JC	262.3	<375	74.8	<105	<94	909.6	106903.1	<9	9454.2	<35	13396.9	<5	8780.1
133-C-JC	147.6	<375	56.1	<105	<94	489.5	73937.6	<9	11493.2	<35	8493.1	<5	8779.3
134-C-JC	297.2	<375	<30	<105	<94	723.0	108079.1	<9	7989.4	<35	8893.4	<5	5674.1
135-C-JC	180.8	<375	70.0	<105	<94	1120.5	87305.1	<9	21200.7	<35	10375.0	<5	11591.9
136-C-JC	61.7	<375	<30	<105	<94	329.9	61943.4	<9	1723.1	<35	2999.4	<5	1362.8
137-C-JC	83.9	<375	<30	217.4	<94	165.3	45510.6	<9	1302.3	<35	1825.8	<5	728.2
138-C-JC	96.2	<375	<30	294.9	<94	139.0	57760.9	<9	946.0	<35	1810.4	<5	556.9
138-G-MB	40.0	<375	<30	156.0	<94	101.0	28628.0	<9	855.0	<35	1482.0	<5	411.0
139-G-JC	<6	<375	<30	<105	<94	45.0	22615.0	<9	3475.0	<35	1242.0	<5	979.0
13-G-MB	<6	<375	<30	220.0	<94	116.0	27268.0	<9	718.0	<35	3716.0	<5	973.0
13-G-MB-D	<6	475.0	<30	<105	<94	88.0	27652.0	<9	912.0	<35	3920.0	<5	960.0
140-C-JC	41.4	<375	<30	<105	128.4	73.0	26158.5	<9	3536.2	<35	618.8	<5	1157.2
140-G-JC	<6	<375	<30	<105	<94	58.0	23528.0	<9	2025.0	<35	581.0	<5	1180.0
141-G-DG	19.0	<375	<30	182.0	<94	<15	25051.0	<9	1166.0	<35	61.0	<5	282.0

Table 5.0-17 Total Metals - July 2006 Soil Analyzed by XRF

Sample ID	Arsenic	Barium	Cadmium	Cobalt	Chromium	Copper	Iron	Mercury	Manganese	Nickel	Lead	Selenium	Zinc
142-G-DG	26.0	1456.0	<30	<105	<94	79.0	68695.0	<9	11702.0	<35	75.0	<5	1881.0
143-G-MB	14.0	<375	<30	133.0	<94	22.0	21307.0	<9	773.0	<35	93.0	<5	293.0
144-C-JC	80.6	<375	<30	<105	<94	287.7	86067.3	<9	2380.7	<35	1918.3	<5	1839.3
145-C-JC	261.8	<375	<30	<105	<94	439.5	135904.4	<9	1074.7	<35	5211.7	15.3	915.0
146-C-JC	1169.1	<375	<30	<105	<94	1264.3	387465.3	<9		<35	26531.5	<5	2230.0
149-C-JC	370.0	<375	<30	<105	<94	490.3	133288.3	<9	2337.9	<35	8747.0	<5	3746.1
14-C-2-6-MB-D	29.4	<375	<30	<105	<94	25.2	22620.5	<9	1198.8	<35	342.4	<5	326.7
14-G-MB	<6	<375	<30	163.0	<94	27.0	21343.0	<9	1245.0	<35	366.0	<5	330.0
150-C-JC	<6	<375	<30	<105	<94	19.3	25374.0	<9	827.6	<35	267.1	<5	447.2
151-C-JC	26.9	<375	<30	159.8	<94	38.7	24671.0	<9	1969.2	<35	268.1	<5	615.3
152-C-JC	17.3	<375	<30	<105	<94	<15	22403.2	<9	1866.4	<35	82.7	<5	282.9
152-C-JC-D	14.0	<375	<30	<105	<94	<15	22130.0	<9	1651.8	<35	91.2	<5	305.5
153-G-MB	<6	<375	<30	<105	<94	27.0	17884.0	<9	2487.0	<35	141.0	<5	318.0
154-G-JC	13.0	409.0	<30	<105	<94	<15	18720.0	12.0	1823.0	<35	93.0	<5	206.0
155-G-JC	<6	<375	<30	<105	<94	<15	19258.0	<9	2706.0	<35	184.0	<5	289.0
156-G-JC	<6	<375	<30	<105	<94	<15	13774.0	<9	494.0	<35	137.0	<5	131.0
157-G-JC	<6	528.0	<30	<105	<94	<15	16150.0	<9	1539.0	<35	50.0	<5	135.0
158-G-DG	19.0	<375	<30	<105	<94	21.0	19371.0	<9	734.0	<35	249.0	<5	262.0
159-G-MB	<6	<375	<30	187.0	<94	21.0	27536.0	<9	1584.0	<35	194.0	<5	739.0
15-C-JC	41.5	<375	<30	<105	<94	114.8	25143.4	<9	4367.5	<35	2274.5	<5	1034.5
15-G-MB	<6	446.0	<30	<105	<94	44.0	16674.0	<9	4468.0	<35	1465.0	<5	1023.0
160-C-MB	90.6	<375	<30	243.6	<94	197.1	56346.1	<9	1276.4	<35	3264.7	<5	943.4
160-G-MB	54.0	<375	<30	284.0	<94	250.0	51936.0	<9	2573.0	<35	1978.0	<5	861.0
161-C-DG	187.2	<375	<30	<105	<94	85.7	60398.8	<9	1269.1	<35	552.6	<5	1014.3
162-C-DG	115.8	<375	<30	<105	<94	188.6	93985.7	<9	1559.5	<35	779.6	<5	895.5
163-C-DG	44.5	<375	<30	<105	<94	150.6	42436.9	<9	970.0	<35	741.9	<5	592.6
165-C-DG	150.2	<375	<30	<105	<94	313.0	54984.9	<9	451.0	<35	3011.7	<5	522.0
166-C-DG	171.6	<375	<30	<105	<94	499.0	52637.3	<9	4364.5	<35	4005.3	<5	2742.4
169-C-DG	30.4	<375	<30	<105	<94	66.7	31213.3	<9	1101.3	<35	802.1	<5	339.0
169-C-DG-D	<6	<375	<30	174.3	<94	42.7	26187.8	<9	1283.8	<35	455.6	<5	355.5
16-G-JC	25.0	<375	<30	222.0	<94	22.0	24878.0	<9	604.0	<35	448.0	<5	565.0
170-C-2-6-JC	16.4	<375	<30	<105	<94	19.9	27645.5	<9	1116.1	<35	52.3	<5	179.9
170-G-MB	10.0	<375	<30	<105	<94	<15	24738.0	<9	964.0	<35	69.0	<5	172.0
171-G-JC	11.0	<375	<30	156.0	121.0	18.0	23162.0	<9	1175.0	<35	55.0	<5	197.0
174-G-DG	55.0	618.0	<30	200.0	<94	91.0	33466.0	<9	760.0	<35	519.0	<5	314.0
175-G-MB	29.0	563.0	<30	166.0	<94	32.0	27135.0	<9	821.0	<35	302.0	<5	387.0
175-G-MB-D	34.0	<375	<30	<105	<94	35.0	27970.0	<9	777.0	<35	277.0	<5	357.0
179-C-JC	71.2	<375	<30	<105	169.6	95.5	35692.6	<9	2099.5	<35	1757.6	<5	840.6
17-G-MB	13.0	555.0	<30	<105	<94	<15	28620.0	<9	944.0	<35	140.0	<5	292.0
181-C-DG	266.5	<375	44.9	<105	<94	378.9	70685.4	<9	5817.5	<35	5288.6	<5	4466.3
182-C-JC	<6	<375	<30	<105	<94	168.8	47055.0	<9	701.2	<35	2706.6	<5	413.4
184-G-MB	26.0	520.0	<30	<105	<94	18.0	21188.0	<9	375.0	<35	177.0	<5	165.0
185-G-JC	13.0	<375	<30	178.0	<94	<15	16369.0	<9	606.0	<35	132.0	<5	162.0
186-G-CP	<6	<375	<30	112.0	<94	<15	17044.0	<9	1365.0	<35	105.0	<5	338.0
189-G-DG	14.0	<375	32.0	<105	<94	<15	15344.0	<9	5358.0	<35	187.0	<5	673.0
18-C-DG	488.3	<375	80.1	<105	<94	918.7	138706.3	<9	6065.0	<35	12581.7	<5	6610.7
190-G-DG	21.0	<375	<30	<105	<94	104.0	9270.0	<9	3933.0	<35	158.0	<5	345.0
191-G-DG	<6	<375	<30	<105	<94	29.0	20805.0	<9	4481.0	<35	213.0	<5	418.0
192-G-MB	119.0	600.0	<30	174.0	<94	<15	32791.0	<9	1318.0	<35	105.0	<5	249.0
193-G-MB	17.0	<375	<30	135.0	<94	<15	18612.0	<9	1246.0	<35	74.0	<5	210.0
194-G-MB	13.0	<375	<30	<105	<94	<15	13670.0	<9	2645.0	<35	173.0	<5	359.0

Sample ID	Arsenic	Barium	Cadmium	Cobalt	Chromium	Copper	Iron	Mercury	Manganese	Nickel	Lead	Selenium	Zinc
195-G-JC	<6	624.0	<30	129.0	<94	<15	19497.0	<9	1014.0	<35	54.0	<5	147.0
196-G-JC	13.0	<375	<30	<105	<94	21.0	18512.0	<9	1989.0	<35	153.0	<5	292.0
19-C-DG	283.4	<375	<30	<105	<94	754.8	127872.9	<9	15051.8	<35	12277.7	<5	3417.8
202-G-DG	<6	419.0	<30	124.6	<94	17.7	21420.9	<9	1640.2	<35	306.3	<5	440.7
20-C-DG	435.3	<375	<30	558.3	<94	538.2	140083.5	<9	584.8	<35	11483.6	<5	947.4
21-C-DG	880.8	<375	139.2	<105	<94	2003.5	316829.0	<9	5588.2	<35	38745.5	<5	16178.7
22-C-DG	438.8	<375	<30	<105	<94	1319.3	146109.5	<9	11730.0	<35	26624.6	<5	10161.5
23-C-DG	<6	<375	55.2	<105	<94	856.5	90387.8	<9	4786.2	<35	14478.1	<5	4257.3
258-G-MB	16.2	<375	<30	<105	<94	<15	33725.2	<9	1480.1	<35	275.3	<5	196.7
25-C-DG	378.3	<375	<30	<105	<94	1213.4	226707.3	<9	11655.3	<35	9651.5	<5	2767.5
260-G-MB	9.5	<375	<30	176.7	<94	19.1	25516.9	<9	1507.4	<35	70.0	<5	164.9
262-G-MB	<6	<375	<30	264.9	<94	<15	29274.7	<9	1419.8	<35	131.9	<5	183.3
26-C-DG	71.9	<375	56.0	<105	<94	812.4	119565.8	<9	2078.6	<35	3628.9	<5	6416.2
27-C-DG	83.4	<375	<30	<105	<94	204.6	51296.7	<9	2947.2	<35	2582.2	<5	699.8
28-G-MB	<6	<375	<30	138.0	<94	128.0	24236.0	<9	1826.0	<35	1847.0	<5	636.0
295-G-MB	45.7	<375	<30	<105	<94	<15	29552.0	<9	2831.1	<35	203.1	<5	495.6
29-G-JC	<6	<375	<30	<105	153.0	156.0	27517.0	<9	7752.0	<35	1583.0	<5	1170.0
30-C-MB-D	<6	<375	<30	<105	127.8	126.1	28718.5	<9	4109.3	<35	1663.2	<5	1524.8
30-G-JC	<6	<375	<30	<105	<94	67.0	19830.0	<9	3452.0	<35	1399.0	<5	1213.0
318-G-SG	<6	<375	<30	187.1	<94	109.0	25995.1	<9	1275.7	<35	2257.0	<5	780.5
33-G-JC	24.0	<375	<30	294.0	<94	25.0	27033.0	<9	621.0	<35	111.0	<5	249.0
342-G-SG	<6	<375	<30	<105	<94	<15	19202.8	<9	2140.0	<35	84.5	<5	161.0
344-G-SG	18.1	<375	<30	<105	<94	<15	15867.0	<9	614.2	<35	140.1	<5	101.4
346-G-SG	<6	<375	<30	<105	<94	<15	18935.4	<9	1140.7	<35	173.5	<5	209.4
348-G-SG	<6	<375	<30	<105	<94	<15	18617.1	<9	1001.6	<35	552.2	<5	240.3
34-G-MG	18.0	660.0	<30	243.0	<94	<15	27919.0	<9	892.0	<35	103.0	<5	307.0
350-G-SG	<6	<375	<30	<105	<94	59.2	26174.1	<9	2556.8	<35	3411.1	<5	1075.0
352-G-SG	<6	<375	<30	<105	<94	37.7	18336.9	<9	1643.7	<35	948.7	<5	770.7
355-G-MB	13.0	<375	<30	<105	102.1	<15	24571.5	<9	766.5	<35	80.1	<5	449.4
355-G-MB-D	<6	<375	<30	164.2	103.7	<15	25319.6	<9	898.9	<35	82.6	<5	457.4
356-G-SG	<6	<375	<30	157.8	<94	<15	19458.7	<9	850.4	<35	100.5	<5	606.0
358-G-MB	<6	<375	<30	<105	<94	<15	20554.5	<9	1909.0	<35	98.0	<5	203.5
35-C-DG	131.6	<375	<30	526.1	<94	214.3	107317.4	<9	1749.9	<35	1895.7	<5	1483.2
364-G-DG	13.0	516.1	<30	217.6	<94	<15	27364.6	<9	960.3	<35	149.2	<5	173.2
366-G-DG	<6	476.4	<30	194.6	<94	<15	36280.6	<9	1111.1	<35	261.0	<5	190.4
368-G-DG	<6	<375	<30	237.6	<94	<15	24964.6	<9	1188.7	<35	183.2	<5	219.3
36-C-DG	294.9	<375	<30	<105	<94	610.5	122813.2	<9	5210.1	<35	11444.7	<5	2858.0
370-G-DG	<6	<375	<30	229.6	<94	<15	25705.8	<9	871.9	<35	82.7	<5	181.7
372-G-DG	<6	<375	<30	156.1	<94	42.7	26567.3	<9	1170.9	<35	321.6	<5	410.2
372-G-DG-D	<6	617.0	<30	150.9	<94	20.2	24578.5	<9	1158.2	<35	316.6	<5	387.2
374-G-DG	22.3	<375	<30	182.2	<94	20.3	32786.2	<9	2171.1	<35	460.9	<5	562.9
377-G-DG	11.5	<375	<30	<105	<94	<15	17662.9	<9	2224.1	<35	96.0	<5	273.9
38-C-DG	147.0	<375	<30	<105	<94	177.2	47010.4	<9	5367.5	<35	3354.6	<5	825.4
39-C-DG	311.3	<375	50.1	<105	<94	916.3	173932.4	<9	8189.4	<35	13423.2	<5	8003.9
3-G-MB	47.0	<375	<30	234.0	<94	<15	29613.0	<9	953.0	<35	262.0	<5	193.0
3-G-MB-D	52.0	<375	<30	177.0	<94	<15	29287.0	<9	825.0	<35	208.0	<5	199.0
42-C-DG	<6	<375	<30	242.3	<94	155.7	31429.8	<9	2917.8	<35	2714.3	<5	2481.3
43-C-DG	79.6	<375	<30	166.6	<94	105.5	35099.4	<9	499.4	<35	1385.2	<5	577.4
44-C-DG	31.7	<375	<30	<105	<94	<15	22662.0	<9	1014.6	<35	590.5	<5	266.5
44-G-MB	22.0	<375	<30	<105	<94	20.0	19066.0	<9	836.0	<35	270.0	<5	300.0
45-G-JC	<6	<375	<30	136.0	95.0	<15	19234.0	<9	1567.0	<35	344.0	<5	247.0

Table 5.0-17   Total Metals - July 2006 Soil Analyzed by XRF

Sample ID	Arsenic	Barium	Cadmium	Cobalt	Chromium	Copper	Iron	Mercury	Manganese	Nickel	Lead	Selenium	Zinc
46-G-JC	13.0	<375	<30	<105	<94	26.0	16254.0	<9	2188.0	<35	210.0	<5	354.0
47-G-JC	14.0	412.0	<30	<105	<94	<15	19697.0	12.0	1090.0	<35	57.0	<5	163.0
48-G-DG	56.0	537.0	<30	<105	<94	192.0	43694.0	<9	1699.0	<35	2026.0	<5	1146.0
49-G-JC	51.0	<375	<30	<105	<94	222.0	37799.0	<9	2965.0	<35	975.0	<5	751.0
4-G-MB	45.0	508.0	<30	<105	<94	29.0	30381.0	<9	986.0	<35	122.0	<5	190.0
501-G-MB	11.6	<375	<30	<105	<94	<15	15447.5	<9	6131.8	<35	93.3	<5	383.8
502-G-MB	15.6	<375	<30	<105	<94	24.1	27076.9	<9	3458.2	<35	276.6	<5	263.3
503-G-MB	<6	<375	<30	332.4	<94	54.5	40469.7	<9	1523.7	<35	400.7	<5	425.6
505-G-MB	15.5	<375	<30	<105	<94	<15	11343.0	<9	1857.6	<35	197.4	<5	255.6
509-G-MB	<6	<375	<30	203.5	<94	<15	24119.5	<9	905.1	<35	208.7	<5	186.8
510-G-MB	<6	<375	<30	218.6	<94	<15	24260.6	<9	932.0	<35	249.1	<5	173.6
511-G-MB	<6	<375	<30	<105	<94	<15	25793.8	<9	901.9	<35	276.1	<5	254.5
51-C-JC	66.9	<375	<30	<105	<94	215.4	61600.1	<9	1783.1	<35	1309.7	<5	656.9
52-C-JC	58.7	680.4	<30	<105	<94	153.7	50239.4	<9	1763.3	<35	1552.6	<5	930.4
530-G-MB	<6	<375	<30	268.4	<94	121.3	33240.3	<9	2968.3	<35	2932.8	<5	830.9
531-G-MB	<6	<375	<30	<105	132.7	106.9	30763.6	<9	3381.5	<35	4970.1	<5	1555.7
532-G-SG	<6	<375	<30	<105	<94	92.3	21068.3	<9	2840.5	<35	2884.2	<5	2062.6
533-G-SG	<6	<375	<30	<105	<94	58.1	23244.6	<9	2341.4	<35	1777.2	<5	1079.0
534-G-SG	<6	<375	<30	154.8	<94	109.0	28048.9	<9	3504.2	<35	2179.4	<5	1213.1
536-G-SG	124.3	<375	<30	<105	<94	107.6	16603.1	<9	1908.0	<35	3769.9	<5	1434.2
537-G-SG	<6	<375	<30	<105	<94	33.4	13213.4	<9	99.7	<35	910.1	<5	518.2
538-G-SG	<6	<375	<30	<105	113.3	60.0	22800.9	<9	2454.2	<35	1794.0	<5	625.7
53-C-JC	179.9	<375	<30	<105	<94	538.7	84661.7	<9	8868.4	<35	5675.7	<5	3701.9
540-G-SG	<6	<375	<30	167.0	<94	25.4	21009.2	<9	845.0	<35	1172.4	<5	463.6
541-G-SG	<6	<375	<30	<105	<94	46.7	23709.7	<9	1280.9	<35	2367.3	<5	1230.0
542-G-SG	<6	<375	<30	190.2	<94	97.0	25779.2	<9	2363.5	<35	4677.2	<5	1421.4
543-G-SG	<6	<375	<30	<105	<94	80.2	25666.1	<9	2519.9	<35	3778.1	<5	1321.8
544-G-SG	62.6	<375	<30	<105	<94	142.9	20387.9	<9	228.3	<35	2408.6	<5	867.3
545-G-SG	<6	<375	<30	<105	<94	92.5	21588.1	<9	1172.5	<35	2268.7	<5	815.3
546-G-SG	<6	544.6	<30	134.1	<94	96.1	24524.8	<9	2375.1	<35	2778.8	<5	923.0
547-G-SG	<6	<375	51.4	<105	119.4	96.3	27585.7	<9	2499.9	<35	3089.6	<5	1238.2
548-G-DG	<6	<375	<30	211.1	<94	109.0	28621.8	<9	3002.9	<35	3672.0	<5	1174.4
549-G-DG	71.4	<375	<30	<105	<94	97.9	27298.0	<9	2735.8	<35	3268.5	<5	1291.7
54-C-JC	419.9	<375	<30	<105	<94	4823.2	99545.5	<9	397.5	<35	54231.7	<5	1914.3
550-G-SG	<6	753.6	<30	<105	<94	111.8	39128.7	<9	4235.0	<35	2309.2	<5	456.0
551-G-MM	17.5	<375	<30	<105	<94	<15	20340.4	11.2	1718.0	<35	68.2	<5	310.3
552-G-TS	9.0	442.6	<30	<105	<94	<15	16945.4	<9	1485.3	<35	78.7	<5	236.5
556-G-MM	227.8	<375	<30	<105	<94	159.1	96582.0	<9	1067.3	<35	4713.3	<5	694.8
556-G-MM-D	264.1	<375	<30	<105	<94	145.8	109301.3	<9	1268.6	<35	5113.3	<5	777.9
557-G-TS	<6	<375	<30	<105	<94	<15	17750.0	<9	849.0	<35	239.4	<5	858.3
559-G-MM	<6	445.5	<30	<105	<94	62.6	21729.2	<9	1099.9	<35	570.6	<5	2066.1
55-C-JC	439.5	<375	<30	<105	<94	1084.8	162018.8	<9	2623.4	<35	15434.6	<5	2265.1
560-G-TS	27.2	<375	<30	<105	<94	25.0	22634.7	<9	1294.5	<35	1002.6	<5	1074.4
567-G-MM	42.9	<375	<30	<105	<94	21.0	62792.6	<9	8803.2	<35	733.0	<5	940.8
568-G-MM	20.0	<375	<30	<105	<94	<15	21796.8	<9	910.4	<35	209.5	<5	640.6
568-G-MM-D	<6	433.8	<30	<105	<94	<15	22492.8	<9	1009.8	<35	224.1	<5	684.8
569-G-MM	<6	<375	<30	<105	94.2	<15	20336.6	<9	621.8	<35	386.2	<5	477.5
56-C-JC	1252.7	<375	<30	<105	<94	1293.6	207266.1	<9	4406.4	<35	26364.5	<5	3135.5
574-G-MM	13.2	389.4	<30	<105	<94	<15	15225.7	<9	220.0	<35	208.5	<5	346.5
575-G-MB	<6	<375	<30	189.0	<94	23.8	23191.9	<9	1233.9	<35	438.5	<5	403.9
575-G-MB-D	20.0	<375	<30	<105	<94	<15	24165.5	<9	1315.9	<35	441.5	<5	415.1

Table 5.0-17 Total Metals - July 2006 Soil Analyzed by XRF

Sample ID	Arsenic	Barium	Cadmium	Cobalt	Chromium	Copper	Iron	Mercury	Manganese	Nickel	Lead	Selenium	Zinc
576-G-MM	10.2	432.1	<30	<105	<94	21.6	19686.9	<9	790.8	<35	101.9	<5	226.0
577-G-MM	<6	<375	<30	168.3	<94	<15	21870.1	<9	821.5	<35	161.4	<5	436.2
578-G-MM	14.1	413.4	<30	129.3	<94	<15	22311.5	<9	1130.6	<35	192.0	<5	352.1
578-G-MM	<6	<375	<30	<105	<94	<15	22479.5	<9	1163.4	<35	199.1	<5	365.8
579-G-MM	<6	<375	<30	121.4	101.3	<15	21938.4	<9	1604.7	<35	195.1	<5	478.1
579-G-MM	<6	<375	<30	<105	104.4	<15	22977.5	<9	1635.8	<35	241.4	<5	489.0
59-C-JC	11.9	<375	<30	156.2	<94	<15	22450.5	<9	1341.7	<35	130.0	<5	321.4
5-G-CP	83.0	415.0	<30	167.0	<94	81.0	29267.0	<9	747.0	<35	138.0	5.0	155.0
601-G-MB	<6	<375	<30	117.1	<94	<15	17529.7	<9	1102.5	<35	250.4	<5	258.5
602-G-MB	31.4	<375	<30	157.0	<94	37.6	33159.1	<9	1147.9	<35	955.8	<5	314.2
602-G-MB-D	30.0	<375	<30	177.5	<94	38.5	30905.8	<9	1133.0	<35	921.5	<5	277.5
60-G-MB	10.0	<375	<30	<105	<94	<15	23415.0	<9	1597.0	<35	103.0	<5	307.0
617-G-SG	<6	<375	<30	<105	<94	197.0	23295.9	<9	656.2	<35	1630.1	<5	602.7
619-G-SG	<6	<375	<30	<105	<94	90.7	22611.0	<9	1844.1	<35	2652.8	<5	700.2
61-G-JC	8.0	<375	<30	<105	<94	18.0	22349.0	<9	2447.0	<35	65.0	<5	259.0
621-G-MB	9.5	441.4	<30	119.6	<94	<15	15450.8	<9	1329.6	<35	54.5	<5	133.3
621-G-MM	9.5	441.4	<30	119.6	<94	<15	15450.8	<9	1329.6	<35	54.5	<5	133.3
622-G-MM	<6	<375	31.3	<105	<94	54.1	17696.0	<9	1462.5	<35	807.6	<5	1471.7
624-G-MM	<6	<375	<30	<105	<94	<15	18064.7	<9	1575.1	<35	716.8	<5	711.4
625-G-MM	<6	<375	<30	<105	<94	40.4	22444.5	<9	1843.0	<35	710.8	<5	982.0
625-G-MM-D	<6	584.8	<30	<105	<94	26.7	21738.6	<9	1553.0	<35	691.4	<5	946.0
626-G-MM	<6	<375	<30	<105	<94	239.5	62.3	<9		<35	9.8	<5	
627-G-MM	30.3	<375	<30	<105	<94	43.5	18735.8	<9	1520.3	<35	1331.4	<5	831.5
628-G-MM	<6	<375	<30	<105	<94	<15	15876.0	<9	1733.1	<35	842.2	<5	347.9
631-G-MM	<6	<375	<30	195.1	<94	75.2	22397.5	<9	1795.5	<35	3327.1	<5	1332.4
632-G-MM	<6	447.7	<30	154.9	<94	23.6	26351.2	<9	1898.7	<35	1418.8	<5	860.8
632-G-MM-D	<6	<375	<30	<105	<94	28.4	26808.3	<9	2226.7	<35	1443.0	<5	839.2
633-G-MM	<6	<375	<30	<105	<94	25.1	21673.3	<9	1230.9	<35	719.7	<5	801.4
634-G-MM	<6	<375	<30	<105	<94	32.0	22661.4	<9	1023.9	<35	846.9	<5	739.1
635-G-MM	<6	<375	<30	<105	<94	38.7	24651.3	15.6	1891.5	<35	1592.0	<5	809.2
635-G-MM-D	<6	<375	<30	<105	<94	27.5	24030.8	<9	1783.1	<35	1489.7	<5	781.5
636-G-MM	<6	503.0	<30	<105	<94	41.1	20569.8	<9	1858.7	<35	1650.4	<5	528.7
637-G-MM	<6	<375	<30	155.6	110.6	37.2	24577.8	<9	1132.0	<35	2409.4	<5	762.4
638-G-MM	<6	<375	<30	<105	<94	32.5	24327.3	<9	1453.0	<35	637.9	<5	405.6
639-G-MM	18.0	<375	<30	<105	99.7	<15	24227.1	<9	1613.0	<35	433.3	<5	319.7
63-G-DG	<6	<375	<30	158.0	<94	24.0	22838.0	12.0	715.0	<35	140.0	<5	292.0
640-G-MM	13.6	424.6	<30	137.8	<94	<15	22544.1	<9	1209.3	<35	184.3	<5	590.1
640-G-MM-D	22.3	418.5	<30	<105	<94	<15	23719.9	<9	1255.4	<35	174.0	<5	628.0
648-G-MM	<6	<375	<30	<105	<94	<15	26586.2	<9	1967.9	<35	811.7	<5	490.8
649-G-MB	<6	<375	<30	127.1	<94	17.3	18533.7	<9	840.2	<35	490.5	<5	384.8
64-G-JC	12.0	<375	<30	<105	<94	24.0	21899.0	<9	916.0	<35	165.0	<5	335.0
650-G-MM	<6	<375	<30	<105	<94	<15	19773.2	<9	1031.3	<35	144.1	<5	392.9
650-G-MM-D	<6	<375	<30	<105	<94	<15	19158.6	<9	964.7	<35	136.4	<5	389.7
654-G-MM	<6	<375	<30	130.0	<94	<15	19873.0	<9	740.3	<35	467.7	<5	406.5
654-G-MM-D	<6	<375	<30	118.0	<94	<15	19270.8	<9	767.3	<35	436.8	<5	391.6
654-G-MM-D	<6	<375	<30	<105	<94	<15	20800.0	<9	851.5	<35	468.5	<5	424.2
655-G-MM	<6	<375	<30	<105	<94	<15	21728.3	<9	949.5	<35	595.3	<5	439.0
656-G-MB	17.3	<375	<30	<105	<94	<15	21052.8	<9	1096.7	<35	228.4	<5	254.0
65-C-JC	311.2	<375	<30	<105	<94	270.7	109910.5	<9	2680.6	<35	2361.5	<5	2071.4
6-G-CP	43.0	<375	<30	185.0	<94	<15	27667.0	<9	665.0	<35	104.0	<5	141.0
71-C-JC	284.1	<375	<30	<105	<94	353.1	53243.8	<9	1555.1	<35	5771.7	<5	587.7

Table 5.0-17   Total Metals - July 2006 Soil Analyzed by XRF

Sample ID	Arsenic	Barium	Cadmium	Cobalt	Chromium	Copper	Iron	Mercury	Manganese	Nickel	Lead	Selenium	Zinc
74-G-MB	17.0	<375	<30	<105	98.0	18.0	15898.0	<9	896.0	<35	190.0	<5	166.0
75-G-JC	14.0	647.0	<30	147.0	<94	<15	22157.0	<9	1192.0	<35	109.0	<5	196.0
76-G-JC	<6	<375	<30	<105	<94	<15	13920.0	<9	1703.0	<35	102.0	<5	253.0
77-G-DG	27.0	<375	<30	147.0	<94	<15	21436.0	<9	1171.0	<35	128.0	<5	264.0
77-G-DG-D	23.0	<375	<30	146.0	<94	18.0	22793.0	<9	1424.0	<35	149.0	<5	265.0
78-G-DG	32.0	<375	<30	146.0	<94	20.0	22169.0	<9	1452.0	<35	196.0	<5	355.0
79-G-DG	20.0	<375	<30	185.0	<94	21.0	21830.0	12.0	1899.0	<35	117.0	<5	330.0
7-G-MB	19.0	<375	<30	<105	<94	33.0	21559.0	<9	363.0	<35	178.0	<5	145.0
80-G-MB	71.0	<375	<30	<105	<94	306.0	39713.0	<9	3004.0	<35	2114.0	<5	1654.0
81-G-MB	30.0	<375	<30	<105	<94	151.0	24925.0	<9	2755.0	<35	818.0	<5	1054.0
82-C-6-18-MB	62.8	436.7	<30	<105	<94	52.0	28568.2	<9	1772.6	<35	622.3	<5	793.0
82-G-MB	<6	<375	<30	<105	<94	23.0	6928.0	<9	1128.0	<35	78.0	<5	397.0
83-C-JC	21.3	<375	<30	<105	<94	16.8	17829.4	<9	1909.0	<35	294.1	<5	549.6
87-G-JC	9.0	<375	<30	<105	<94	<15	15152.0	<9	1811.0	<35	41.0	<5	318.0
88-G-JC	<6	<375	<30	<105	<94	<15	19234.0	<9	1292.0	<35	66.0	<5	264.0
88-G-MB-D	110.0	<375	<30	172.0	152.0	20.0	24068.0	<9	956.0	<35	171.0	<5	214.0
89-G-JC	9.0	<375	<30	<105	<94	18.0	17498.0	<9	1387.0	<35	77.0	<5	245.0
8-G-MB	22.0	<375	<30	128.0	<94	<15	19703.0	<9	1036.0	<35	89.0	<5	174.0
90-G-DG	60.0	573.0	<30	<105	<94	19.0	18719.0	<9	5628.0	<35	111.0	<5	488.0
91-G-DG	79.0	<375	<30	107.0	<94	<15	16840.0	<9	567.0	<35	31.0	<5	127.0
92-G-DG	23.0	<375	<30	237.0	<94	<15	21326.0	<9	610.0	<35	56.0	<5	169.0
96-G-JC	80.0	<375	<30	279.0	<94	28.0	41811.0	<9	2379.0	<35	212.0	<5	170.0
97-G-JC	78.0	691.0	<30	<105	<94	43.0	39083.0	<9	2127.0	<35	275.0	<5	239.0
98-G-DG	39.0	<375	<30	<105	<94	27.0	27056.0	<9	986.0	<35	199.0	<5	228.0
99-G-DG	72.0	503.0	<30	<105	<94	30.0	29046.0	11.0	1447.0	<35	159.0	11.0	170.0
9-G-MB	25.0	752.0	<30	<105	104.0	<15	25579.0	<9	655.0	<35	55.0	<5	125.0
106-C-DG	93.6	740.1	<30	209.3	<94	98.4	32612.7	<9	992.3	<35	2673.0	<5	385.7
107-C-MB	47.9	<375	<30	<105	<94	213.5	34001.9	<9	1690.6	<35	2815.8	<5	606.2
111-C-2-6-MB	15.6	527.6	<30	197.4	<94	20.8	28858.2	<9	331.3	<35	49.9	<5	154.3
111-C-6-18-MB	13.8	485.1	<30	150.5	<94	<15	30167.5	<9	464.5	<35	50.5	<5	172.3
114-C-2-6-JC	21.2	434.8	<30	165.8	<94	<15	24051.6	10.0	418.6	<35	159.8	<5	155.4
114-C-6-18-JC	32.7	571.1	<30	<105	<94	<15	23863.6	<9	363.2	<35	133.2	<5	151.3
116-C-DG	242.1	806.7	<30	<105	<94	281.7	125967.4	<9	2178.7	<35	11286.3	14.2	995.6
117-C-DG	115.8	703.3	<30	<105	<94	321.6	48934.9	<9	3167.0	<35	3820.1	<5	1374.0
118-C-DG	<6	501.5	<30	<105	<94	27.1	27523.5	<9	1105.8	<35	585.1	<5	634.6
11-C-DG	<6	630.4	<30	<105	<94	25.9	25647.6	<9	805.0	<35	259.4	<5	338.2
122-C-MB	<6	572.1	<30	<105	<94	94.2	26586.3	<9	2210.9	<35	2103.4	<5	986.2
123-C-DG	<6	543.2	<30	<105	<94	226.1	28356.3	<9	7685.6	<35	1512.8	<5	1418.2
123-C-JC	<6	<375	<30	<105	<94	198.1	26853.4	<9	6014.7	<35	952.5	<5	1471.8
124-C-JC	<6	478.5	<30	<105	<94	137.0	25885.3	<9	2719.5	<35	1769.1	<5	1103.7
127-C-DG	98.6	721.4	<30	<105	<94	248.8	58596.1	<9	1575.6	<35	3053.2	<5	1432.2
12-C-DG	<6	453.4	<30	<105	<94	40.6	24642.7	<9	847.9	<35	598.7	<5	536.8
139-C-DG	55.6	495.5	<30	<105	<94	80.1	28171.3	<9	2254.0	<35	1684.8	<5	644.8
139-C-JC	38.9	<375	<30	<105	<94	87.6	37678.2	<9	6299.6	<35	1142.2	<5	1016.6
13-C-MB	<6	514.4	<30	209.2	<94	158.0	37484.9	<9	1516.1	<35	2277.8	<5	752.5
143-C-2-6-JC	25.2	411.3	<30	<105	<94	<15	28492.8	<9	1057.8	<35	103.3	<5	384.0
143-C-6-18-JC	13.0	<375	<30	<105	136.4	21.8	30370.9	<9	1332.0	<35	109.5	<5	596.1
147-C-JC	282.8	724.4	<30	<105	<94	357.6	99249.1	<9	683.3	<35	4632.7	9.8	750.2
148-C-JC	349.2	786.8	<30	<105	<94	685.4	122991.2	<9	1358.7	<35	9599.3	18.9	2378.7
14-C-2-6-MB	29.1	458.5	<30	<105	<94	24.6	23872.5	<9	1488.1	<35	362.3	<5	373.1
14-C-6-18-MB	23.9	541.3	<30	<105	<94	77.0	28655.9	<9	1386.8	<35	502.4	<5	444.5

Table 5.0-17 Total Metals - July 2006 Soil Analyzed by XRF

Sample ID	Arsenic	Barium	Cadmium	Cobalt	Chromium	Copper	Iron	Mercury	Manganese	Nickel	Lead	Selenium	Zinc
164-C-DG	227.8	<375	<30	<105	<94	1292.7	142150.9	<9	424.1	<35	28809.5	<5	616.0
167-C-DG	27.9	<375	<30	<105	<94	39.5	24369.0	<9	2305.0	<35	309.3	<5	718.3
168-C-DG	215.2	<375	<30	<105	<94	340.1	87728.6	<9	6903.9	<35	6194.2	14.5	5314.1
16-C-MB	18.6	599.4	<30	<105	<94	19.7	33091.7	<9	1022.9	<35	85.8	<5	308.3
170-C-2-6-JC-D	15.9	<375	<30	<105	<94	22.4	27507.6	<9	1000.8	<35	64.6	<5	175.0
170-C-6-18-JC	29.4	440.6	<30	<105	<94	27.6	30384.2	<9	992.8	<35	56.6	<5	159.1
174-C-MB	53.9	495.6	<30	<105	<94	98.2	36079.7	<9	932.2	<35	474.3	<5	405.1
176-C-DG	<6	805.3	56.7	<105	<94	384.1	62887.9	<9	9988.7	<35	6828.2	11.9	8882.9
180-C-DG	81.8	665.8	<30	<105	<94	150.1	49814.5	<9	3233.1	<35	2843.2	<5	1592.5
183-C-JC	14.8	480.1	<30	<105	<94	28.0	18931.9	<9	885.3	<35	116.2	<5	227.2
192-C-MB	104.6	458.6	<30	<105	<94	<15	43113.4	<9	2482.6	<35	89.3	<5	233.8
194-C-2-6-MB	7.8	753.0	<30	158.8	<94	<15	23155.2	<9	426.3	<35	38.6	<5	123.1
194-C-6-18-MB	10.8	483.0	<30	<105	<94	<15	21810.3	<9	219.6	<35	46.5	<5	109.2
200-G-DG	<6	<375	<30	<105	<94	65.1	30810.6	<9	1536.6	<35	1054.6	<5	685.4
204-G-DG	60.2	657.7	<30	<105	<94	77.9	33578.4	<9	5872.4	<35	1954.2	<5	535.4
206-G-DG	35.6	600.7	126.5	<105	<94	119.3	28454.2	<9	39338.9	39.4	919.8	<5	5496.1
208-G-DG	<6	499.6	<30	<105	<94	225.8	23480.3	<9	849.1	<35	1211.4	<5	2360.6
210-G-DG	34.5	634.1	<30	<105	<94	137.6	24080.5	<9	482.3	<35	1405.7	<5	625.6
212-G-DG	85.4	636.3	<30	<105	<94	123.1	39125.0	<9	1071.7	<35	3123.9	<5	467.2
214-G-DG	64.4	494.2	<30	<105	<94	153.2	33058.3	<9	998.1	<35	4782.9	<5	700.1
216-G-DG	36.0	511.1	<30	<105	<94	28.9	29906.9	<9	1955.0	<35	1106.1	<5	785.9
218-G-DG	36.9	<375	<30	<105	<94	<15	24890.9	<9	831.7	<35	537.6	<5	621.2
220-G-DG	226.0	<375	<30	<105	<94	214.9	77327.0	<9	2609.7	<35	9198.5	<5	934.2
222-G-DG	<6	495.1	<30	<105	<94	<15	24391.2	<9	859.5	<35	189.4	<5	613.2
222-G-DG-D	19.6	638.8	<30	<105	<94	<15	23361.9	<9	779.5	<35	167.3	<5	606.5
224-G-DG	<6	492.0	<30	<105	<94	38.9	21961.2	<9	1266.2	<35	710.9	<5	668.6
224-G-DG-D	45.8	465.5	<30	<105	<94	25.4	23997.0	<9	1583.9	<35	761.8	<5	729.6
226-G-DG	<6	396.2	<30	<105	<94	<15	18346.2	<9	907.5	<35	354.9	<5	415.7
228-C-DG	33.4	<375	<30	<105	<94	31.8	24476.7	<9	2677.9	<35	1447.9	<5	814.0
230-C-DG	<6	<375	<30	<105	<94	27.6	24914.1	<9	1860.9	<35	1518.0	<5	991.2
24-C-DG	334.2	<375	<30	<105	<94	2631.6	333603.2	<9	12888.5	<35	13416.8	<5	12748.8
252-G-DG	15.3	<375	<30	<105	<94	<15	23840.3	<9	1075.7	<35	200.5	<5	412.8
254-G-DG	<6	454.9	<30	<105	<94	23.4	21632.7	<9	992.9	<35	287.0	<5	411.9
256-G-DG	<6	573.0	<30	<105	<94	<15	19669.5	<9	649.5	<35	311.6	<5	676.2
258-C-2-18-MB	21.7	448.7	<30	<105	<94	26.3	35970.4	<9	1385.7	<35	282.3	<5	215.0
262-C-2-18-MB	14.2	620.3	<30	187.1	<94	20.0	33747.9	<9	1360.5	<35	137.3	<5	214.0
269-G-MB	18.7	843.9	<30	<105	<94	19.7	28834.7	<9	1276.7	<35	77.1	<5	252.9
271-G-MB	18.3	481.8	<30	<105	<94	232.6	24269.3	<9	1392.5	<35	238.8	<5	730.0
273-G-MB	11.0	<375	<30	<105	<94	<15	17608.3	<9	728.6	<35	84.4	<5	1011.7
275-G-MB	<6	620.1	<30	<105	<94	<15	29408.8	<9	1589.4	<35	117.0	<5	933.0
277-G-MB	<6	<375	<30	<105	<94	16.0	11104.8	<9	2243.6	<35	91.2	<5	1516.0
279-C-MB	45.1	816.0	<30	<105	<94	85.2	42373.1	<9	2045.9	<35	787.2	<5	589.9
281-C-MB	70.4	630.1	<30	<105	<94	189.2	53636.5	<9	1211.9	<35	1789.2	8.5	491.9
283-C-MB	130.7	725.6	<30	214.3	<94	139.1	48583.6	<9	1674.6	<35	2739.7	7.2	380.6
285-G-MB	15.1	<375	<30	<105	<94	25.6	26835.8	<9	1557.2	<35	309.6	<5	357.7
287-G-MB	<6	<375	<30	<105	<94	22.9	29351.7	<9	1345.4	<35	166.9	<5	1395.2
289-G-MB	17.1	479.1	<30	192.1	<94	<15	27074.8	<9	862.9	<35	137.3	<5	232.3
289-G-MB-D	12.7	418.9	<30	184.9	<94	<15	28954.9	<9	1032.8	<35	160.6	<5	239.7
291-C-MB	44.9	746.4	<30	<105	<94	100.6	37659.3	<9	4528.9	<35	1122.2	<5	1395.6
293-C-MB	55.1	585.8	<30	<105	<94	65.7	43588.6	<9	2795.0	<35	1924.0	<5	531.9
29-C-JC	52.0	<375	<30	212.6	<94	124.3	47286.8	<9	4676.4	<35	1091.5	<5	1331.5

Table 5.0-17 Total Metals - July 2006 Soil Analyzed by XRF

Sample ID	Arsenic	Barium	Cadmium	Cobalt	Chromium	Copper	Iron	Mercury	Manganese	Nickel	Lead	Selenium	Zinc
300-C-DG	74.3	620.3	<30	<105	<94	582.4	42882.2	<9	2054.1	<35	1549.9	<5	587.2
302-C-SG	64.4	616.3	<30	<105	<94	182.7	61585.1	<9	1911.5	<35	787.7	<5	683.5
304-C-SG	81.1	687.8	<30	<105	<94	283.0	51512.3	<9	2676.2	<35	1175.6	<5	848.2
306-C-SG	54.2	<375	<30	199.2	<94	348.4	56160.2	<9	2031.7	<35	1109.5	<5	1227.0
308-C-SG	93.9	647.5	<30	<105	<94	493.2	60443.2	<9	6476.0	<35	2184.3	<5	833.3
30-C-MB	34.0	494.0	<30	<105	<94	92.7	25619.8	<9	3265.2	<35	1715.8	<5	1503.8
310-C-SG	84.6	489.5	<30	<105	<94	121.2	36066.9	<9	4229.0	<35	2523.9	<5	847.3
314-C-SG	<6	<375	<30	<105	<94	565.1	128399.0	<9	636.7	<35	8956.3	33.4	663.1
316-C-SG	40.4	<375	<30	<105	<94	23.6	23337.0	<9	540.0	<35	395.2	<5	302.6
318-C-SG	38.4	725.9	<30	<105	<94	<15	18280.7	<9	1041.0	<35	627.9	<5	168.4
320-C-SG	<6	<375	<30	405.3	<94	515.7	93371.8	<9	1899.7	<35	12927.8	<5	771.8
322-C-DG	56.6	<375	<30	<105	<94	40.3	22852.1	<9	2280.3	<35	423.9	<5	508.0
324-C-DG	<6	<375	<30	<105	<94	22.6	21244.6	<9	2431.3	<35	550.6	<5	600.3
326-C-DG	59.4	452.2	<30	<105	<94	79.6	26498.9	<9	3485.4	<35	2230.7	<5	1104.4
328-C-DG	<6	466.9	<30	<105	<94	71.1	24946.7	<9	3676.5	<35	1902.0	<5	939.5
332-C-DG	<6	<375	<30	<105	<94	165.8	24159.1	<9	2663.5	<35	2490.7	<5	1086.3
334-C-DG	75.5	538.8	<30	<105	<94	91.6	31536.3	<9	7212.5	<35	6181.9	<5	1141.9
336-C-DG	<6	<375	<30	<105	<94	32.2	21360.5	<9	1644.5	<35	368.1	<5	520.0
338-C-DG	13.9	596.2	<30	<105	<94	29.0	20965.2	<9	2472.0	<35	113.4	<5	445.6
340-C-DG	8.7	815.6	<30	<105	<94	<15	19144.7	<9	3961.1	<35	92.9	<5	310.1
360-G-DG	43.0	518.8	<30	157.2	<94	<15	35101.4	<9	2683.6	<35	110.4	<5	419.9
362-G-DG	<6	439.5	<30	<105	<94	<15	25332.0	<9	1224.8	<35	151.6	<5	160.2
37-C-DG	40.8	571.8	33.0	<105	<94	133.5	37984.7	<9	7308.5	<35	1933.5	<5	1253.1
40-C-DG	216.2	1045.4	45.2	<105	<94	929.4	102104.4	<9	9978.1	<35	10708.8	17.5	10369.8
41-C-DG	300.7	1124.3	<30	<105	<94	391.0	70940.0	<9	4354.7	<35	5054.4	9.4	2641.1
44-C-2-6-JC	20.1	439.7	<30	<105	<94	28.5	18146.7	<9	758.6	<35	272.7	<5	174.9
44-C-6-18-JC	28.0	672.2	<30	<105	<94	20.3	22329.2	<9	1047.4	<35	374.3	<5	257.4
48-C-MB	43.0	513.5	<30	<105	<94	117.0	38291.5	<9	1480.5	<35	1323.3	<5	638.4
49-C-DG	28.0	539.3	<30	<105	<94	84.9	36786.8	<9	2667.1	<35	451.7	<5	989.0
500-C-2-18-MB	17.5	483.8	<30	181.6	<94	<15	33192.6	<9	1054.9	<35	59.8	<5	173.7
500-G-MB	15.7	515.1	<30	<105	<94	<15	22978.5	<9	9579.1	<35	60.3	<5	350.0
503-C-2-18-MB	25.8	938.4	<30	<105	<94	40.2	41493.9	<9	2286.1	<35	374.0	<5	534.6
504-G-MB	9.7	<375	<30	<105	<94	<15	14763.2	<9	1886.6	<35	134.5	<5	227.2
50-C-JC	28.1	845.7	<30	179.0	<94	96.5	38372.3	<9	1675.9	<35	835.9	<5	834.3
512-G-MB	25.2	599.9	<30	<105	<94	<15	33686.5	<9	1925.8	<35	238.2	<5	242.7
514-C-2-18-MB	16.0	390.1	<30	163.5	<94	24.0	24414.3	9.0	913.0	<35	53.2	<5	158.4
514-G-MB	<6	<375	<30	<105	<94	<15	24579.8	<9	1034.6	<35	58.7	<5	169.4
535-G-SG	<6	422.0	<30	<105	<94	62.6	24501.2	<9	2184.8	<35	2500.7	<5	1079.8
539-G-SG	<6	404.3	<30	<105	<94	24.1	22950.0	<9	1862.2	<35	1243.8	<5	401.7
541-G-MM	<6	404.9	<30	<105	<94	34.6	20433.2	<9	1013.1	<35	283.5	<5	563.1
553-G-MM	19.7	<375	<30	<105	<94	<15	17291.7	<9	1378.1	<35	295.2	<5	359.9
554-G-MM	<6	<375	<30	<105	<94	<15	17895.1	<9	1753.4	<35	532.2	<5	402.7
555-G-TS	<6	432.5	<30	117.2	<94	<15	16089.4	<9	530.8	<35	169.9	<5	308.8
558-G-MM	15.3	494.4	<30	<105	<94	<15	20838.7	<9	749.8	<35	337.2	<5	1816.8
561-G-TS	31.0	375.7	<30	<105	<94	26.9	22135.5	<9	2633.9	<35	466.2	<5	438.7
562-G-TS	<6	376.1	<30	<105	<94	<15	21807.8	<9	2885.8	<35	276.9	<5	383.5
569-G-MM	<6	376.9	<30	<105	<94	19.5	22412.7	9.7	656.1	<35	398.5	<5	552.7
569-G-MM-D	20.7	<375	<30	<105	<94	<15	22516.8	<9	689.3	<35	389.5	<5	528.1
577-C-2-18-MB	11.6	550.1	<30	<105	<94	21.6	24088.6	<9	846.0	38.6	160.0	<5	447.6
57-C-JC	29.4	492.0	<30	<105	<94	43.5	24055.7	<9	1762.2	<35	561.5	<5	788.5
585-G-MB	6.6	<375	<30	<105	<94	<15	24943.0	<9	841.3	<35	36.4	<5	150.7

Table 5.0-17 Total Metals - July 2006 Soil Analyzed by XRF

Sample ID	Arsenic	Barium	Cadmium	Cobalt	Chromium	Copper	Iron	Mercury	Manganese	Nickel	Lead	Selenium	Zinc
58-C-JC	<6	<375	<30	<105	<94	<15	27578.9	<9	1658.3	<35	115.2	<5	336.3
615-G-SG	160.3	<375	<30	<105	<94	101.0	13945.8	<9	1271.0	<35	3109.4	<5	2961.9
616-G-SG	52.4	601.6	<30	134.3	<94	95.0	23604.0	<9	1727.0	<35	3100.8	<5	1192.8
620-G-MM	9.2	380.4	<30	<105	<94	<15	14545.6	<9	3465.4	<35	65.5	<5	199.9
623-G-MM	<6	<375	<30	<105	<94	35.2	19053.3	<9	1276.7	<35	645.8	<5	1149.6
626-G-MM	105.3	<375	<30	<105	<94	<15	37742.8	<9	5641.5	<35	5783.4	<5	2800.9
629-G-MM	<6	548.3	<30	<105	<94	25.5	19459.5	<9	1294.4	<35	201.1	<5	281.5
630-G-MM	<6	621.4	<30	130.7	<94	112.9	26659.6	<9	2096.8	<35	4196.2	<5	1208.4
641-C-2-18-MB	19.0	547.6	<30	123.7	<94	<15	24839.7	<9	1100.2	<35	346.4	<5	691.2
642-G-MM	<6	<375	42.3	<105	<94	593.1	25061.3	<9	4058.0	<35	4662.7	<5	3234.5
642-G-MM-D	<6	477.6	31.9	<105	<94	602.7	25371.7	<9	4223.2	<35	4773.1	<5	3270.1
64-C-2-6-JC	17.5	442.0	<30	<105	<94	21.5	25666.3	<9	911.2	<35	160.2	<5	333.5
64-C-6-18-JC	17.1	<375	<30	<105	<94	22.1	26182.6	<9	902.4	<35	155.7	<5	370.2
651-G-MM	10.7	<375	<30	<105	<94	25.3	21913.9	<9	933.7	<35	134.8	<5	471.0
700-G-MB	14.0	<375	<30	<105	<94	<15	21220.0	<9	3947.9	<35	170.6	<5	261.0
701-G-MB	13.3	<375	<30	<105	<94	<15	19945.5	<9	1166.5	<35	70.4	<5	136.9
702-C-2-18-MB	15.1	652.8	<30	<105	<94	<15	25470.4	<9	1128.1	<35	130.0	<5	484.5
702-G-MB	14.7	475.7	<30	<105	<94	<15	20537.6	<9	1011.3	<35	105.8	<5	401.3
703-G-MB	<6	588.4	<30	<105	<94	23.2	18618.4	<9	1067.2	<35	122.6	<5	418.3
704-G-MB	18.1	425.2	<30	<105	<94	<15	18544.0	<9	1139.7	<35	190.4	<5	411.1
705-C-2-18-MB	6.6	384.0	<30	<105	<94	<15	13671.5	<9	585.9	<35	38.2	<5	148.3
705-G-MB	15.1	<375	<30	<105	<94	<15	17826.1	<9	2094.0	<35	56.5	<5	299.1
706-G-MB	15.2	<375	<30	<105	<94	<15	16927.1	<9	1883.5	<35	133.3	<5	373.4
707-C-2-18-MB	9.4	613.0	<30	<105	<94	<15	19511.8	<9	1188.7	<35	44.1	<5	304.7
707-G-MB	7.9	<375	<30	<105	<94	<15	16417.0	<9	1301.0	<35	49.2	<5	297.0
708-G-MB	12.4	<375	<30	<105	<94	<15	15758.1	<9	1546.1	<35	29.6	<5	147.3
709-G-MB	7.9	428.7	<30	<105	<94	<15	17273.7	<9	1806.3	<35	39.6	<5	148.9
70-C-JC	199.7	594.4	<30	<105	<94	434.2	62994.5	<9	4759.1	<35	4132.8	<5	1638.3
710-G-MB	10.6	<375	<30	<105	<94	<15	19005.0	<9	1280.2	<35	62.5	<5	139.3
72-C-DG	107.5	873.1	<30	<105	<94	223.5	55585.4	<9	3632.1	<35	2826.1	<5	3070.2
78-C-JC	66.1	<375	<30	<105	<94	63.8	31336.2	<9	1168.4	<35	954.0	<5	406.6
80-C-MB	106.0	<375	<30	<105	<94	255.2	56876.3	<9	3049.1	<35	1800.4	<5	1934.0
81-C-MB	68.0	<375	<30	<105	<94	136.2	39102.4	<9	4664.1	<35	1224.5	<5	1198.4
82-C-2-6-MB	41.6	590.4	<30	<105	<94	60.5	27623.6	<9	3140.4	<35	751.4	<5	1388.8
84-C-JC	38.8	665.3	<30	<105	<94	107.6	56076.5	<9	12591.4	<35	1640.2	<5	4387.8
85-C-JC	17.7	<375	<30	<105	<94	19.5	16332.9	<9	4090.9	<35	215.5	<5	804.3
9-C-2-6-JC	29.8	762.4	<30	140.5	<94	26.8	30512.9	<9	820.6	<35	67.7	<5	163.5
9-C-6-18-JC	43.5	1059.7	<30	<105	<94	33.4	66889.1	<9	1819.6	<35	82.8	<5	408.4

Notes:

All units are milligrams per kilogram.

Results indicated with a "<" sign were below the XRF detection limit.

Table 5.0-18 Total Metals - July 2006 Soil Anlayzed by Laboratory

Location	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc
106-C-DG	3650	5.9U	19.5	52.1	0.65	0.86	1790	4.2	4.1J	32.1	8600	1740	645	810	0.25	3.5J	1160	3.5U	3.9	54.6J	2.5U	5.4	203
107-C-MB	6140	5.9U	16.9	49	0.74	2.1	1070	3.7	6.8	175	17700	2830	1180	1820	0.04J	3.7J	1390	3.5U	5.5	73.6J	2.5U	9.3	357
111-C-2-6-MB	6970	5.9U	6.3	143	0.22J	0.27J	1570	3.7	4.4J	6.3	8720	34.3	1340	244	0.1U	3.6J	1390	3.5U	0.99U	58.1J	2.5U	10.4	101
111-C-6-18-M	8040	6U	7.2	143	0.25J	0.31J	2090	3.4	4.9J	8	10000	39.1	1490	438	0.028J	3.7J	1670	3.5U	0.3J	81.8J	2.5U	11.4	115
112-C-DG	4730	6U	166	76.4	0.44J	17.2	823	3.1	11.9	290	58500	7630	897	6940	0.048J	3.5J	1300	17.6	23.9	209J	2.5U	7.8	4030
113-C-DG	6300	6U	169	65.9	0.54	7.4	1570	4.4	7.9	381	53800	9990	1220	1750	0.06J	5	1450	10.3	17.6	80.4J	2.5U	8.5	1740
114-C-2-6-JC	8720	6U	22.4	68.6	0.48J	0.45J	5030	4.7	5J	14.9	12000	124	1850	326	0.1U	4.6	1120	3.5U	0.73J	88.1J	2.5U	7.9	117
114-C-6-18-J	8720	5.9U	23.7	65.4	0.48J	0.48J	5150	3.4	4.7J	14.6	12600	110	1810	313	0.1U	4.2	1210	1.9J	0.63J	69.3J	2.5U	8.3	119
115-C-DG	3710	5.9U	151	132	0.47J	6.2	2080	1.7	3.7J	460	58800	13200	706	675	0.072J	2.3J	1540	24.9	34.1	78.5J	2.5U	6.7	1280
116-C-DG	4640	5.9U	108	132	0.46J	4.5	2170	2.9	6.7	254	64100	12300	927	1260	0.06J	3.3J	1460	19.8	21	72.1J	2.5U	7.6	1000
117-C-DG	6930	5.9U	37.7	47.8	1.1	4.3	1380	2.7	11.3	231	25400	3410	1040	2310	0.062J	5.2	1170	3.6	9.4	59.7J	2.5U	6	872
118-C-DG	8130	6U	12.1	74.5	0.9	2.6	2520	2.8	6.4	16.7	14800	539	1410	1050	0.055J	5.3	1640	3.5U	0.67J	72.9J	2.5U	7.8	431
11-C-DG	6920	5.9U	8.6	98.3	0.42J	0.81	2520	3.4	4.6J	10	11000	197	1340	639	0.1U	4.1	1680	3.4U	0.36J	75.1J	2.5U	9	185
120-C-MB	4450	6U	28.8	36.9	0.58	3.2	514	2.3	8.7	108	22800	3590	671	2790	0.051J	3.4J	1040	3.5U	6.7	50.9J	2.5U	6	408
121-C-MB	5420	6U	29.7	24.3	0.4J	1.9	538	4.2	5.2	156	30000	1230	1070	1140	0.052J	3J	1150	3.5U	6.1	58.8J	2.5U	9.1	402
122-C-MB	5310	5.9U	11.1	84	0.89	7	1140	4.1	6.2	62.9	9510	1690	886	1950	0.03J	4.5	1080	3.4U	1	51J	2.5U	7.2	549
123-C-DG	15500	5.9U	9.3	162	2.8	9.1	2290	7.4	8.4	137	10500	1310	1630	7080	0.12	8	1260	3.5U	1.8	71J	1.3J	11.7	556
123-C-JC	18000	6U	10	180	3.1	13.6	2900	9	8.5	154	11600	909	1960	7070	0.17	10	1670	3.5U	2.1	97.8J	1.6J	13.5	694
124-C-JC	13600	6U	7	110	1.8	3.2	2400	7.8	6.9	86.2	10600	1630	2700	2710	0.051J	7.6	1880	3.5U	1.4	103J	2.5U	13.7	496
127-C-DG	6370	1.6J	55.5	90.7	0.51	6.2	991	5.7	6.5	251	31500	2640	1670	1280	0.1U	5	1410	6.1	9.3	133J	2.5U	10.4	1240
129-C-JC	4330	4.5J	155	70.6	0.37J	4.8	748	6	2.8J	611	64500	6680	1080	809	0.051J	4.1	1460	17.9	29	153J	2.5U	8.8	1820
12-C-DG	7080	6U	10.6	98.6	0.66	3	2600	4.2	5J	31	12500	585	1490	912	0.03J	4.8	1740	3.5U	0.45J	62.8J	2.5U	9.3	439
130-C-JC	2530	4.8J	176	79.5	0.5U	11.3	870	5.8	2.7J	413	53200	5440	779	806	0.064J	3.2J	1090	16.3	24.4	192J	2.5U	31	2630
131-C-JC	2910	8	307	58.7	0.63	35.4	525	6.1	4.8J	804	108999	9000	739	1200	0.075J	6.1	1340	33.7	48.2	252J	2.5U	9.8	5620
132-C-JC	4780	6.7	127	72.7	1.1	43.8	1700	8	20.1	698	63700	13700	1530	6770	0.09J	9	1510	17.2	33.5	461J	2.5U	7.9	7500
133-C-JC	5980	3.7J	105	118	1.7	54.3	4860	5.4	16.7	479	48800	8410	1940	8600	0.046J	9.9	1550	12.6	30.4	424J	2.5U	9.1	7800
134-C-JC	4660	4.6J	149	63.3	1.1	32.3	713	5.6	14.6	696	65400	8220	1200	5920	0.07J	6.3	1230	16.4	31	300J	2.5U	8.4	5770
135-C-JC	6340	2.9J	103	191	1.9	46.7	1170	5.8	31.6	751	49200	8650	1410	12200	0.03J	11.8	1300	10.4	25.1	420J	2.5U	7.4	7570
136-C-JC	4750	2.3J	95.4	70.7	0.58	7.9	638	6.6	4.5J	314	43100	2900	1010	1410	0.068J	4.5	1010	8.8	15	107J	2.5U	9.2	1710
137-C-JC	6440	3.3J	75	78.2	0.66	1	684	16.6	8.6	165	31900	1740	1060	1090	0.035J	6.5	990	2.4J	8.4	67.3J	2.5U	12.7	580
138-C-JC	6330	2.4J	75.1	120	0.35J	0.87	1250	4.7	5.9	160	35100	1950	1630	848	0.1U	4.9	1460	5.3	10.1	83.8J	2.5U	11.1	601
139-C-DG	4680	6U	27.3	91.1	0.7	1.5	1550	4.2	7.6	70.6	20200	1510	868	2020	0.1U	3.9J	1020	3.5U	1.3	84.6J	2.5U	10.4	391
139-C-JC	8370	5.9U	29.9	166	0.94	4.4	2410	6.9	13.4	89.3	24000	987	1390	4610	0.11	7.6	1660	3.4U	1.5	96.1J	2.5U	14.3	581
13-C-MB	4720	6U	24	50.8	0.68	2.1	1170	3.6	5.1	133	23500	1990	942	1310	0.091U	3.5J	1040	3.5U	2.7	89.4J	2.5U	10	475
140-C-JC	9690	5.9U	14.8	201	1.4	7.2	3410	7.8	9.6	45.4	12700	524	2290	2770	0.061J	8.3	1390	3.4U	0.5J	128J	2.5U	15.6	575
143-C-2-6-JC	8740	6U	11	157	0.45J	0.5U	4050	6	4.3J	11.3	13500	82.6	1970	878	0.042J	5.3	1160	3.5U	1U	90.7J	2.5U	15.4	213
143-C-6-18-J	9440	6U	14.5	125	0.57	0.5U	3190	4.5	4.7J	13.1	15300	86.2	2150	1340	0.032J	5.4	897	3.5U	1U	85.5J	2.5U	13.8	371
144-C-JC	5050	1.7J	101	86.7	0.42J	10.2	1400	5.7	5.5	285	56100	2070	1360	1890	0.1U	4.9	1110	8.1	11.4	153J	2.5U	9.2	2220
145-C-JC	3230	10	213	75.2	0.5U	0.5U	181J	5	5U	476	83600	4900	812	710	0.032J	1.4J	1350	21.8	30.2	50.6J	2.5U	11.7	1200
146-C-JC	1190	28.8	663	61.9	0.5U	0.5U	99.9J	1.6	0.88J	1380	195999	31200	225J	185	0.08J	0.53J	2180	61.1	100	500U	2.5U	5.7	2290
147-C-JC	2960	12.2	269	56.8	0.25J	0.5U	286J	3.4	0.67J	398	68300	4380	614	454	0.1U	2J	1340	17.4	19.9	49J	2.5U	8.7	873
148-C-JC	3490	15.7	304	103	0.3J	6.4	427J	5.6	4.7J	787	77600	10200	610	880	0.1U	2.3J	1440	25.7	36.6	97.8J	2.5U	11.2	2400
149-C-JC	3710	12.3	279	62.7	0.59	13.4	1320	4.4	5.7	621	80900	8270	880	1610	0.053J	4.7	1650	21.9	34.1	173J	2.5U	18.9	3220
14-C-2-6-MB	6460	5.9U	19.1	287	0.43J	0.24J	3310	5.7	5.3	24.4	14700	315	1230	1350	0.027J	4.6	1320	3.5U	0.99U	98.2J	2.5U	15.3	254
14-C-2-6-MBD	6130	6U	19.4	286	0.44J	0.5U	3030	5.6	5.2	25.1	14400	328	1180	1320	0.35	4.4	1300	3.5U	1U	71.2J	2.5U	14.7	248
14-C-6-18-MB	6570	5.9U	27.9	233	0.72	0.5U	3110	5.6	5.5	53	18600	447	1030	1490	0.1U	4.6	1110	3.5U	0.65J	90.3J	2.5U	13.2	275
150-C-JC	12000	6U	16.3	95.1	0.62	2.4	1330	7.7	6.3	30.7	16900	251	2170	941	0.056J	6.5	1300	3.5U	1.1	73J	2.5U	21	360
151-C-JC	8000	6U	18	217	0.52	3.2	3610	6.2	7.8	23.4	13400	238	2110	1850	0.036J	6.8	1860	3.5U	1	78.4J	2.5U	17.7	406
152-C-JC	10100	6U	13	237	0.45J	1.2	3020	8.1	8.6	13.6	16100	81.5	2380	2060	0.03J	8	2210	3.5U	0.66J	88.7J	2.5U	24.6	185
152-C-JCD	8660	6U	12.5	204	0.5J	0.5U	2500	7.4	7	12.9	13500	90.7	1970	1730	0.074J	6.8	1830	3.5U	1U	85.4J	2.5U	20.6	188
15-C-JC	10800	5.9U	10	257	1.5	2.5	5130	6.8	8.7	66.1	11400	1910	2430	3650	0.081J	7.9	1600	3.5U	0.91J	122J	2.5U	14.9	494
160-C-MB	6480	1.9J	93.3	102	0.34J	4.6	1040	5.3	5.7	220	40200	3120	1450	1010	0.1U	4.2	2060	6.9	10.9	108J	2.5U	13.1	892
161-C-DG	5360	3.8J	176	82.4	0.35J	5.2	1060	2.5	9.2	107	42000	583	1410	1170	0.044J	3.3J	972	5.5	7	50.4J	2.5U	9.8	986
162-C-DG	4460	4.2J	115	51.5	0.38J	0.5U	618	3	5.6	187	63300	640	1030	1030	0.095U	2.3J	785	6.2	7.4	57.3J	2.5U	10.2	916
163-C-DG	7450	5.9U	42.5	54.6	0.51	3	583	5.2	6.3	181	32600	812	1610	1040	0.027J	4.1	1150	3.7	5.5	74.9J	2.5U	11.6	611
164-C-DG	2010	25.8	211	80.8	0.5U	0.5U	210J	3.3	5U	1130	68800	31700	421J	297	0.047J	1J	1120	47.4	74.6	57.1J	2.5U	8.1	516
165-C-DG	4130	4.4J	104	72.1	0.29J	2	335J	3.5	2.8J	375	42100	3130	761	411	0.034J	2.4J	1160	9.9	15.4	77.6J	2.5U	7.8	673
166-C-DG	4560	3.1J	144	48.9	1.4	20.8	1020	1.7	11.9	581	40600	4020	716	3380	0.095U	4.8	971	8.6	14.6	80.9J	2.5U	5.9	3070

Table 5.0-18 Total Metals - July 2006 Soil Anlayzed by Laboratory

Location	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc
167-C-DG	7810	6U	19.3	246	0.59	4.3	3040	6.2	8	32.2	16400	293	1960	2040	0.1U	7.3	1590	3.5U	1.6	75J	2.5U	18.8	544
168-C-DG	8210	6	114	85.8	0.86	24.9	693	5.6	11.7	357	53900	5660	2140	4350	0.067J	6.8	1150	13	24.8	76J	2.5U	15.9	4220
169-C-DG	6390	6U	46.8	44	0.35J	1.5	766	5.1	5.9	79.5	23000	752	1460	1150	0.032J	5.3	790	3J	4.8	72.8J	2.5U	14	328
169-C-DGD	8270	6U	28.5	70.6	0.53	0.5U	1130	7.1	6.2	42.1	18600	422	1820	1210	0.055J	7.1	1090	1.4J	2	76.6J	2.5U	16.4	250
16-C-MB	7260	6U	12	218	0.31J	0.77	4420	4.2	8.4	17.5	15700	72.4	1780	1040	0.1U	5	1880	3.5U	0.53J	110J	2.5U	14.5	251
170-C-2-6-JC	11300	5.9U	14.6	117	0.5	0.36J	1260	8.2	6.9	11.4	16500	48	2490	983	0.032J	7.3	1210	3.4U	0.48J	83.3J	2.5U	22.3	94.9
170-C-2-6-JCD	12000	5.9U	15	129	0.66	0.5U	1320	10.9	6.8	11.5	16900	45.8	2620	1020	0.1U	8.7	1380	3.5U	0.99U	106J	2.5U	23.1	100
170-C-6-18-J	15200	5.9U	17.6	112	0.65	0.36J	1080	10.7	7.1	12.3	21100	50.4	2820	931	0.046J	8.6	1620	3.4U	0.57J	77.5J	2.5U	27.1	106
174-C-MB	8790	5.9U	36.2	97.4	0.44J	0.86	844	5.5	6.1	78.1	22300	390	1710	780	0.056J	4.4	1420	1.7J	1.8	70.3J	2.5U	15.8	285
176-C-DG	6700	4.7J	129	92.6	1.3	42.7	888	4.7	18.2	554	51100	7250	1980	8100	0.1U	10.5	1430	16.1	23.2	544	2.5U	10.1	7490
179-C-JC	6260	1.7J	84.2	48.9	0.83	4.2	841	3.3	9.5	130	30100	1780	1300	2010	0.042J	5.6	1240	2.1J	5.1	56.5J	2.5U	9.2	898
180-C-DG	8200	0.8J	105	72.2	0.56	7	1020	5.3	7	217	37600	2550	2040	2710	0.045J	5.3	1020	5	8.2	52.2J	2.5U	14.6	1330
181-C-DG	2750	5.5J	213	68.4	0.45J	24.3	686	2.5	7.4	544	51900	5550	755	4330	0.084J	5	1310	14.9	22.1	63.8J	2.5U	8.9	4520
182-C-JC	7680	5.9U	69.4	73.9	0.54	1.5	600	5.2	6.5	145	32600	2750	1410	698	0.095U	5.4	1560	8.2	12.2	63.6J	2.5U	15.4	366
183-C-JC	7780	5.9U	13.7	165	0.35J	0.59	2400	6.3	5.7	13.5	13200	94.4	1760	769	0.094J	5.4	1860	3.5U	0.67J	69.7J	2.5U	18.1	148
18-C-DG	2780	10.3	233	46.6	0.44J	60.1	600	1.4	11.5	1040	78900	13300	750	3820	0.19	1.8J	1410	43.4	63.5	629	2.5U	6.2	8380
192-C-MB	8240	5.9U	125	156	2	0.74	3550	2.9	12.7	37.3	36200	103	1420	2420	0.072J	9.7	1990	3.4U	0.87J	61.7J	2.5U	10.5	233
194-C-2-6-MB	9110	6U	8	127	0.53	0.43J	1920	4.2	5.9	7.1	15100	29.1	1840	350	0.065J	4.1	1340	3.5U	0.27J	68.3J	2.5U	12.7	69.8
194-C-6-18-M	9880	6U	10.6	104	0.61	0.54	1620	4.2	5J	8.3	14100	36.6	1610	182	0.051J	3.8J	1150	3.5U	0.33J	75.6J	2.5U	13.4	61.6
19-C-DG	6510	6.7	196	99.3	0.99	10.7	1110	2.8	26.5	744	70100	12300	1040	10700	0.2	4.3	1290	26.6	34.7	130J	2.5U	11.1	2970
20-C-DG	4280	11.5	308	114	0.38J	0.5U	686	1.8	0.6J	636	79000	11000	495J	476	0.08J	1.8J	2020	29.5	38.3	500U	2.5U	7.6	853
21-C-DG	1900	28.8	443	81.8	0.56	107	330J	0.71J	9.6	1820	150000	0.99U	309J	3180	0.11	1.7J	1690	66.3	96.8	1060	2.5U	5.3	20100
22-C-DG	4970	16.1	181	140	1.3	55.3	951	2.5	19.2	1370	82600	30500	1220	8400	0.11	5.3	1810	43.7	67	636	2.5U	8.2	9330
23-C-DG	4700	7	114	49.8	1.3	22.2	2570	3	18	954	57800	12700	1160	3510	0.084J	5.9	1280	23.8	37.1	59.1J	2.5U	7.3	3690
24-C-DG	13800	5.9J	123	59	6.1	44.8	1510	27.2	24.8	2730	126000	11900	1740	6440	0.11	17.1	1180	28.4	52.6	608	2.5U	10.1	9700
25-C-DG	10000	6.8	250	63.7	4.1	0.5U	441J	58.1	35.1	1110	120000	8920	210J	7410	0.04J	6.2	1190	7.9	26.9	500U	2.5U	9.7	2310
26-C-DG	9200	6U	51.3	64.2	2.2	33.6	2750	12.9	8.9	762	63900	3260	1420	1520	0.081J	16.2	1100	3.7	17.4	295J	2.5U	19.2	4850
27-C-DG	3700	2.8J	55.8	57	0.64	0.5U	342J	5.3	8.7	163	34000	2360	517	2420	0.094J	4.2	808	4.3	6.5	218J	2.5U	7.4	542
29-C-JC	8200	6U	29.9	130	1.3	4	1430	9.3	8.5	116	26300	840	1580	2740	0.076J	7.8	1150	3.5U	2	112J	2.5U	14	558
30-C-MB	8790	5.9U	12.1	187	2.1	7	4030	7.2	7.2	64.5	11700	1440	1760	2780	0.11	7.6	1170	3.5U	1	151J	2.5U	13.3	759
30-C-MBD	11600	5.9U	12.2	175	2.3	6.2	3550	8.8	8.1	80.5	13500	1350	2380	3100	0.08J	9.3	1350	3.4U	0.97J	101J	2.5U	16	745
35-C-DG	5660	2.8J	142	101	0.43J	3.7	1360	4.9	6.3	206	61000	2200	1380	1310	0.048J	4.5	1240	10	16	102J	2.5U	9.8	1490
36-C-DG	2890	6.5	262	83	1	10.1	618	4.5	10.9	618	76100	12500	812	3190	0.066J	5.3	1350	23.4	37.3	150J	2.5U	7.2	3320
37-C-DG	3880	2.3J	71.2	155	0.93	5.1	1660	7	13.8	144	27900	1980	1300	6010	0.1U	13.5	1100	1.6J	4.9	141J	2.5U	5.8	1220
38-C-DG	2560	3J	78.3	60.3	1.1	2.6	968	3.7	5.6	160	33500	2850	758	3720	0.095U	5.3	2070	3.9	8.1	139J	2.5U	6.5	945
39-C-DG	3710	9.5	307	73	0.8	30.1	619	6.8	10.9	790	93200	16600	1060	5260	0.1	8.6	1260	28.4	59.2	303J	2.5U	7.4	6530
40-C-DG	4870	4.4J	223	61.8	0.92	39.9	948	8.8	14.6	666	61500	9720	1330	6900	0.074J	11.8	1260	15.9	31.7	441J	2.5U	8.4	7980
41-C-DG	3660	4.9J	278	90.1	0.82	11	901	6.1	7.2	341	45300	5410	714	2590	0.067J	4.9	1170	9.8	17.1	146J	2.5U	7.9	2270
42-C-DG	5590	1.9J	34.4	121	0.63	14.9	1300	6.8	9.6	184	23500	3030	1260	2850	0.04J	6.9	1080	3.3J	8	201J	2.5U	13.9	2500
43-C-DG	3220	2.5J	72.6	46.7	0.45J	0.5U	632	5.3	2.7J	98.2	26000	1260	454J	447	0.058J	2.8J	996	1.7J	2.3	95.6J	2.5U	7.4	470
44-C-2-6-JC	4320	6U	18.1	112	0.32J	0.5U	1640	5.2	4.4J	21	12200	238	690	792	0.03J	3.5J	1030	3.5U	0.54J	88.4J	2.5U	11.1	156
44-C-6-18-JC	5460	5.9U	21	124	0.41J	0.5U	1770	5.6	5.7	26	14200	335	787	995	0.1U	4.2	983	3.5U	0.74J	82.6J	2.5U	11.8	207
44-C-DG	4330	1.7J	35.3	115	0.35J	0.5U	1360	4.6	3.7J	36.5	15800	549	679	917	0.044J	3J	1170	3.5U	1.1	104J	2.5U	11.6	244
48-C-MB	7810	5.9U	36.3	63.5	0.45J	0.49U	696	6.8	6.2	106	24900	1170	1820	1290	0.052J	5.5	856	2.7J	3.9	76.5J	2.5U	13.8	577
49-C-DG	8320	5.9U	22.1	120	0.51	2.4	824	7.7	10.2	73.9	18900	372	1710	2180	0.034J	6.6	886	3.4U	0.82J	168J	2.5U	14.2	709
50-C-JC	7990	6U	30.3	94.6	0.5J	1.3	1140	7.4	8	89.2	21300	691	1620	1560	0.1U	6	951	3.5U	1.4	102J	2.5U	14.3	582
51-C-JC	6710	1.9J	56	60.4	0.38J	0.5U	833	5.7	6.4	179	39600	1190	1560	1460	0.052J	4.5	1090	4.6	6.1	65.9J	2.5U	10.9	578
52-C-JC	6380	6U	52.9	62.1	0.43J	2.6	1060	10.2	6.9	172	35600	1580	1630	1730	0.045J	7.3	1290	4.5	6.4	118J	2.5U	11.4	1020
53-C-JC	4220	3.1J	122	66.2	0.8	14.5	626	3.4	12	355	53300	4970	1060	7210	0.1	5.1	861	11.6	17.8	158J	2.5U	8.2	3140
54-C-JC	966	15.2	290	55	0.49U	2.8	175J	1.6	2.3J	2400	42400	63500	198J	218	0.11	0.55J	663	47.9	106	141J	2.5U	3J	1220
55-C-JC	1820	14.6	360	51.1	0.87	3.4	427J	4.3	3.8J	980	86600	15900	240J	1160	0.12	3.2J	676	36.8	46.8	88.3J	2.5U	8.1	2160
56-C-JC	1510	16.6	680	84.1	0.68	8.3	476J	1.1	4.9J	1090	111999	25700	220J	2050	0.082J	2.8J	1750	38.6	66	113J	2.5U	7.8	2860
57-C-JC	7750	6U	22.7	113	0.45J	4.2	3530	8	6.1	38.3	15400	521	1810	1560	0.063J	6.9	1650	3.5U	1.1	67.2J	2.5U	17	749
58-C-JC	10300	6U	18.3	106	0.74	1.3	3200	8.2	7.9	17.3	16100	115	2680	1490	0.07J	9.6	1580	3.5U	0.64J	78.6J	2.5U	20	219
59-C-JC	8470	6U	10.4	161	0.4J	1.6	2510	6.5	7.2	15	12500	131	2080	1410	0.086J	6.8	1420	3.5U	0.63J	76.2J	2.5U	18.8	197
64-C-2-6-JC	8590	5.9U	12.8	154	0.41J	0.78	2350	4.8	5.7	13.9	14500	141	1830	829	0.042J	4.4	1250	3.5U	0.56J	64.2J	2.5U	14.6	195
64-C-6-18-JC	9780	5.9U	12.1	127	0.49	0.98	1410	5.3	6.5	18.8	15200	145	1930	914	0.05J	4.3	1370	3.4U	0.59J	66.4J	2.5U	15.3	229
65-C-JC	2420	6.2	280	39.4	0.46J	10.9	230J	2	9.4	327	63400	2540	528	1900	0.078J	2.6J	849	10.5	16.7	43.5J	2.5U	5.2	2560

Table 5.0-18 Total Metals - July 2006 Soil Anlayzed by Laboratory

Location	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc
70-C-JC	4490	0.92J	98.1	31.4	0.66	11.3	594	3.3	10.7	450	38100	3600	996	2900	0.045J	3.6J	957	8.3	15.4	67.8J	2.5U	7.5	2010
71-C-JC	5390	1.6J	227	114	0.61	2.8	342J	4	7	463	35100	5380	1090	1190	0.14	3.8J	1730	9.4	16.6	79J	2.5U	13.2	493
72-C-JC	6680	1.1J	63	70.8	0.52	13.3	439J	4.8	9.6	217	35300	2800	1480	2400	0.095U	5.1	872	6	9.3	81.3J	2.5U	14.3	2580
73-C-JC	6260	5.9U	62.6	32.9	0.5	1.1	638	4.1	6.4	62.1	20800	854	1230	888	0.04J	5.2	911	2.4J	4.5	66.7J	2.5U	9.9	270
80-C-MB	4570	5.9U	60	118	0.53	15.2	3180	4	8	320	38600	1580	1410	1780	0.13	5	1100	5.6	10.6	82.5J	2.5U	8.7	2230
81-C-MB	6850	5.9U	75.3	190	0.44J	8	4760	4.1	8.5	198	26100	1130	1840	2590	0.14	4.9	1500	2.3J	5.8	77.1J	2.5U	11.6	1090
82-C-2-6-MB	11600	6U	19.9	171	1.6	8.1	3470	8.8	11.2	51.2	15400	690	2670	3010	0.047J	9.3	1510	3.5U	0.72J	97.7J	2.5U	17.9	728
82-C-6-18-MB	5820	6U	62.6	85.8	0.76	4.9	3260	2.7	6.5	43.7	17800	592	1200	1440	0.05J	4.4	718	1.1J	1.8	58.4J	2.5U	8.7	665
83-C-JC	4890	6U	14.1	192	0.29J	2.9	3950	4.2	6.3	29	9920	268	1380	1620	0.1	4.6	1370	3.5U	0.76J	67J	2.5U	11.1	415
84-C-JC	9180	6U	34.1	153	1.3	14.8	1820	8.9	12.2	110	38000	1510	3060	9590	0.062J	13.5	1180	1.6J	4.7	207J	2.5U	14.6	3940
85-C-JC	4290	6U	8.4	488	0.24J	2	11700	6.2	4.5J	33.3	6360	173	1730	2960	0.29	7	1730	3.5U	0.75J	119J	2.5U	9.3	572
9-C-2-6-JC	9090	5.9U	28.9	80	0.71	0.5U	2320	5.7	9.2	12.8	19800	54.8	1600	720	0.1U	5.9	1660	3.5U	0.99U	495U	2.5U	11.8	102
9-C-6-18-JC	7640	5.9U	36.8	79.1	1.2	0.5U	2420	6	19	42	43700	76.3	1260	1440	0.1U	15.8	1520	1.6J	0.99U	495U	2.5U	12.4	407

Notes:

J - Estimated value due to anlayte detection between the Method Reporting Limit and Detection Limit.

U - Analyte not detected. Reported value is less than (<) the detection limit.

All units are milligrams per kilogram dry weight, unless otherwise indicated.

Table 5.0-19 Comparison of XRF and Laboratory Total Metals Results for Soil - July 2006

	Analyte of Interest				
Parameter	**Arsenic**	**Cadmium**	**Copper**	**Lead**	**Zinc**
Average RPD	41%	63%	25%	13%	35%
Number of Samples	154	16	169	87	87
R^2 Value	0.9	0.83	0.88	0.82	0.94
Associated p Value	<0.001	<0.001	<0.001	<0.001	<0.001

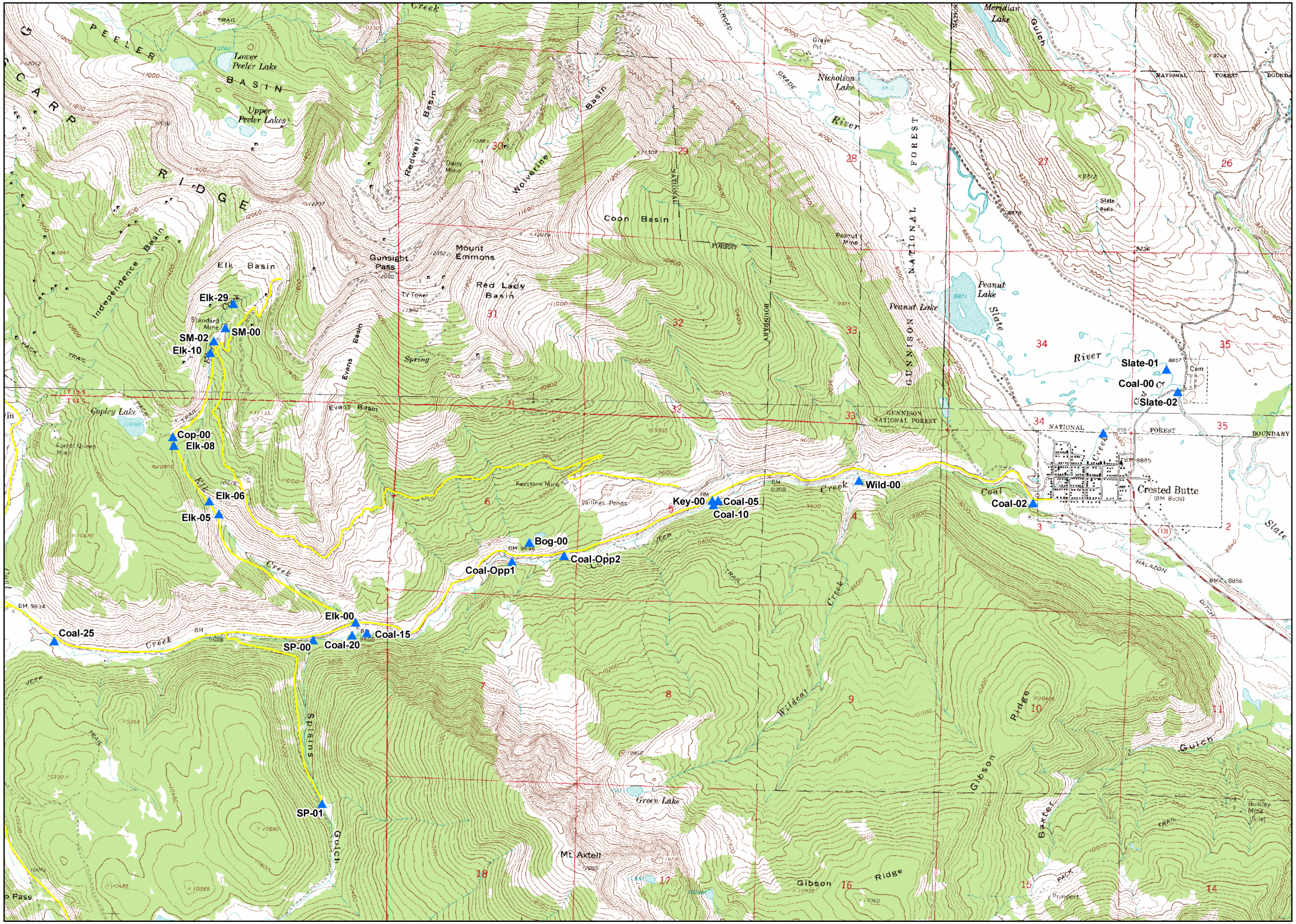
Notes:

RPD - Relative Percent Difference

RPD and correlation evaluations were performed using only detections.

Figures

Standard Mine 2006 Sampling Locations Figure 2.0-1



Legend

- ▲ Stream Locations
- Tailings
- Water_Bodies
- Road

Location of Standard Mine

In Gunnison County, Colorado

N S W E

0 0.25 0.5 1

Miles

UTM Zone 13 North

TechLaw

EPA United States Environmental Protection Agency

Figure 2.8-1 Soil Sample Design Phase 1

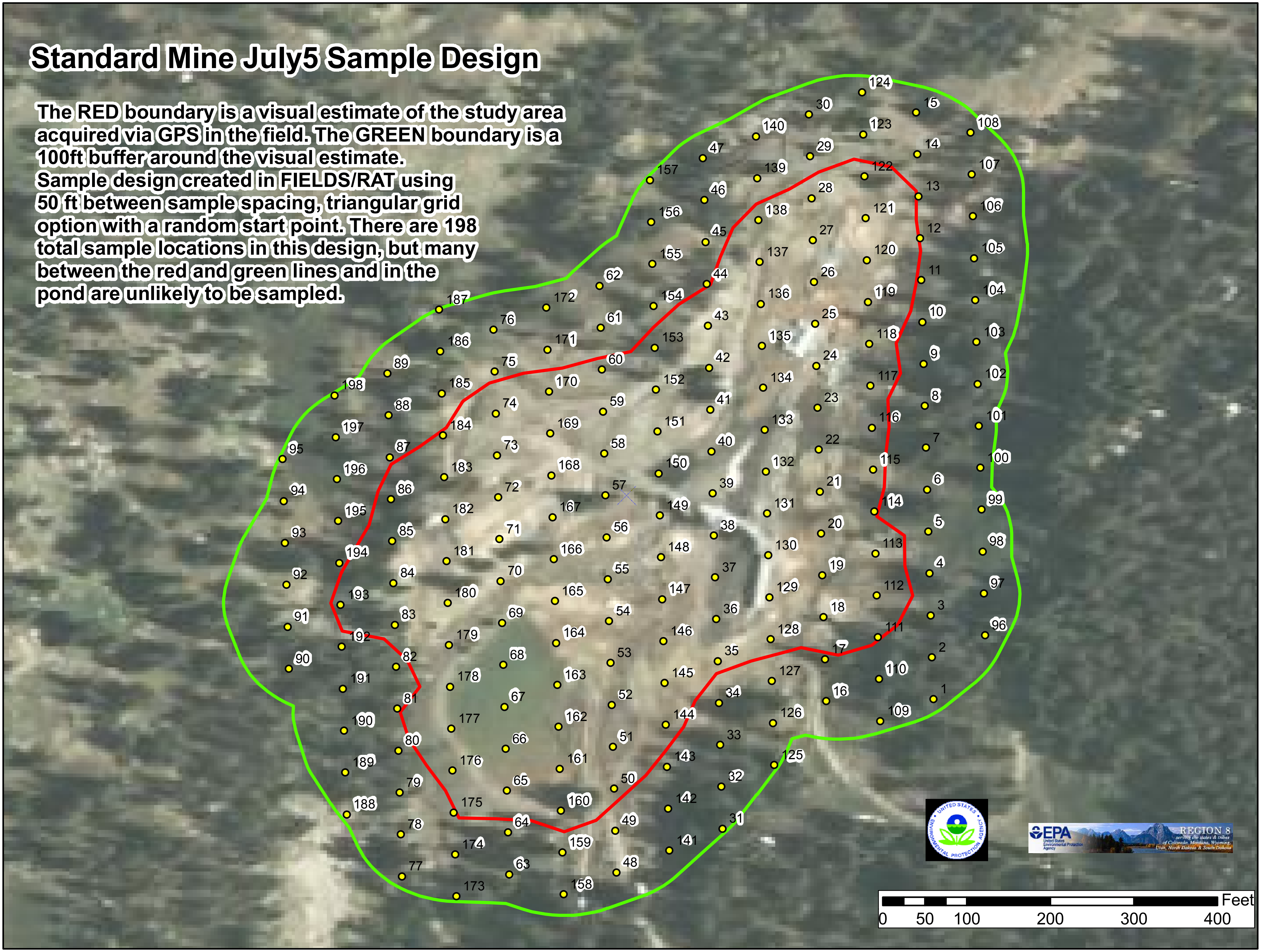
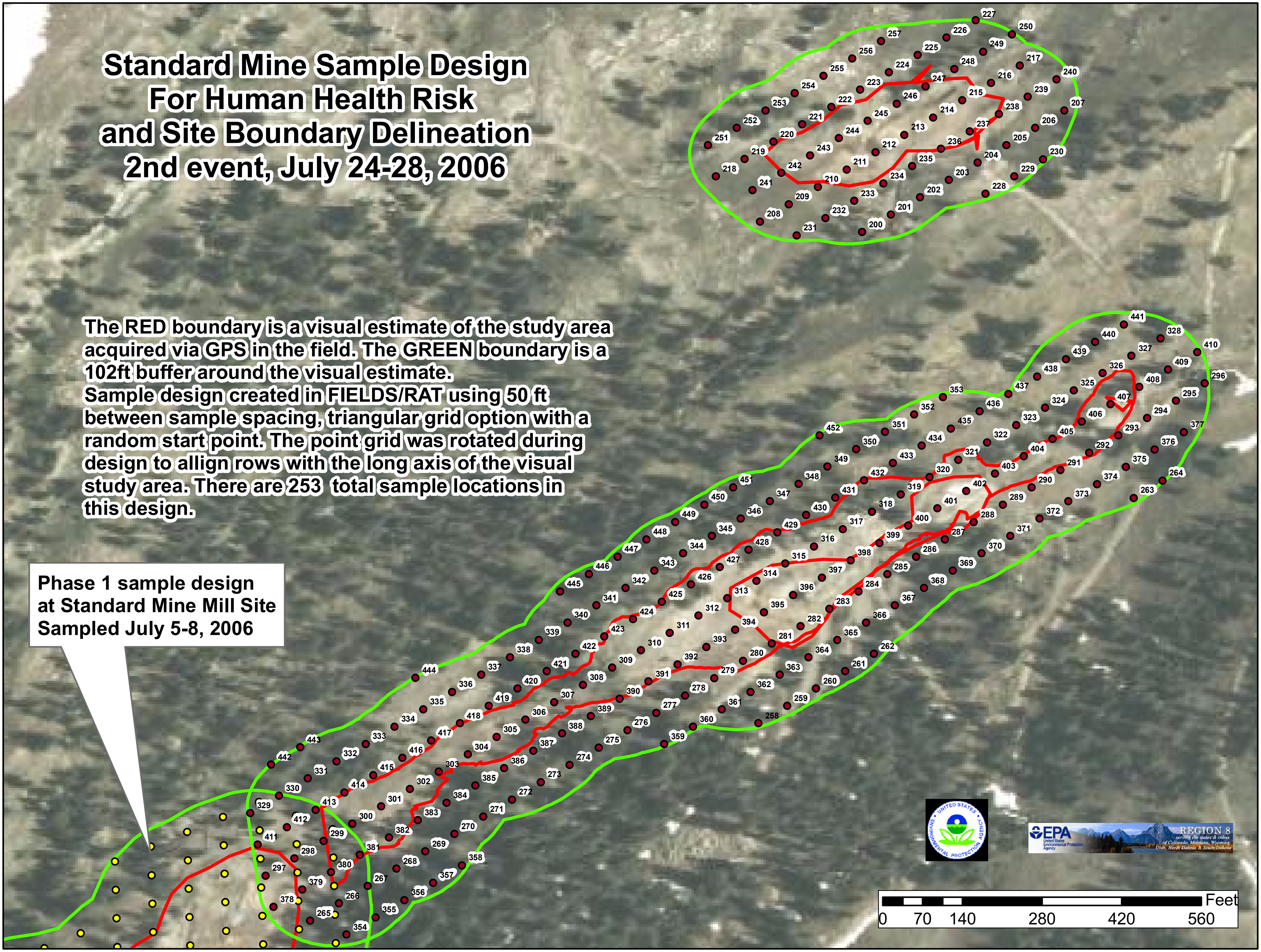


Figure 2.8-2 Soil Sample Design Phase 2



Appendix A
Macroinvertebrate Assemblage Results

MACROINVERTEBRATE RESULTS
July 2006 Sampling Event
Standard Mine, Colorado

Analyzed for:
U.S. Environmental Protection Agency, Region 8
Ecosystems Protection and Remediation, Program Support

Analyzed by:
GEI Consultants Inc. / Chadwick Ecological Division
5575 South Sycamore Street, Suite 101
Littleton, CO 80120

Under Subcontract with:
Syracuse Research Corporation
Environmental Science Center
999 18th Street, Suite 1975, North Tower
Denver, CO 80202

MACROINVERTEBRATE DENSITY
CLIENT: SYRACUSE RESEARCH
SITE: COAL-00
SAMPLED: 07/17/06

TAXA		REP 1
INSECTA		
EPHEMEROPTERA		**190**
Baetidae	Acentrella sp.	56
Baetidae	Baetis tricaudatus	72
Ephemerellidae	Drunella doddsi	6
Heptageniidae	Cinygmula sp.	20
Heptageniidae	Epeorus deceptivus	8
Heptageniidae	Epeorus longimanus	18
Heptageniidae	Rhithrogena robusta	10
PLECOPTERA		**48**
Chloroperlidae	Suwallia sp.	30
Nemouridae	Zapada oregonensis gr.	10
Perlidae	Hesperoperla pacifica	4
Perlodidae	Megarcys signata	4
COLEOPTERA		**74**
Elmidae	Heterlimnius corpulentus	42
Elmidae	Narpus concolor	14
Elmidae	Zaitzevia parvula	18
TRICHOPTERA		**28**
Brachycentridae	Micrasema bactro	2
Hydropsychidae	Arctopsyche grandis	6
Hydropsychidae	Hydropsyche sp.	2
Lepidostomatidae	Lepidostoma sp.	10
Rhyacophilidae	Rhyacophila brunnea/vao	4
Rhyacophilidae	Rhyacophila sibirica gr.	4
DIPTERA		**230**
Chironomidae	Cricotopus sp.	8
Chironomidae	Diamesa sp.	7
Chironomidae	Eukiefferiella sp.	8
Chironomidae	Micropsectra sp.	7
Chironomidae	Orthocladius (Euorthocladius) sp.	7
Chironomidae	Orthocladius/Cricotopus gr.	138
Chironomidae	Unid. Orthocladiinae	7
Chironomidae	Psilometriocnemus sp.	7
Chironomidae	Tvetenia sp.	29
Simuliidae	Simulium sp.	10
Tipulidae	Dicranota sp.	2
TOTAL (#/sample)		570

NUMBER OF TAXA	31
SHANNON-WEAVER (H')	4.02
TOTAL EPT TAXA	17
EPT INDEX (% of Total Taxa)	55
EPHEMEROPTERA ABUNDANCE (% of Total Sample)	33

# EPHEMEROPTERA	7
# PLECOPTERA TAXA	4
# TRICHOPTERA TAXA	6
% EPT (% of total density)	46.7
# INTOLERANT TAXA	20
TOLERANT ORGANISMS (% of total density)	28
DOMINANT TAXA (% of total density)	24.2
FILTERS (% of total density)	3.2
SCRAPER (% of total density)	9.1
CLINGER TAXA (#)	20
CLINGER (% of total density)	62.8

MACROINVERTEBRATE DENSITY
CLIENT: SYRACUSE RESEARCH
SITE: COAL-05
SAMPLED: 07/17/06

TAXA		REP 1
INSECTA		
EPHEMEROPTERA		**206**
Ameletidae	Ameletus sp.	4
Baetidae	Acentrella sp.	4
Baetidae	Baetis bicaudatus	12
Baetidae	Baetis tricaudatus	103
Ephemerellidae	Drunella coloradensis	1
Ephemerellidae	Drunella doddsi	3
Heptageniidae	Cinygmula sp.	40
Heptageniidae	Epeorus deceptivus	25
Heptageniidae	Epeorus longimanus	5
Heptageniidae	Rhithrogena robusta	9
PLECOPTERA		**28**
Chloroperlidae	Suwallia sp.	11
Nemouridae	Zapada oregonensis gr.	14
Perlodidae	Megarcys signata	3
COLEOPTERA		**9**
Elmidae	Heterlimnius corpulentus	8
Elmidae	Narpus concolor	1
TRICHOPTERA		**7**
Brachycentridae	Micrasema bactro	1
Rhyacophilidae	Rhyacophila brunnea/vao	4
Rhyacophilidae	Rhyacophila sibirica gr.	2
DIPTERA		**28**
Chironomidae	Conchapelopia/Thienemannimyia s	3
Chironomidae	Corynoneura sp.	1
Chironomidae	Diamesa sp.	7
Chironomidae	Eukiefferiella sp.	1
Chironomidae	Micropsectra sp.	1
Chironomidae	Orthocladius/Cricotopus gr.	2
Chironomidae	Tvetenia sp.	12
Empididae	Oreogeton sp.	1
ANNELIDA		
OLIGOCHAETA		**1**
Enchytraeidae	Enchytraeidae	1

TOTAL (#/sample)	279
NUMBER OF TAXA	27
SHANNON-WEAVER (H')	3.39
TOTAL EPT TAXA	16
EPT INDEX (% of Total Taxa)	59
EPHEMEROPTERA ABUNDANCE (% of Total Sample)	74

# EPHEMEROPTERA	10
# PLECOPTERA TAXA	3
# TRICHOPTERA TAXA	3
% EPT (% of total density)	86.4
# INTOLERANT TAXA	16
TOLERANT ORGANISMS (% of total density)	6
DOMINANT TAXA (% of total density)	36.9
FILTERS (% of total density)	0
SCRAPER (% of total density)	26.2
CLINGER TAXA (#)	15
CLINGER (% of total density)	49.8

MACROINVERTEBRATE DENSITY
CLIENT: SYRACUSE RESEARCH
SITE: COAL-10
SAMPLED: 07/17/06

TAXA		REP 1
INSECTA		
EPHEMEROPTERA		**69**
Ameletidae	Ameletus sp.	2
Baetidae	Baetis bicaudatus	2
Baetidae	Baetis tricaudatus	18
Heptageniidae	Cinygmula sp.	30
Heptageniidae	Epeorus deceptivus	11
Heptageniidae	Epeorus longimanus	4
Heptageniidae	Rhithrogena robusta	2
PLECOPTERA		**24**
Chloroperlidae	Suwallia sp.	17
Leuctridae	Perlomyia utahensis	1
Nemouridae	Zapada oregonensis gr.	5
Perlodidae	Megarcys signata	1
HEMIPTERA		**1**
Saldidae	Saldidae	1
COLEOPTERA		**14**
Elmidae	Heterlimnius corpulentus	12
Elmidae	Narpus concolor	2
TRICHOPTERA		**11**
Brachycentridae	Micrasema bactro	1
Glossosomatidae	Glossosoma sp.	1
Rhyacophilidae	Rhyacophila brunnea/vao	3
Rhyacophilidae	Rhyacophila rotunda gr.	1
Rhyacophilidae	Rhyacophila sibirica gr.	5
DIPTERA		**14**
Chironomidae	Conchapelopia/Thienemannimyia s	1
Chironomidae	Diamesa sp.	5
Chironomidae	Polypedilum sp.	1
Empididae	Oreogeton sp.	3
Simuliidae	Prosimulium sp.	4
ANNELIDA		
OLIGOCHAETA		**6**
Enchytraeidae	Enchytraeidae	6

TOTAL (#/sample)	139
NUMBER OF TAXA	25
SHANNON-WEAVER (H')	3.83
TOTAL EPT TAXA	16
EPT INDEX (% of Total Taxa)	64
EPHEMEROPTERA ABUNDANCE (% of Total Sample)	50

# EPHEMEROPTERA	7
# PLECOPTERA TAXA	4
# TRICHOPTERA TAXA	5
% EPT (% of total density)	74.8
# INTOLERANT TAXA	17
TOLERANT ORGANISMS (% of total density)	5
DOMINANT TAXA (% of total density)	21.6
FILTERS (% of total density)	2.9
SCRAPER (% of total density)	33.1
CLINGER TAXA (#)	15
CLINGER (% of total density)	71.2

MACROINVERTEBRATE DENSITY
CLIENT: SYRACUSE RESEARCH
SITE: COAL-15
SAMPLED: 07/18/06

TAXA		REP 1
INSECTA		
EPHEMEROPTERA		**256**
Ameletidae	Ameletus sp.	1
Baetidae	Acentrella sp.	3
Baetidae	Baetis bicaudatus	54
Baetidae	Baetis tricaudatus	61
Ephemerellidae	Drunella doddsi	7
Ephemerellidae	Drunella grandis	4
Ephemerellidae	Ephemerella dorothea	1
Heptageniidae	Cinygmula sp.	86
Heptageniidae	Epeorus deceptivus	10
Heptageniidae	Epeorus longimanus	9
Heptageniidae	Rhithrogena robusta	20
PLECOPTERA		**50**
Chloroperlidae	Suwallia sp.	37
Nemouridae	Zapada oregonensis gr.	11
Perlidae	Hesperoperla pacifica	1
Perlodidae	Skwala americana	1
COLEOPTERA		**11**
Dytiscidae	Agabus sp.	1
Elmidae	Heterlimnius corpulentus	10
TRICHOPTERA		**17**
Brachycentridae	Micrasema bactro	1
Rhyacophilidae	Rhyacophila brunnea/vao	13
Rhyacophilidae	Rhyacophila sibirica gr.	3
DIPTERA		**67**
Chironomidae	Cricotopus sp.	5
Chironomidae	Diamesa sp.	8
Chironomidae	Orthocladius/Cricotopus gr.	25
Chironomidae	Pagastia sp.	6
Chironomidae	Polypedilum sp.	5
Chironomidae	Potthastia gaedii gr.	2
Chironomidae	Rheocricotopus sp.	6
Chironomidae	Tvetenia sp.	6
Empididae	Oreogeton sp.	3
Simuliidae	Simulium sp.	1
TOTAL (#/sample)		401
NUMBER OF TAXA		30

SHANNON-WEAVER (H')	3.81
TOTAL EPT TAXA	18
EPT INDEX (% of Total Taxa)	60
EPHEMEROPTERA ABUNDANCE	
(% of Total Sample)	64

# EPHEMEROPTERA	11
# PLECOPTERA TAXA	4
# TRICHOPTERA TAXA	3
% EPT (% of total density)	80.5
# INTOLERANT TAXA	18
TOLERANT ORGANISMS (% of total density)	8
DOMINANT TAXA (% of total density)	21.4
FILTERS (% of total density)	0.2
SCRAPER (% of total density)	27.9
CLINGER TAXA (#)	18
CLINGER (% of total density)	61.1

MACROINVERTEBRATE DENSITY
CLIENT: SYRACUSE RESEARCH
SITE: COAL-20
SAMPLED: 07/18/06

TAXA		REP 1
INSECTA		
EPHEMEROPTERA		**119**
Ameletidae	Ameletus sp.	2
Baetidae	Acentrella sp.	1
Baetidae	Baetis bicaudatus	1
Baetidae	Baetis tricaudatus	10
Heptageniidae	Cinygmula sp.	44
Heptageniidae	Epeorus deceptivus	5
Heptageniidae	Epeorus longimanus	10
Heptageniidae	Rhithrogena robusta	46
PLECOPTERA		**37**
Chloroperlidae	Suwallia sp.	25
Chloroperlidae	Sweltsa sp.	3
Nemouridae	Zapada oregonensis gr.	6
Perlidae	Hesperoperla pacifica	2
Perlodidae	Megarcys signata	1
COLEOPTERA		**18**
Elmidae	Heterlimnius corpulentus	17
Elmidae	Zaitzevia parvula	1
TRICHOPTERA		**5**
Brachycentridae	Brachycentrus americanus	1
Limnephilidae	Psychoglypha sp.	2
Rhyacophilidae	Rhyacophila brunnea/vao	1
Rhyacophilidae	Rhyacophila sibirica gr.	1
DIPTERA		**25**
Chironomidae	Cricotopus bicinctus	2
Chironomidae	Cricotopus sp.	4
Chironomidae	Micropsectra sp.	5
Chironomidae	Orthocladius/Cricotopus gr.	5
Chironomidae	Parametriocnemus sp.	2
Chironomidae	Polypedilum sp.	2
Chironomidae	Rheocricotopus sp.	2
Simuliidae	Simuliidae	1
Tipulidae	Hexatoma sp.	2
HYDRACARINA		**1**
Lebertiidae	Lebertia sp.	1
ANNELIDA		

OLIGOCHAETA		**2**
Enchytraeidae	Enchytraeidae	2

TOTAL (#/sample)	207
NUMBER OF TAXA	30
SHANNON-WEAVER (H')	3.70
TOTAL EPT TAXA	17
EPT INDEX (% of Total Taxa)	57
EPHEMEROPTERA ABUNDANCE (% of Total Sample)	57

# EPHEMEROPTERA '	8
# PLECOPTERA TAXA	5
# TRICHOPTERA TAXA	4
% EPT (% of total density)	77.8
# INTOLERANT TAXA	18
TOLERANT ORGANISMS (% of total density)	9
DOMINANT TAXA (% of total density)	22.2
FILTERS (% of total density)	1
SCRAPER (% of total density)	28.5
CLINGER TAXA (#)	18
CLINGER (% of total density)	84.5

MACROINVERTEBRATE DENSITY
CLIENT: SYRACUSE RESEARCH
SITE: COAL-25
SAMPLED: 07/20/06

TAXA		REP 1
INSECTA		
EPHEMEROPTERA		**150**
Baetidae	Acentrella sp.	3
Baetidae	Baetidae	10
Baetidae	Baetis tricaudatus	107
Heptageniidae	Cinygmula sp.	20
Heptageniidae	Epeorus longimanus	10
PLECOPTERA		**16**
Chloroperlidae	Suwallia sp.	10
Nemouridae	Zapada oregonensis gr.	3
Perlodidae	Skwala americana	3
COLEOPTERA		**360**
Elmidae	Heterlimnius corpulentus	333
Elmidae	Optioservus sp.	7
Elmidae	Zaitzevia parvula	20
TRICHOPTERA		**10**
Brachycentridae	Micrasema bactro	3
Lepidostomatidae	Lepidostoma sp.	7
DIPTERA		**288**
Chironomidae	Conchapelopia/Thienemannimyia s	9
Chironomidae	Cricotopus sp.	10
Chironomidae	Orthocladius/Cricotopus gr.	55
Chironomidae	Unid. Orthocladiinae	9
Chironomidae	Pagastia sp.	9
Chironomidae	Potthastia gaedii gr.	9
Chironomidae	Tvetenia sp.	166
Simuliidae	Prosimulium sp.	13
Simuliidae	Simulium sp.	7
Tipulidae	Hexatoma sp.	1
ANNELIDA		
OLIGOCHAETA		**15**
Enchytraeidae	Enchytraeidae	7
Lumbriculidae	Lumbriculidae	1
Naididae	Nais sp.	7
TOTAL (#/sample)		839

NUMBER OF TAXA	26
SHANNON-WEAVER (H')	2.99
TOTAL EPT TAXA	10
EPT INDEX (% of Total Taxa)	38
EPHEMEROPTERA ABUNDANCE (% of Total Sample)	18

# EPHEMEROPTERA	5
# PLECOPTERA TAXA	3
# TRICHOPTERA TAXA	2
% EPT (% of total density)	21
# INTOLERANT TAXA	15
TOLERANT ORGANISMS (% of total density)	10
DOMINANT TAXA (% of total density)	39.7
FILTERS (% of total density)	2.4
SCRAPER (% of total density)	4.4
CLINGER TAXA (#)	13
CLINGER (% of total density)	59.4

MACROINVERTEBRATE DENSITY
CLIENT: SYRACUSE RESEARCH
SITE: COAL-OPP2
SAMPLED: 07/18/06

TAXA		REP 1
INSECTA		
EPHEMEROPTERA		**153**
Ameletidae	Ameletus sp.	6
Baetidae	Baetis bicaudatus	6
Baetidae	Baetis tricaudatus	41
Ephemerellidae	Drunella doddsi	1
Ephemerellidae	Drunella grandis	3
Heptageniidae	Cinygmula sp.	69
Heptageniidae	Epeorus deceptivus	21
Heptageniidae	Epeorus longimanus	6
Heptageniidae	Rhithrogena sp.	1
PLECOPTERA		**58**
Chloroperlidae	Suwallia sp.	41
Nemouridae	Zapada oregonensis gr.	17
COLEOPTERA		**69**
Dytiscidae	Oreodytes sp.	1
Elmidae	Heterlimnius corpulentus	61
Elmidae	Narpus concolor	7
TRICHOPTERA		**18**
Brachycentridae	Brachycentrus americanus	1
Brachycentridae	Micrasema bactro	6
Hydropsychidae	Arctopsyche grandis	6
Rhyacophilidae	Rhyacophila brunnea/vao	4
Rhyacophilidae	Rhyacophila sibirica gr.	1
DIPTERA		**127**
Chironomidae	Cricotopus sp.	16
Chironomidae	Orthocladius/Cricotopus gr.	87
Chironomidae	Unid. Orthocladiinae	4
Chironomidae	Pagastia sp.	4
Chironomidae	Thienemanniella sp.	5
Chironomidae	Tvetenia sp.	4
Simuliidae	Simulium sp.	6
Tipulidae	Tipulidae	1
HYDRACARINA		**19**
Lebertiidae	Lebertia sp.	4
Protziidae	Protzia sp.	1
Sperchontidae	Sperchon sp.	4
Sperchontidae	Sperchonopsis sp.	10

TOTAL (#/sample)	445
NUMBER OF TAXA	31
SHANNON-WEAVER (H')	3.81
TOTAL EPT TAXA	16
EPT INDEX (% of Total Taxa)	52
EPHEMEROPTERA ABUNDANCE (% of Total Sample)	35

# EPHEMEROPTERA	9
# PLECOPTERA TAXA	2
# TRICHOPTERA TAXA	5
% EPT (% of total density)	51.7
# INTOLERANT TAXA	18
TOLERANT ORGANISMS (% of total density)	27
DOMINANT TAXA (% of total density)	19.6
FILTERS (% of total density)	2.9
SCRAPER (% of total density)	21.8
CLINGER TAXA (#)	18
CLINGER (% of total density)	79.6

MACROINVERTEBRATE DENSITY
CLIENT: SYRACUSE RESEARCH
SITE: COP-01
SAMPLED: 07/18/06

TAXA		REP 1
INSECTA		
EPHEMEROPTERA		**165**
Baetidae	Baetis tricaudatus	150
Heptageniidae	Cinygmula sp.	15
PLECOPTERA		**45**
Chloroperlidae	Suwallia sp.	5
Chloroperlidae	Sweltsa sp.	5
Perlodidae	Isoperla sp.	35
COLEOPTERA		**30**
Elmidae	Heterlimnius corpulentus	30
TRICHOPTERA		**25**
Lepidostomatidae	Lepidostoma sp.	5
Limnephilidae	Psychoglypha sp.	15
Rhyacophilidae	Rhyacophila brunnea/vao	5
DIPTERA		**1185**
Chironomidae	Micropsectra sp.	983
Chironomidae	Orthocladius/Cricotopus gr.	119
Chironomidae	Pseudodiamesa sp.	39
Chironomidae	Tvetenia sp.	39
Simuliidae	Simulium sp.	5
TURBELLARIA		**110**
Planariidae	Girardia sp.	110
ANNELIDA		
OLIGOCHAETA		**5**
Enchytraeidae	Enchytraeidae	5
MOLLUSCA		
PELECYPODA		**20**
Sphaeriidae	Pisidium sp.	20
TOTAL (#/sample)		1585
NUMBER OF TAXA		17

SHANNON-WEAVER (H')	2.15
TOTAL EPT TAXA	8
EPT INDEX (% of Total Taxa)	47
EPHEMEROPTERA ABUNDANCE (% of Total Sample)	10

# EPHEMEROPTERA '	2
# PLECOPTERA TAXA	3
# TRICHOPTERA TAXA	3
% EPT (% of total density)	14.8
# INTOLERANT TAXA	9
TOLERANT ORGANISMS (% of total density)	71
DOMINANT TAXA (% of total density)	62
FILTERS (% of total density)	1.6
SCRAPER (% of total density)	0.9
CLINGER TAXA (#)	8
CLINGER (% of total density)	13.8

MACROINVERTEBRATE DENSITY
CLIENT: SYRACUSE RESEARCH
SITE: ELK-00
SAMPLED: 07/18/06

TAXA		REP 1
INSECTA		
EPHEMEROPTERA		**246**
Baetidae	Baetis bicaudatus	218
Ephemerellidae	Drunella doddsi	8
Heptageniidae	Epeorus deceptivus	3
Heptageniidae	Rhithrogena robusta	17
PLECOPTERA		**10**
Chloroperlidae	Sweltsa sp.	1
Nemouridae	Amphinemura banksi	1
Nemouridae	Zapada oregonensis gr.	7
Perlodidae	Megarcys signata	1
LEPIDOPTERA		**2**
Lepidoptera	Unid. Lepidoptera	2
TRICHOPTERA		**14**
Hydropsychidae	Arctopsyche grandis	6
Lepidostomatidae	Lepidostoma sp.	1
Rhyacophilidae	Rhyacophila hyalinata gr.	4
Rhyacophilidae	Rhyacophila rotunda gr.	3
DIPTERA		**21**
Chironomidae	Corynoneura sp.	2
Chironomidae	Eukiefferiella sp.	1
Chironomidae	Parametriocnemus sp.	3
Chironomidae	Psilometriocnemus sp.	10
Chironomidae	Thienemanniella sp.	1
Chironomidae	Tvetenia sp.	8
Empididae	Neoplasta sp.	1
Simuliidae	Prosimulium sp.	2
Tipulidae	Hexatoma sp.	1
TURBELLARIA		**7**
Planariidae	Girardia sp.	7
TOTAL (#/sample)		308
NUMBER OF TAXA		23
SHANNON-WEAVER (H')		2.01
TOTAL EPT TAXA		12
EPT INDEX (% of Total Taxa)		52
EPHEMEROPTERA ABUNDANCE		

(% of Total Sample)	80

# EPHEMEROPTERA '	4
# PLECOPTERA TAXA	4
# TRICHOPTERA TAXA	4
% EPT (% of total density)	87.7
# INTOLERANT TAXA	14
TOLERANT ORGANISMS (% of total density)	1
DOMINANT TAXA (% of total density)	70.8
FILTERS (% of total density)	2.6
SCRAPER (% of total density)	3.6
CLINGER TAXA (#)	10
CLINGER (% of total density)	16.9

MACROINVERTEBRATE DENSITY
CLIENT: SYRACUSE RESEARCH
SITE: ELK-05
SAMPLED: 07/19/06

TAXA		REP 1
INSECTA		
EPHEMEROPTERA		**400**
Baetidae	Baetis bicaudatus	400
PLECOPTERA		**18**
Chloroperlidae	Sweltsa sp.	5
Nemouridae	Zapada oregonensis gr.	10
Perlodidae	Megarcys signata	3
TRICHOPTERA		**64**
Apataniidae	Allomyia sp.	18
Hydropsychidae	Arctopsyche grandis	1
Rhyacophilidae	Rhyacophila hyalinata gr.	45
DIPTERA		**214**
Chironomidae	Diamesa sp.	38
Chironomidae	Eukiefferiella sp.	25
Chironomidae	Micropsectra sp.	6
Chironomidae	Orthocladius/Cricotopus gr.	7
Chironomidae	Unid. Orthocladiinae	6
Chironomidae	Psilometriocnemus sp.	75
Chironomidae	Tvetenia sp.	31
Empididae	Clinocera sp.	8
Empididae	Neoplasta sp.	5
Simuliidae	Prosimulium sp.	13
TURBELLARIA		**13**
Planariidae	Girardia sp.	13
TOTAL (#/sample)		709
NUMBER OF TAXA		18
SHANNON-WEAVER (H')		2.49
TOTAL EPT TAXA		7
EPT INDEX (% of Total Taxa)		39
EPHEMEROPTERA ABUNDANCE (% of Total Sample)		56

# EPHEMEROPTERA '	1
# PLECOPTERA TAXA	3
# TRICHOPTERA TAXA	3
% EPT (% of total density)	68

# INTOLERANT TAXA	8
TOLERANT ORGANISMS (% of total density)	10
DOMINANT TAXA (% of total density)	56.4
FILTERS (% of total density)	2
SCRAPER (% of total density)	0
CLINGER TAXA (#)	9
CLINGER (% of total density)	15.5

MACROINVERTEBRATE DENSITY
CLIENT: SYRACUSE RESEARCH
SITE: ELK-06
SAMPLED: 07/19/06

TAXA		REP 1
INSECTA		
EPHEMEROPTERA		**15**
Baetidae	Baetis bicaudatus	15
TRICHOPTERA		**3**
Limnephilidae	Psychoglypha sp.	3
DIPTERA		**57**
Chironomidae	Corynoneura sp.	2
Chironomidae	Micropsectra sp.	32
Chironomidae	Orthocladius/Cricotopus gr.	5
Chironomidae	Unid. Orthocladiinae	2
Chironomidae	Parametriocnemus sp.	2
Chironomidae	Psilometriocnemus sp.	14
TURBELLARIA		**6**
Planariidae	Girardia sp.	6
TOTAL (#/sample)		81
NUMBER OF TAXA		9
SHANNON-WEAVER (H')		2.52 **
TOTAL EPT TAXA		2
EPT INDEX (% of Total Taxa)		22
EPHEMEROPTERA ABUNDANCE (% of Total Sample)		19

** Should be interpreted cautiously when total abundance is less than 100 organisms

# EPHEMEROPTERA '	1
# PLECOPTERA TAXA	0
# TRICHOPTERA TAXA	1
% EPT (% of total density)	22.2
# INTOLERANT TAXA	2
TOLERANT ORGANISMS (% of total density)	48
DOMINANT TAXA (% of total density)	39.5
FILTERS (% of total density)	0
SCRAPER (% of total density)	0
CLINGER TAXA (#)	1
CLINGER (% of total density)	6.2

MACROINVERTEBRATE DENSITY
CLIENT: SYRACUSE RESEARCH
SITE: ELK-08
SAMPLED: 07/19/06

TAXA		REP 1
INSECTA		
EPHEMEROPTERA		**7**
Baetidae	Baetis bicaudatus	2
Baetidae	Baetis tricaudatus	5
PLECOPTERA		**1**
Nemouridae	Amphinemura banksi	1
TRICHOPTERA		**3**
Limnephilidae	Psychoglypha sp.	3
DIPTERA		**50**
Chironomidae	Diamesa sp.	18
Chironomidae	Eukiefferiella sp.	2
Chironomidae	Orthocladius/Cricotopus gr.	2
Chironomidae	Unid. Orthocladiinae	1
Chironomidae	Pseudodiamesa sp.	1
Chironomidae	Psilometriocnemus sp.	15
Chironomidae	Stempellinella sp.	1
Chironomidae	Tvetenia sp.	3
Simuliidae	Prosimulium sp.	2
Simuliidae	Simulium sp.	5
TURBELLARIA		**2**
Planariidae	Girardia sp.	2
TOTAL (#/sample)		63
NUMBER OF TAXA		15
SHANNON-WEAVER (H')		3.18 **
TOTAL EPT TAXA		4
EPT INDEX (% of Total Taxa)		27
EPHEMEROPTERA ABUNDANCE (% of Total Sample)		11

** Should be interpreted cautiously when total abundance is less than 100 organisms

# EPHEMEROPTERA	2
# PLECOPTERA TAXA	1
# TRICHOPTERA TAXA	1
% EPT (% of total density)	17.5
# INTOLERANT TAXA	5
TOLERANT ORGANISMS (% of total density)	6

DOMINANT TAXA (% of total density)	28.6
FILTERS (% of total density)	11.1
SCRAPER (% of total density)	0
CLINGER TAXA (#)	3
CLINGER (% of total density)	14.3

MACROINVERTEBRATE DENSITY
CLIENT: SYRACUSE RESEARCH
SITE: ELK-29
SAMPLED: 07/19/06

TAXA		REP 1
INSECTA		
EPHEMEROPTERA		**22**
Ameletidae	Ameletus sp.	5
Baetidae	Baetis bicaudatus	5
Baetidae	Baetis tricaudatus	1
Heptageniidae	Cinygmula sp.	11
PLECOPTERA		**30**
Chloroperlidae	Sweltsa sp.	14
Leuctridae	Leuctridae	2
Nemouridae	Zapada cinctipes	8
Perlidae	Hesperoperla pacifica	6
TRICHOPTERA		**29**
Limnephilidae	Psychoglypha sp.	3
Rhyacophilidae	Rhyacophila hyalinata gr.	2
Uenoidae	Neothremma alicia	24
DIPTERA		**165**
Ceratopogonidae	Ceratopogoninae	1
Chironomidae	Corynoneura sp.	5
Chironomidae	Heleniella sp.	5
Chironomidae	Larsia (?) sp.	5
Chironomidae	Micropsectra sp.	18
Chironomidae	Rheocricotopus sp.	5
Chironomidae	Stempellinella sp.	53
Chironomidae	Thienemanniella sp.	5
Chironomidae	Tvetenia sp.	42
Empididae	Neoplasta sp.	9
Empididae	Oreogeton sp.	11
Simuliidae	Prosimulium sp.	6
TURBELLARIA		**15**
Planariidae	Girardia sp.	15
ANNELIDA		
OLIGOCHAETA		**235**
Enchytraeidae	Enchytraeidae	235
TOTAL (#/sample)		496
NUMBER OF TAXA		25

SHANNON-WEAVER (H')	3.05
TOTAL EPT TAXA	11
EPT INDEX (% of Total Taxa)	44
EPHEMEROPTERA ABUNDANCE (% of Total Sample)	4

# EPHEMEROPTERA	4
# PLECOPTERA TAXA	4
# TRICHOPTERA TAXA	3
% EPT (% of total density)	16.3
# INTOLERANT TAXA	12
TOLERANT ORGANISMS (% of total density)	52
DOMINANT TAXA (% of total density)	47.4
FILTERS (% of total density)	1.2
SCRAPER (% of total density)	7.1
CLINGER TAXA (#)	5
CLINGER (% of total density)	7.9

MACROINVERTEBRATE DENSITY
CLIENT: SYRACUSE RESEARCH
SITE: SP-00
SAMPLED: 07/18/06

TAXA		REP 1
INSECTA		
EPHEMEROPTERA		**180**
Ameletidae	Ameletus sp.	1
Baetidae	Baetis bicaudatus	11
Baetidae	Baetis tricaudatus	5
Ephemerellidae	Drunella doddsi	3
Heptageniidae	Cinygmula sp.	79
Heptageniidae	Epeorus deceptivus	33
Heptageniidae	Epeorus longimanus	4
Heptageniidae	Rhithrogena robusta	44
PLECOPTERA		**41**
Chloroperlidae	Suwallia sp.	18
Chloroperlidae	Sweltsa sp.	10
Nemouridae	Zapada cinctipes	1
Nemouridae	Zapada oregonensis gr.	4
Perlidae	Hesperoperla pacifica	8
COLEOPTERA		**19**
Elmidae	Heterlimnius corpulentus	19
TRICHOPTERA		**24**
Hydropsychidae	Arctopsyche grandis	1
Lepidostomatidae	Lepidostoma sp.	1
Rhyacophilidae	Rhyacophila brunnea/vao	6
Rhyacophilidae	Rhyacophila sibirica gr.	16
DIPTERA		**79**
Ceratopogonidae	Ceratopogoninae	1
Chironomidae	Conchapelopia/Thienemannimyia s	2
Chironomidae	Corynoneura sp.	2
Chironomidae	Micropsectra sp.	6
Chironomidae	Pagastia sp.	2
Chironomidae	Parametriocnemus sp.	6
Chironomidae	Rheocricotopus sp.	11
Chironomidae	Stempellinella sp.	23
Chironomidae	Tvetenia sp.	11
Empididae	Oreogeton sp.	10
Simuliidae	Prosimulium sp.	5
HYDRACARINA		**1**
Protziidae	Protzia sp.	1

ANNELIDA		
OLIGOCHAETA		**44**
Enchytraeidae	Enchytraeidae	44

TOTAL (#/sample)	388
NUMBER OF TAXA	31
SHANNON-WEAVER (H')	4.04
TOTAL EPT TAXA	17
EPT INDEX (% of Total Taxa)	55
EPHEMEROPTERA ABUNDANCE (% of Total Sample)	46

# EPHEMEROPTERA	8
# PLECOPTERA TAXA	5
# TRICHOPTERA TAXA	4
% EPT (% of total density)	63.1
# INTOLERANT TAXA	19
TOLERANT ORGANISMS (% of total density)	14
DOMINANT TAXA (% of total density)	20.4
FILTERS (% of total density)	1.5
SCRAPER (% of total density)	30.7
CLINGER TAXA (#)	14
CLINGER (% of total density)	64.4

MACROINVERTEBRATE DENSITY
CLIENT: SYRACUSE RESEARCH
SITE: SP-01
SAMPLED: 07/18/06

TAXA		REP 1
INSECTA		
EPHEMEROPTERA		**179**
Ameletidae	Ameletus sp.	3
Baetidae	Baetis bicaudatus	70
Ephemerellidae	Ephemerella dorothea	5
Heptageniidae	Cinygmula sp.	73
Heptageniidae	Epeorus deceptivus	5
Heptageniidae	Epeorus longimanus	3
Heptageniidae	Rhithrogena robusta	20
PLECOPTERA		**74**
Chloroperlidae	Sweltsa sp.	20
Leuctridae	Leuctridae	5
Nemouridae	Zapada cinctipes	18
Nemouridae	Zapada oregonensis gr.	20
Perlidae	Hesperoperla pacifica	11
COLEOPTERA		**25**
Elmidae	Heterlimnius corpulentus	25
TRICHOPTERA		**19**
Rhyacophilidae	Rhyacophila brunnea/vao	8
Rhyacophilidae	Rhyacophila rotunda gr.	3
Uenoidae	Neothremma alicia	8
DIPTERA		**501**
Chironomidae	Cricotopus bicinctus	16
Chironomidae	Eukiefferiella sp.	33
Chironomidae	Larsia (?) sp.	16
Chironomidae	Orthocladius (Euorthocladius) sp.	16
Chironomidae	Orthocladius/Cricotopus gr.	160
Chironomidae	Pagastia sp.	80
Chironomidae	Parametriocnemus sp.	16
Chironomidae	Rheocricotopus sp.	33
Chironomidae	Tvetenia sp.	113
Empididae	Clinocera sp.	3
Empididae	Oreogeton sp.	5
Simuliidae	Prosimulium sp.	10
ANNELIDA		
OLIGOCHAETA		**30**
Enchytraeidae	Enchytraeidae	30

TOTAL (#/sample)	828
NUMBER OF TAXA	29
SHANNON-WEAVER (H')	4.02
TOTAL EPT TAXA	15
EPT INDEX (% of Total Taxa)	52
EPHEMEROPTERA ABUNDANCE (% of Total Sample)	22

# EPHEMEROPTERA	7
# PLECOPTERA TAXA	5
# TRICHOPTERA TAXA	3
% EPT (% of total density)	32.9
# INTOLERANT TAXA	17
TOLERANT ORGANISMS (% of total density)	29
DOMINANT TAXA (% of total density)	19.3
FILTERS (% of total density)	1.2
SCRAPER (% of total density)	10.7
CLINGER TAXA (#)	15
CLINGER (% of total density)	46.1

GEI Consultants
Chadwick Ecological Division

Geotechnical
Water Resources
Environmental and
Ecological Services

January 25, 2007

Ms. Janet Burris
Syracuse Research Corporation
Environmental Science Center
999 18th Street, Suite 1975, North Tower
Denver, CO 80202

Dear Ms. Burris:

Enclosed are the results of the analyses of the 15 benthic macroinvertebrates samples collected September 11-13, 2006 from Colorado. Data are reported as number of organisms per sample. The invertebrates were identified to species level where possible. In addition, we have sorted organisms by family as requested.

A reference collection has been started and will be updated as needed and kept here. The taxa are being sent to experts for verification.

If you have any questions regarding these data, please do not hesitate to call.

Sincerely,

GEI Consultants Inc. / Chadwick Ecological Division

Steven P. Canton
President

Enclosures

www.geiconsultants.com

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303.794.5530 fax: 303.794.5041

MACROINVERTEBRATE DENSITY
CLIENT: SYRACUSE RESEARCH
SITE: COAL-00
SAMPLED: 09/11/06

TAXA		REP 1
INSECTA		
EPHEMEROPTERA		**67**
Ameletidae	Ameletus sp.	6
Baetidae	Baetis tricaudatus	6
Ephemerellidae	Drunella doddsi	1
Heptageniidae	Epeorus longimanus	1
Heptageniidae	Rhithrogena robusta	53
PLECOPTERA		**64**
Chloroperlidae	Sweltsa sp.	55
Nemouridae	Zapada cinctipes	5
Nemouridae	Zapada oregonensis gr.	4
COLEOPTERA		**27**
Dytiscidae	Liodessus obscurellus	1
Dytiscidae	Oreodytes sp.	1
Elmidae	Heterlimnius corpulentus	17
Elmidae	Optioservus castanipennis	4
Elmidae	Zaitzevia parvula	4
TRICHOPTERA		**16**
Hydropsychidae	Arctopsyche grandis	10
Lepidostomatidae	Lepidostoma sp.	3
Rhyacophilidae	Rhyacophila brunnea gr.	1
Rhyacophilidae	Rhyacophila pellisa	1
Uenoidae	Oligophlebodes minutus	1
DIPTERA		**8**
Chironomidae	Chironomidae	7
Tipulidae	Hexatoma sp.	1
HYDRACARINA		**5**
Protziidae	Protzia sp.	3
Sperchontidae	Sperchon sp.	2

MACROINVERTEBRATE DENSITY
CLIENT: SYRACUSE RESEARCH
SITE: COAL-00
SAMPLED: 09/11/06

TAXA	REP 1
TOTAL DENSITY (#/sample)	187
NUMBER OF TAXA	22
SHANNON-WEAVER (H')	3.15
TOTAL EPT TAXA	13
EPT INDEX (% of Total Taxa)	59
EPHEMEROPTERA ABUNDANCE (% of Total Number)	36.0
# EPHEMEROPTERA TAXA	5
# PLECOPTERA TAXA	3
# TRICHOPTERA TAXA	5
% EPT (% of Total Number)	78.6
# INTOLERANT TAXA	16
TOLERANT ORGANISMS (% of Total Number)	2.7
DOMINANT TAXON (% of Total Number)	29
FILTERERS (% of Total Number)	5.3
SCRAPERS (% of Total Number)	3.7
# CLINGER TAXA	12
CLINGERS (% of Total Number)	81.3

MACROINVERTEBRATE DENSITY
CLIENT: SYRACUSE RESEARCH
SITE: COAL-05
SAMPLED: 09/11/06

TAXA		REP 1
INSECTA		
EPHEMEROPTERA		**80**
Ameletidae	Ameletus sp.	40
Baetidae	Baetis bicaudatus	6
Baetidae	Baetis tricaudatus	21
Ephemerellidae	Drunella doddsi	1
Heptageniidae	Rhithrogena robusta	12
PLECOPTERA		**11**
Chloroperlidae	Sweltsa sp.	1
Nemouridae	Zapada oregonensis gr.	4
Perlodidae	Cultus aestivalis	2
Perlodidae	Isoperla sp.	1
Perlodidae	Megarcys signata	1
Perlodidae	Skwala americana	2
COLEOPTERA		**55**
Elmidae	Heterlimnius corpulentus	52
Elmidae	Narpus concolor	3
TRICHOPTERA		**10**
Hydropsychidae	Arctopsyche grandis	7
Glossosomatidae	Glossosoma sp.	1
Rhyacophilidae	Rhyacophila brunnea gr.	2
DIPTERA		**23**
Ceratopogonidae	Ceratopogoninae	3
Chironomidae	Chironomidae	16
Empididae	Oreogeton sp.	3
Tipulidae	Rhabdomastix sp.	1
ANNELIDA		
OLIGOCHAETA		**23**
Enchytraeidae	Enchytraeidae	23

MACROINVERTEBRATE DENSITY
CLIENT: SYRACUSE RESEARCH
SITE: COAL-05
SAMPLED: 09/11/06

TAXA	REP 1
TOTAL DENSITY (#/sample)	202
NUMBER OF TAXA	21
SHANNON-WEAVER (H')	3.32
TOTAL EPT TAXA	14
EPT INDEX (% of Total Taxa)	67
EPHEMEROPTERA ABUNDANCE (% of Total Number)	39.6
# EPHEMEROPTERA TAXA	5
# PLECOPTERA TAXA	6
# TRICHOPTERA TAXA	3
% EPT (% of Total Number)	50.0
# INTOLERANT TAXA	14
TOLERANT ORGANISMS (% of Total Number)	11.9
DOMINANT TAXON (% of Total Number)	25.7
FILTERERS (% of Total Number)	3.5
SCRAPERS (% of Total Number)	1.0
# CLINGER TAXA	13
CLINGERS (% of Total Number)	44.1

MACROINVERTEBRATE DENSITY
CLIENT: SYRACUSE RESEARCH
SITE: COAL-10
SAMPLED: 09/12/06

TAXA		REP 1
INSECTA		
EPHEMEROPTERA		**61**
Ameletidae	Ameletus sp.	8
Baetidae	Acentrella sp.	1
Baetidae	Baetis bicaudatus	20
Baetidae	Baetis tricaudatus	20
Ephemerellidae	Drunella doddsi	3
Heptageniidae	Cinygmula sp.	1
Heptageniidae	Rhithrogena robusta	8
PLECOPTERA		**31**
Chloroperlidae	Sweltsa sp.	4
Nemouridae	Zapada oregonensis gr.	23
Perlidae	Hesperoperla pacifica	1
Perlodidae	Megarcys signata	3
COLEOPTERA		**39**
Elmidae	Heterlimnius corpulentus	38
Elmidae	Narpus concolor	1
TRICHOPTERA		**32**
Brachycentridae	Micrasema bactro	15
Glossosomatidae	Glossosoma sp.	1
Hydropsychidae	Arctopsyche grandis	8
Rhyacophilidae	Rhyacophila brunnea gr.	7
Rhyacophilidae	Rhyacophila hyalinata gr.	1
DIPTERA		**35**
Ceratopogonidae	Ceratopogoninae	1
Chironomidae	Chironomidae	32
Simuliidae	Simulium sp.	1
Tipulidae	Hexatoma sp.	1
HYDRACARINA		**7**
Protziidae	Protzia sp.	6
Sperchontidae	Sperchon sp.	1
ANNELIDA		
OLIGOCHAETA		**43**
Enchytraeidae	Enchytraeidae	43

MACROINVERTEBRATE DENSITY
CLIENT: SYRACUSE RESEARCH
SITE: COAL-10
SAMPLED: 09/12/06

TAXA	REP 1
TOTAL DENSITY (#/sample)	248
NUMBER OF TAXA	25
SHANNON-WEAVER (H')	3.71
TOTAL EPT TAXA	16
EPT INDEX (% of Total Taxa)	64
EPHEMEROPTERA ABUNDANCE (% of Total Number)	24.6
# EPHEMEROPTERA TAXA	7
# PLECOPTERA TAXA	4
# TRICHOPTERA TAXA	5
% EPT (% of Total Number)	50.0
# INTOLERANT TAXA	17
TOLERANT ORGANISMS (% of Total Number)	20.2
DOMINANT TAXON (% of Total Number)	17.3
FILTERERS (% of Total Number)	3.6
SCRAPERS (% of Total Number)	2.0
# CLINGER TAXA	15
CLINGERS (% of Total Number)	46.4

MACROINVERTEBRATE DENSITY
CLIENT: SYRACUSE RESEARCH
SITE: COAL-15
SAMPLED: 09/12/06

TAXA		REP 1
INSECTA		
EPHEMEROPTERA		**138**
Ameletidae	Ameletus sp.	2
Baetidae	Baetis bicaudatus	2
Baetidae	Baetis tricaudatus	38
Ephemerellidae	Drunella doddsi	26
Heptageniidae	Rhithrogena robusta	68
Leptophlebiidae	Paraleptophlebia sp.	2
PLECOPTERA		**30**
Chloroperlidae	Sweltsa sp.	6
Nemouridae	Zapada cinctipes	4
Nemouridae	Zapada oregonensis gr.	12
Perlidae	Hesperoperla pacifica	2
Perlodidae	Megarcys signata	2
Perlodidae	Skwala americana	4
COLEOPTERA		**55**
Elmidae	Cleptelmis sp.	5
Elmidae	Heterlimnius corpulentus	50
TRICHOPTERA		**39**
Hydropsychidae	Arctopsyche grandis	27
Rhyacophilidae	Rhyacophila brunnea gr.	4
Rhyacophilidae	Rhyacophila hyalinata gr.	2
Rhyacophilidae	Rhyacophila pellisa	4
Rhyacophilidae	Rhyacophila sp.	2
DIPTERA		**148**
Chironomidae	Chironomidae	140
Empididae	Oreogeton sp.	6
Tipulidae	Hexatoma sp.	2
HYDRACARINA		**2**
Sperchontidae	Sperchon sp.	2
TURBELLARIA		**2**
Planariidae	Polycelis coronata	2
ANNELIDA		
OLIGOCHAETA		**10**
Enchytraeidae	Enchytraeidae	10

MACROINVERTEBRATE DENSITY
CLIENT: SYRACUSE RESEARCH
SITE: COAL-15
SAMPLED: 09/12/06

TAXA	REP 1
TOTAL DENSITY (#/sample)	424
NUMBER OF TAXA	25
SHANNON-WEAVER (H')	3.27
TOTAL EPT TAXA	17
EPT INDEX (% of Total Taxa)	68
EPHEMEROPTERA ABUNDANCE (% of Total Number)	32.5
# EPHEMEROPTERA TAXA	6
# PLECOPTERA TAXA	6
# TRICHOPTERA TAXA	5
% EPT (% of Total Number)	48.8
# INTOLERANT TAXA	19
TOLERANT ORGANISMS (% of Total Number)	2.8
DOMINANT TAXON (% of Total Number)	33.0
FILTERERS (% of Total Number)	6.4
SCRAPERS (% of Total Number)	6.1
# CLINGER TAXA	14
CLINGERS (% of Total Number)	50.5

MACROINVERTEBRATE DENSITY
CLIENT: SYRACUSE RESEARCH
SITE: COAL-20
SAMPLED: 09/12/06

TAXA		REP 1
INSECTA		
EPHEMEROPTERA		**97**
Ameletidae	Ameletus sp.	13
Baetidae	Baetis tricaudatus	22
Ephemerellidae	Ephemerella dorothea/excrucians	4
Heptageniidae	Cinygmula sp.	4
Heptageniidae	Epeorus longimanus	2
Heptageniidae	Rhithrogena robusta	52
PLECOPTERA		**53**
Chloroperlidae	Sweltsa sp.	20
Nemouridae	Zapada cinctipes	4
Perlidae	Hesperoperla pacifica	7
Perlodidae	Cultus aestivalis	4
Perlodidae	Skwala americana	18
COLEOPTERA		**246**
Elmidae	Cleptelmis sp.	4
Elmidae	Heterlimnius corpulentus	236
Elmidae	Narpus concolor	2
Elmidae	Optioservus castanipennis	2
Elmidae	Zaitzevia parvula	2
TRICHOPTERA		**67**
Brachycentridae	Micrasema bactro	14
Hydropsychidae	Arctopsyche grandis	29
Rhyacophilidae	Rhyacophila brunnea gr.	12
Rhyacophilidae	Rhyacophila pellisa	2
Rhyacophilidae	Rhyacophila sp.	4
Uenoidae	Oligophlebodes minutus	6
DIPTERA		**194**
Ceratopogonidae	Ceratopogoninae	6
Chironomidae	Chironomidae	168
Psychodidae	Pericoma sp.	12
Tipulidae	Dicranota sp.	2
Tipulidae	Hexatoma sp.	6
HYDRACARINA		**20**
Hydryphantidae	Hydryphantidae	2
Protziidae	Protzia sp.	12
Sperchontidae	Sperchon sp.	6
ANNELIDA		
OLIGOCHAETA		**10**
Enchytraeidae	Enchytraeidae	10

MACROINVERTEBRATE DENSITY
CLIENT: SYRACUSE RESEARCH
SITE: COAL-20
SAMPLED: 09/12/06

TAXA	REP 1
TOTAL DENSITY (#/sample)	687
NUMBER OF TAXA	31
SHANNON-WEAVER (H')	3.30
TOTAL EPT TAXA	17
EPT INDEX (% of Total Taxa)	55
EPHEMEROPTERA ABUNDANCE (% of Total Number)	14.1
# EPHEMEROPTERA TAXA	6
# PLECOPTERA TAXA	5
# TRICHOPTERA TAXA	6
% EPT (% of Total Number)	31.6
# INTOLERANT TAXA	24
TOLERANT ORGANISMS (% of Total Number)	4.4
DOMINANT TAXON (% of Total Number)	34.4
FILTERERS (% of Total Number)	4.2
SCRAPERS (% of Total Number)	2.0
# CLINGER TAXA	19
CLINGERS (% of Total Number)	61.7

MACROINVERTEBRATE DENSITY
CLIENT: SYRACUSE RESEARCH
SITE: COAL-25
SAMPLED: 09/12/06

TAXA		REP 1
INSECTA		
EPHEMEROPTERA		**312**
Ameletidae	Ameletus sp.	37
Baetidae	Baetis tricaudatus	13
Ephemerellidae	Drunella doddsi	23
Ephemerellidae	Drunella grandis	7
Ephemerellidae	Ephemerella dorothea/excrucians	30
Heptageniidae	Heptageniidae	53
Heptageniidae	Rhithrogena robusta	1
Leptophlebiidae	Paraleptophlebia sp.	148
PLECOPTERA		**30**
Chloroperlidae	Sweltsa sp.	20
Nemouridae	Zapada cinctipes	3
Perlodidae	Isoperla sp.	3
Perlodidae	Megarcys signata	3
Perlodidae	Skwala americana	1
COLEOPTERA		**597**
Elmidae	Cleptelmis sp.	3
Elmidae	Heterlimnius corpulentus	551
Elmidae	Narpus concolor	3
Elmidae	Optioservus castanipennis	20
Elmidae	Zaitzevia parvula	20
TRICHOPTERA		**57**
Brachycentridae	Brachycentrus americanus	3
Brachycentridae	Micrasema bactro	13
Hydropsychidae	Arctopsyche grandis	41
DIPTERA		**44**
Chironomidae	Chironomidae	30
Empididae	Oreogeton sp.	3
Tipulidae	Hexatoma sp.	11
HYDRACARINA		**6**
Protziidae	Protzia sp.	3
Sperchontidae	Sperchon sp.	3

MACROINVERTEBRATE DENSITY
CLIENT: SYRACUSE RESEARCH
SITE: COAL-25
SAMPLED: 09/12/06

TAXA	REP 1
TOTAL DENSITY (#/sample)	1046
NUMBER OF TAXA	26
SHANNON-WEAVER (H')	2.71
TOTAL EPT TAXA	16
EPT INDEX (% of Total Taxa)	62
EPHEMEROPTERA ABUNDANCE (% of Total Number)	29.8
# EPHEMEROPTERA TAXA	8
# PLECOPTERA TAXA	5
# TRICHOPTERA TAXA	3
% EPT (% of Total Number)	38.1
# INTOLERANT TAXA	21
TOLERANT ORGANISMS (% of Total Number)	0.6
DOMINANT TAXON (% of Total Number)	52.7
FILTERERS (% of Total Number)	4.2
SCRAPERS (% of Total Number)	9.2
# CLINGER TAXA	17
CLINGERS (% of Total Number)	76.0

MACROINVERTEBRATE DENSITY
CLIENT: SYRACUSE RESEARCH
SITE: COAL-OPP2
SAMPLED: 09/12/06

TAXA		REP 1
INSECTA		
EPHEMEROPTERA		**40**
Ameletidae	Ameletus sp.	5
Baetidae	Baetis bicaudatus	4
Baetidae	Baetis tricaudatus	7
Ephemerellidae	Drunella doddsi	1
Heptageniidae	Rhithrogena robusta	23
PLECOPTERA		**35**
Chloroperlidae	Haploperla sp.	1
Chloroperlidae	Sweltsa sp.	12
Leuctridae	Perlomyia utahensis	1
Nemouridae	Zapada cinctipes	2
Nemouridae	Zapada oregonensis gr.	10
Perlodidae	Cultus aestivalis	1
Perlodidae	Megarcys signata	6
Perlodidae	Skwala americana	2
COLEOPTERA		**58**
Dytiscidae	Stictotarsus sp.	1
Elmidae	Cleptelmis sp.	1
Elmidae	Heterlimnius corpulentus	55
Elmidae	Narpus concolor	1
TRICHOPTERA		**23**
Brachycentridae	Micrasema bactro	1
Glossosomatidae	Glossosoma sp.	1
Hydropsychidae	Arctopsyche grandis	13
Lepidostomatidae	Lepidostoma sp.	1
Rhyacophilidae	Rhyacophila brunnea gr.	7
DIPTERA		**26**
Chironomidae	Chironomidae	21
Psychodidae	Pericoma sp.	2
Tipulidae	Hexatoma sp.	3
HYDRACARINA		**1**
Protziidae	Protzia sp.	1

MACROINVERTEBRATE DENSITY
CLIENT: SYRACUSE RESEARCH
SITE: COAL-OPP2
SAMPLED: 09/12/06

TAXA	REP 1
TOTAL DENSITY (#/sample)	183
NUMBER OF TAXA	26
SHANNON-WEAVER (H')	3.56
TOTAL EPT TAXA	18
EPT INDEX (% of Total Taxa)	69
EPHEMEROPTERA ABUNDANCE (% of Total Number)	21.9
# EPHEMEROPTERA TAXA	5
# PLECOPTERA TAXA	8
# TRICHOPTERA TAXA	5
% EPT (% of Total Number)	53.6
# INTOLERANT TAXA	21
TOLERANT ORGANISMS (% of Total Number)	0.5
DOMINANT TAXON (% of Total Number)	30.1
FILTERERS (% of Total Number)	7.1
SCRAPERS (% of Total Number)	1.1
# CLINGER TAXA	15
CLINGERS (% of Total Number)	73.8

MACROINVERTEBRATE DENSITY
CLIENT: SYRACUSE RESEARCH
SITE: ELK-00
SAMPLED: 09/12/06

TAXA		REP 1
INSECTA		
EPHEMEROPTERA		**101**
Baetidae	Baetis tricaudatus	28
Ephemerellidae	Drunella doddsi	1
Heptageniidae	Rhithrogena robusta	72
PLECOPTERA		**10**
Capniidae	Capniidae	4
Chloroperlidae	Sweltsa sp.	1
Nemouridae	Zapada oregonensis gr.	4
Perlodidae	Megarcys signata	1
COLEOPTERA		**2**
Elmidae	Heterlimnius corpulentus	2
TRICHOPTERA		**32**
Hydropsychidae	Parapsyche elsis	7
Limnephilidae	Limnephilidae	1
Rhyacophilidae	Rhyacophila hyalinata gr.	4
Rhyacophilidae	Rhyacophila sp.	5
Rhyacophilidae	Rhyacophila vofixa gr.	15
DIPTERA		**20**
Chironomidae	Chironomidae	10
Empididae	Oreogeton sp.	9
Empididae	Trichoclinocera sp.	1
HYDRACARINA		**1**
Sperchontidae	Sperchon sp.	1
TURBELLARIA		**9**
Planariidae	Polycelis coronata	9
ANNELIDA		
OLIGOCHAETA		**2**
Enchytraeidae	Enchytraeidae	2

MACROINVERTEBRATE DENSITY
CLIENT: SYRACUSE RESEARCH
SITE: ELK-00
SAMPLED: 09/12/06

TAXA	REP 1
TOTAL DENSITY (#/sample)	177
NUMBER OF TAXA	19
SHANNON-WEAVER (H')	3.02
TOTAL EPT TAXA	12
EPT INDEX (% of Total Taxa)	63
EPHEMEROPTERA ABUNDANCE (% of Total Number)	57.1
# EPHEMEROPTERA TAXA	3
# PLECOPTERA TAXA	4
# TRICHOPTERA TAXA	5
% EPT (% of Total Number)	80.8
# INTOLERANT TAXA	13
TOLERANT ORGANISMS (% of Total Number)	1.7
DOMINANT TAXON (% of Total Number)	40.7
FILTERERS (% of Total Number)	0.0
SCRAPERS (% of Total Number)	0.6
# CLINGER TAXA	10
CLINGERS (% of Total Number)	63.3

MACROINVERTEBRATE DENSITY
CLIENT: SYRACUSE RESEARCH
SITE: ELK-05
SAMPLED: 09/13/06

TAXA		REP 1
INSECTA		
EPHEMEROPTERA		**8**
Baetidae	Baetis tricaudatus	8
PLECOPTERA		**28**
Capniidae	Capniidae	1
Chloroperlidae	Sweltsa sp.	3
Nemouridae	Zapada cinctipes	2
Nemouridae	Zapada oregonensis gr.	21
Perlodidae	Megarcys signata	1
COLEOPTERA		**1**
Elmidae	Heterlimnius corpulentus	1
TRICHOPTERA		**35**
Hydropsychidae	Parapsyche elsis	11
Limnephilidae	Ecclisomyia sp.	1
Limnephilidae	Limnephilidae	1
Rhyacophilidae	Rhyacophila hyalinata gr.	10
Rhyacophilidae	Rhyacophila vofixa gr.	12
DIPTERA		**33**
Chironomidae	Chironomidae	31
Empididae	Oreogeton sp.	1
Empididae	Trichoclinocera sp.	1
TURBELLARIA		**29**
Planariidae	Polycelis coronata	29
ANNELIDA		
OLIGOCHAETA		**1**
Enchytraeidae	Enchytraeidae	1

MACROINVERTEBRATE DENSITY
CLIENT: SYRACUSE RESEARCH
SITE: ELK-05
SAMPLED: 09/13/06

TAXA	REP 1
TOTAL DENSITY (#/sample)	135
NUMBER OF TAXA	17
SHANNON-WEAVER (H')	3.14
TOTAL EPT TAXA	11
EPT INDEX (% of Total Taxa)	65
EPHEMEROPTERA ABUNDANCE (% of Total Number)	5.9
# EPHEMEROPTERA TAXA	1
# PLECOPTERA TAXA	5
# TRICHOPTERA TAXA	5
% EPT (% of Total Number)	52.6
# INTOLERANT TAXA	12
TOLERANT ORGANISMS (% of Total Number)	0.7
DOMINANT TAXON (% of Total Number)	23.0
FILTERERS (% of Total Number)	0.0
SCRAPERS (% of Total Number)	0.0
# CLINGER TAXA	8
CLINGERS (% of Total Number)	44.4

MACROINVERTEBRATE DENSITY
CLIENT: SYRACUSE RESEARCH
SITE: ELK-06
SAMPLED: 09/13/06

TAXA		REP 1
INSECTA		
COLEOPTERA		**2**
Elmidae	Heterlimnius corpulentus	2
TRICHOPTERA		**8**
Hydropsychidae	Parapsyche elsis	4
Rhyacophilidae	Rhyacophila hyalinata gr.	2
Rhyacophilidae	Rhyacophila vofixa gr.	2
DIPTERA		**1**
Chironomidae	Chironomidae	1
TURBELLARIA		**4**
Planariidae	Polycelis coronata	4

TOTAL DENSITY (#/sample)	15
NUMBER OF TAXA	6
SHANNON-WEAVER (H')	2.44 *
TOTAL EPT TAXA	3
EPT INDEX (% of Total Taxa)	50
EPHEMEROPTERA ABUNDANCE (% of Total Number)	0.0

*Should be interpreted cautiously when total abundance is less than 100 organisms.

# EPHEMEROPTERA TAXA	0
# PLECOPTERA TAXA	0
# TRICHOPTERA TAXA	2
% EPT (% of Total Number)	53.3
# INTOLERANT TAXA	5
TOLERANT ORGANISMS (% of Total Number)	0.0
DOMINANT TAXON (% of Total Number)	26.7
FILTERERS (% of Total Number)	0.0
SCRAPERS (% of Total Number)	0.0
# CLINGER TAXA	4
CLINGERS (% of Total Number)	66.7

MACROINVERTEBRATE DENSITY
CLIENT: SYRACUSE RESEARCH
SITE: ELK-08
SAMPLED: 09/13/06

TAXA		REP 1
INSECTA		
PLECOPTERA		**3**
Leuctridae	Despaxia augusta	2
Perlodidae	Isoperla sp.	1
TRICHOPTERA		**6**
Hydropsychidae	Hydropsychidae	1
Limnephilidae	Psychoglypha sp.	1
Rhyacophilidae	Rhyacophila vofixa gr.	3
Uenoidae	Neothremma alicia	1
DIPTERA		**38**
Chironomidae	Chironomidae	33
Empididae	Chelifera sp.	2
Empididae	Neoplasta sp.	2
Empididae	Oreogeton sp.	1
TURBELLARIA		**7**
Planariidae	Polycelis coronata	7
TOTAL DENSITY (#/sample)		54
NUMBER OF TAXA		11
SHANNON-WEAVER (H')		2.11 *
TOTAL EPT TAXA		6
EPT INDEX (% of Total Taxa)		55
EPHEMEROPTERA ABUNDANCE (% of Total Number)		0.0

*Should be interpreted cautiously when total abundace is less than 100 organisms.

# EPHEMEROPTERA TAXA	0
# PLECOPTERA TAXA	2
# TRICHOPTERA TAXA	4
% EPT (% of Total Number)	16.7
# INTOLERANT TAXA	7
TOLERANT ORGANISMS (% of Total Number)	0.0
DOMINANT TAXON (% of Total Number)	61.1
FILTERERS (% of Total Number)	0.0
SCRAPERS (% of Total Number)	1.9
# CLINGER TAXA	3
CLINGERS (% of Total Number)	9.3

MACROINVERTEBRATE DENSITY
CLIENT: SYRACUSE RESEARCH
SITE: ELK-10
SAMPLED: 09/13/06

TAXA		REP 1
INSECTA		
TRICHOPTERA		**1**
Limnephilidae	Limnephilidae	1
DIPTERA		**4**
Chironomidae	Chironomidae	3
Empididae	Oreogeton sp.	1
HYDRACARINA		**1**
Sperchontidae	Sperchon sp.	1
TOTAL DENSITY (#/sample)		6
NUMBER OF TAXA		4
SHANNON-WEAVER (H')		1.79 *
TOTAL EPT TAXA		1
EPT INDEX (% of Total Taxa)		25
EPHEMEROPTERA ABUNDANCE (% of Total Number)		0.0

*Should be interpreted cautiously when total abundance is less than 100 organisms.

# EPHEMEROPTERA TAXA	0
# PLECOPTERA TAXA	0
# TRICHOPTERA TAXA	1
% EPT (% of Total Number)	16.7
# INTOLERANT TAXA	1
TOLERANT ORGANISMS (% of Total Number)	16.7
DOMINANT TAXON (% of Total Number)	50.0
FILTERERS (% of Total Number)	0.0
SCRAPERS (% of Total Number)	0.0
# CLINGER TAXA	0
CLINGERS (% of Total Number)	0.0

MACROINVERTEBRATE DENSITY
CLIENT: SYRACUSE RESEARCH
SITE: ELK-29
SAMPLED: 09/13/06

TAXA		REP 1
INSECTA		
EPHEMEROPTERA		**43**
Ameletidae	Ameletus sp.	6
Heptageniidae	Heptageniidae	36
Heptageniidae	Rhithrogena robusta	1
PLECOPTERA		**69**
Perlidae	Hesperoperla pacifica	7
Perlodidae	Isoperla sp.	2
Leuctridae	Leuctridae	3
Perlodidae	Megarcys signata	1
Chloroperlidae	Sweltsa sp.	41
Nemouridae	Zapada cinctipes	11
Nemouridae	Zapada oregonensis gr.	4
TRICHOPTERA		**80**
Limnephilidae	Limnephilidae	3
Limnephilidae	Psychoglypha sp.	8
Rhyacophilidae	Rhyacophila hyalinata gr.	1
Uenoidae	Neothremma alicia	68
DIPTERA		**105**
Ceratopogonidae	Ceratopogoninae	2
Chironomidae	Chironomidae	67
Empididae	Chelifera sp.	13
Empididae	Oreogeton sp.	19
Muscidae	Limnophora sp.	2
Tipulidae	Limnophila sp.	1
Tipulidae	Tipula sp.	1
NEMATODA		**2**
Nematoda	Unid. Nematoda	2
ANNELIDA		
OLIGOCHAETA		**60**
Enchytraeidae	Enchytraeidae	60
TURBELLARIA		**20**
Planariidae	Polycelis coronata	20

MACROINVERTEBRATE DENSITY
CLIENT: SYRACUSE RESEARCH
SITE: ELK-29
SAMPLED: 09/13/06

TAXA	REP 1
TOTAL DENSITY (#/sample)	379
NUMBER OF TAXA	24
SHANNON-WEAVER (H')	3.50
TOTAL EPT TAXA	14
EPT INDEX (% of Total Taxa)	58
EPHEMEROPTERA ABUNDANCE (% of Total Number)	11.3
# EPHEMEROPTERA TAXA	3
# PLECOPTERA TAXA	7
# TRICHOPTERA TAXA	4
% EPT (% of Total Number)	50.7
# INTOLERANT TAXA	17
TOLERANT ORGANISMS (% of Total Number)	15.8
DOMINANT TAXON (% of Total Number)	17.9
FILTERERS (% of Total Number)	0.0
SCRAPERS (% of Total Number)	27.4
# CLINGER TAXA	8
CLINGERS (% of Total Number)	24.5

MACROINVERTEBRATE DENSITY
CLIENT: SYRACUSE RESEARCH
SITE: SP-00
SAMPLED: 09/12/06

TAXA		REP 1
INSECTA		
EPHEMEROPTERA		**135**
Ameletidae	Ameletus sp.	5
Baetidae	Baetis tricaudatus	25
Ephemerellidae	Drunella doddsi	30
Ephemerellidae	Ephemerella dorothea/excrucians	5
Heptageniidae	Heptageniidae	10
Heptageniidae	Rhithrogena robusta	60
PLECOPTERA		**100**
Chloroperlidae	Sweltsa sp.	15
Nemouridae	Zapada cinctipes	15
Nemouridae	Zapada oregonensis gr.	15
Perlidae	Hesperoperla pacifica	55
COLEOPTERA		**135**
Elmidae	Heterlimnius corpulentus	135
TRICHOPTERA		**120**
Brachycentridae	Micrasema bactro	20
Hydropsychidae	Parapsyche elsis	15
Limnephilidae	Limnephilidae	20
Rhyacophilidae	Rhyacophila brunnea gr.	25
Rhyacophilidae	Rhyacophila pellisa	25
Rhyacophilidae	Rhyacophila vofixa gr.	5
Uenoidae	Neothremma alicia	10
DIPTERA		**765**
Ceratopogonidae	Ceratopogoninae	10
Chironomidae	Chironomidae	730
Empididae	Chelifera sp.	10
Empididae	Oreogeton sp.	5
Psychodidae	Pericoma sp.	5
Tipulidae	Dicranota sp.	5
HYDRACARINA		**5**
Sperchontidae	Sperchon sp.	5
ANNELIDA		
OLIGOCHAETA		**65**
Enchytraeidae	Enchytraeidae	65

MACROINVERTEBRATE DENSITY
CLIENT: SYRACUSE RESEARCH
SITE: SP-00
SAMPLED: 09/12/06

TAXA	REP 1
TOTAL DENSITY (#/sample)	1325
NUMBER OF TAXA	26
SHANNON-WEAVER (H')	2.76
TOTAL EPT TAXA	17
EPT INDEX (% of Total Taxa)	65
EPHEMEROPTERA ABUNDANCE (% of Total Number)	10.2
# EPHEMEROPTERA TAXA	6
# PLECOPTERA TAXA	4
# TRICHOPTERA TAXA	7
% EPT (% of Total Number)	26.8
# INTOLERANT TAXA	19
TOLERANT ORGANISMS (% of Total Number)	5.3
DOMINANT TAXON (% of Total Number)	55.1
FILTERERS (% of Total Number)	0.0
SCRAPERS (% of Total Number)	3.8
# CLINGER TAXA	13
CLINGERS (% of Total Number)	31.3

MACROINVERTEBRATE DENSITY
CLIENT: SYRACUSE RESEARCH
SITE: SP-01
SAMPLED: 09/12/06

TAXA		REP 1
INSECTA		
EPHEMEROPTERA		**84**
Ameletidae	Ameletus sp.	12
Baetidae	Baetis tricaudatus	18
Ephemerellidae	Drunella doddsi	20
Ephemerellidae	Ephemerella dorothea/excrucians	6
Heptageniidae	Rhithrogena robusta	28
PLECOPTERA		**130**
Chloroperlidae	Sweltsa sp.	42
Leuctridae	Leuctridae	6
Nemouridae	Zapada cinctipes	44
Nemouridae	Zapada oregonensis gr.	8
Perlidae	Hesperoperla pacifica	30
COLEOPTERA		**46**
Elmidae	Heterlimnius corpulentus	46
TRICHOPTERA		**12**
Hydropsychidae	Parapsyche elsis	6
Limnephilidae	Limnephilidae	2
Rhyacophilidae	Rhyacophila acropedes	2
Uenoidae	Neothremma alicia	2
DIPTERA		**348**
Ceratopogonidae	Ceratopogoninae	4
Chironomidae	Chironomidae	338
Dixidae	Dixa sp.	2
Empididae	Oreogeton sp.	2
Tipulidae	Dicranota sp.	2
HYDRACARINA		**2**
Sperchontidae	Sperchon sp.	2
ANNELIDA		
OLIGOCHAETA		**30**
Enchytraeidae	Enchytraeidae	30

MACROINVERTEBRATE DENSITY
CLIENT: SYRACUSE RESEARCH
SITE: SP-01
SAMPLED: 09/12/06

TAXA	REP 1
TOTAL DENSITY (#/sample)	652
NUMBER OF TAXA	22
SHANNON-WEAVER (H')	2.77
TOTAL EPT TAXA	14
EPT INDEX (% of Total Taxa)	64
EPHEMEROPTERA ABUNDANCE (% of Total Number)	12.9
# EPHEMEROPTERA TAXA	5
# PLECOPTERA TAXA	5
# TRICHOPTERA TAXA	4
% EPT (% of Total Number)	34.7
# INTOLERANT TAXA	16
TOLERANT ORGANISMS (% of Total Number)	4.9
DOMINANT TAXON (% of Total Number)	51.8
FILTERERS (% of Total Number)	0.0
SCRAPERS (% of Total Number)	3.4
# CLINGER TAXA	9
CLINGERS (% of Total Number)	28.8

Appendix B
Habitat Assessment Results

Stream Habitat Characteristics Data Summary
July 2006
Standard Mine
Gunnison County, Colorado

Prepared For:
United States Environmental Protection Agency, Region 8
Ecosystem Protection and Remediation – Program Support

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July 2006

Introduction

This data summary was prepared in support of ongoing investigation activities occurring at the Standard Mine, located in Gunnison County, Colorado and includes an evaluation of the aquatic biological communities observed in the Coal Creek watershed that was performed in July 2006. Biological communities are affected by habitat quality as well as water and streambed-sediment quality. Stream habitat assessment is therefore an important means of determining physical factors affecting biological communities that may influence overall habitat impacts observed during investigation activities. The Environmental Protection Agency's Rapid Bioassessment Protocols (RBPs)(Barbour 1999) were used to separate water-quality effects from habitat-influenced effects on biological communities at 16 locations along Coal Creek, Elk Creek, and a reference site in Splain's Gulch.

The RBPs include a descriptive, visual-based habitat assessment for riffle-run dominated streams. Habitat conditions were determined using RBPs that were applicable to high gradient streams prevalent in the watershed, and included the following characteristics: epifaunal substrate, embeddedness, velocity/depth regime, sediment deposition, channel flow status, channel alteration, frequency of riffles, bank stability, vegetative protection, and riparian vegetative zone width. Scores for each habitat characteristic were totaled and compared to the reference station to provide a final habitat ranking. Specific scores associated with each of the habitat parameters are included in Table 1.0. Table 2.0 includes the classification and ranking methodology for habitat parameters used in the RBPs.

Locations selected for habitat assessments are listed in Table 1.0 and are the same as those selected for aquatic macroinvertebrate sampling during the July 2006 Standard Mine sampling event (ESAT 2006). Scoring sheets for each site are included in the appendix to this data summary. A brief description is given below for each of the 16 stations.

Site Summaries

Coal-00 RBP Habitat Score = 159 – Optimal

This site is located on Coal Creek upstream from the confluence of Coal Creek. A 100 meter reach was assessed from a pedestrian bridge (not included in the assessment) upstream along the creek. Residences were located along both creek banks, however significant bank alteration was not observed. Overall flow along the reach was low, resulting in a marginal score for Channel Flow Status. The reach scored either optimal or suboptimal for the remaining parameters, resulting in an optimal overall score.

Coal-05 RBP Habitat Score = 166 – Optimal

This site is located on Coal Creek approximately 50 meters downstream of the Keystone Mine Waste Water Treatment Facility discharge. A 100 meter reach was assessed from the point of discharge confluence extending downstream. The majority of parameters scored optimal, with two suboptimal scores (Sediment Deposition and Bank Stability for the left bank). Some sediment deposition was noted at various locations along the reach, and notable erosion was observed along the left bank. The right bank scored poor for Riparian Vegetative Zone Width due to the close proximity of a highway embankment, resulting in a limited riparian area. Overall the reach received an optimal score.

Coal-10 RBP Habitat Score = 167 – Optimal

This site is located approximately 50 meters upstream of the Keystone Mine Waste Water Treatment Facility discharge. A 100 meter reach was assessed from the point of discharge confluence extending upstream. All parameters scored either optimal or suboptimal, with an optimal overall score. The Town of Crested Butte water intake is located within this reach, and included a man-made earthen water diversion. This resulted in less varied depth/flow regime as well as a lower score for Channel Alteration.

Coal-Opp2 RBP Habitat Score = 183 – Optimal

This site is located downstream of the Iron Fen outfall. A 100 meter reach was assessed extending downstream from the farthest downstream Iron Fen outfall location. All parameters scored in the optimal range, with only one parameter falling in the suboptimal range. Frequency of Riffles or Bends scored in the mid-suboptimal range due to the existence of beaver ponds, which increased the depth regime in several areas and ultimately removed some riffle habitat. Overall the reach received an optimal score.

Coal-15 RBP Habitat Score = 193 – Optimal

This site is located approximately 100 meters downstream of the Elk Creek confluence. A 100 meter reach was assessed from the point of confluence extending downstream. All parameters for this site scored in the optimal range, with an overall optimal score. Note that this site received the highest habitat score for areas assessed during this event.

Coal-20 RBP Habitat Score = 188 – Optimal

This site is located approximately 50 meters upstream from the Elk Creek confluence. A 100 meter reach was assessed that extended from the point of confluence upstream. All habitat parameters scored optimal, with only one parameter scoring in the suboptimal range. The overall score for this reach was optimal, and was the second highest scoring reach assessed during this event.

Coal-25 RBP Habitat Score = 177 – Optimal

This site is located downstream from the Ruby/Anthracite drainage confluence, and is the farthest upstream location assessed along Coal Creek during this event. A man-made culvert exists in the vicinity of this sampling location. A 100 meter reach was assessed from the culvert (not included in the assessment) extending upstream. Habitat parameters scored either optimal or suboptimal. Suboptimal scores were given due to areas of increased sedimentation, which impacted overall available epifaunal substrate; areas of sloughing along the left and right banks, and a limited riparian zone width due to the close proximity of the county road located adjacent to the right bank. Overall the reach received an optimal score.

Elk-00 RBP Habitat Score = 163 – Optimal

This site is located along Elk Creek, approximately 100 meters upstream from the confluence with Coal Creek. There is a man-made culvert in the vicinity of the sampling location. A 100 meter reach was assessed from the culvert (not included in the assessment) extending upstream along Elk Creek. Habitat parameters scored in the optimal, suboptimal, and marginal ranges. Suboptimal scores were recorded primarily due to fast and shallow flow, which limited the velocity/depth regime, and resulted in erosion of the left and right banks in some areas (decreasing bank stability). Due to the steep upland influence relatively close to the creek, the riparian width was limited on the left bank. A marginal score was recorded for Channel Flow Status due to low streamflow, resulting in limited available epifaunal substrate. Overall the reach received an optimal score.

Elk-05 RBP Habitat Score = 180 – Optimal

This site is located along Elk Creek approximately 50 meters downstream from the confluence of a series of small drainages. A 100 meter reach was assessed starting from the lowermost drainage extending downstream. Habitat parameters all scored optimal, with the exception of Velocity/Depth Regime, which scored marginal. This was due to the presence of only shallow flow regimes (fast-shallow and slow-shallow) with no significant deep flow regimes. Overall the site received an optimal score.

Elk-06 RBP Habitat Score = 178 – Optimal

This site is located upstream from the confluence of a series of small drainages along Elk Creek. For this site, a 100 meter reach was assessed starting from the uppermost drainage extending upstream. Habitat parameters all scored either optimal or suboptimal. Suboptimal scores were given due to the presence of only 3 out of 4 possible velocity/depth regimes as well as indications of left bank instability. Left bank instability was exacerbated due to limited vegetative protection. In addition, due to the steep upland terrain defining the left bank of this reach, the riparian zone width was less than 15 meters. Overall this reach received an optimal score.

Elk-08 RBP Habitat Score = 156 – Optimal

This site is located just downstream of the confluence of the Copley Lake outfall along Elk Creek. For this site, a 100 meter reach was assessed starting from the outfall moving in a downstream direction. Habitat scores for this reach ranged from marginal to optimal. Marginal scores were given in the areas of Bank Stability (both left and right banks) as well as Channel Flow Status. Signs of erosion were noted between 30 and 60% of the total left and right bank areas, thus contributing to overall bank instability. In addition, only 25 to 75% of the existing channel was filled with water, resulting in a significant amount of riffle substrate exposure. Velocity/Depth Regime and Vegetative Protection received suboptimal scores due to the lack of shallow flow regimes as well as patchy vegetative cover respectively. Overall the reach received a score on the low end of the optimal range.

Elk-10 RBP Habitat Score = 107 – Suboptimal

This site is located along Elk Creek approximately 30 meters below the Standard Mine tailings impoundment. A 100 meter reach was assessed from the base of the impoundment extending downstream. Habitat parameter scores for this reach ranged from marginal to optimal. Marginal scores were given due to the prevalence of basal bedrock along a significant portion of the reach, resulting in limited available epifaunal substrate. The presence of bedrock along the stream bottom also resulted in the absence of deep flow regimes. Due to the location of the impoundment just upstream of the reach, and the presence of human fill activity noted along the reach, vegetative cover and riparian areas were impaired. This also contributed to the prevalence of bank instability throughout the reach. In addition, only 25 to 75% of the existing channel was filled with water, resulting in exposure of the limited riffle substrate. Overall the reach received a score on the low end of the suboptimal range. Note that this was the lowest score given to a reach during this event.

Elk-29 RBP Habitat Score = 115 – Suboptimal

This site is located along Elk Creek upstream of the main Standard Mine workings level, below the confluence of several small drainages. A 100 meter reach was assessed from the base of the lowest drainage extending downstream. Habitat scores for this reach ranged from poor to optimal. Poor scores were given due to limited left bank riparian areas (due to steep sidewalls and proximity of upland areas), and left bank instability. Significant eroded or “raw” areas were observed along the left bank throughout the reach, with obvious signs of sloughing. Marginal scores were given to both the left and right banks due to lack of significant stabilizing vegetative cover in the sloughed areas, though no significant sedimentation along the streambed was noted. Marginal scores were also given due to the prevalence of basal bedrock along a significant portion of the reach (similar to Elk-10), resulting in limited available epifaunal substrate. This issue was compounded by limited channel flow (between 25 and 75% of the available bank). The presence of bedrock along the stream bottom also resulted in the absence of deep flow regimes, and a lack of channel bends and riffle areas. Overall the reach received a score on the low end of the suboptimal range. Note that this reach received the second lowest score.

Cop-01 RBP Habitat Score = 136 – Suboptimal

This site is located downstream from Copley Lake (along the Copley Lake outfall flow) before the confluence with Elk Creek. A 100 meter reach was assessed starting at the culvert (located where the outfall crosses the access road adjacent to Elk Creek; not included in the reach), extending upstream towards Copley Lake. Habitat scores for this reach ranged from marginal to optimal. Marginal scores were given due to a consistent slow flow rate over most of the reach, which led to increased sediment deposition and embeddedness. In addition, riffles and/or bends were observed only occasionally over the reach. Overall the reach received a suboptimal score.

SP-00 RBP Habitat Score = 163 – Optimal

This site is located at the base of Splain's Gulch, just before the confluence with Clear Creek. A 100 meter reach was assessed from the point of confluence extending upstream. Habitat scores for this reach ranged from marginal to optimal. A marginal score was given due to the absence of deep flow regimes. In addition, slight bank instability was observed on both the right and left banks, which led to areas of increased sediment deposition along the streambed. Overall the reach received an optimal score.

SP-01 RBP Habitat Score = 182 – Optimal

This site is located along the upper portion of Splain's Gulch, just upstream of the Splain's Gulch Road crossing. A 100 meter reach was assessed from the road crossing (not included in the assessment) extending upstream. Scores for this site ranged from marginal to optimal. A marginal score was given due to the absence of deep flow regimes (similar to SP-00). A suboptimal score was given for Channel Flow Status since water in the stream filled approximately 75-80% of the existing streambed. This, however, did not seem to impact the epifaunal substrate availability. Overall the reach received an optimal score.

Conclusions

Overall habitat conditions throughout the watershed ranged from suboptimal (Elk-10, Elk-29, and Cop-01) to optimal (remaining sites). The primary reason for suboptimal designations of sites as a whole included limitations to the epifaunal substrate (or available cover) within a reach. This was due to the presence of basal bedrock along the streambed as well as limited flow within the existing banks (also reducing available cover). Additional factors included bank instability as well as a lack of streamside vegetative protection. Riparian Vegetative Zone was a significant contributor to the suboptimal designation for Elk-10 and Elk-29. This was primarily due to steep upland terrain located in close proximity to the stream; and, in the case of Elk-10, was also due to human fill activities.

Tables

Table 1.0 Habitat Assessment Scores - Standard Mine - July 2006

	Habitat Assessment Scores															
Habitat Parameter	**Coal-00**	**Coal-05**	**Coal-10**	**Coal-Opp2**	**Coal-15**	**Coal-20**	**Coal-25**	**Elk-00**	**Elk-05**	**Elk-06**	**Elk-08**	**Elk-10**	**Elk-29**	**Cop-01**	**SP-00**	**SP-01 Reference**
Epifaunal Substrate/ Available Cover	16	18	18	19	19	20	19	14	19	19	17	6	10	13	19	20
Embeddedness	18	18	18	19	18	19	15	19	19	18	19	18	20	6	18	19
Velocity/Depth Regime	15	18	12	18	19	15	18	13	10	15	15	12	9	9	10	10
Sediment Deposition	15	13	18	19	19	19	15	19	19	19	18	13	20	6	14	20
Channel Flow Status	10	17	18	16	19	17	18	9	16	17	8	8	9	16	16	15
Channel Alteration	16	17	11	19	20	19	20	19	20	20	19	15	20	18	18	20
Frequency of Riffles or Bends	17	19	18	14	19	19	18	18	19	19	18	13	7	9	18	18
Bank Stability																
Left Bank	9	7	9	10	10	10	8	8	10	7	5	5	2	10	7	10
Right Bank	9	9	9	10	10	10	8	8	10	10	5	4	3	10	8	10
Vegetative Protection																
Left Bank	9	9	10	10	10	10	10	9	10	7	7	3	3	10	9	10
Right Bank	9	9	10	10	10	10	10	9	10	10	7	4	4	10	10	10
Riparian Vegetative Zone Width																
Left Bank	8	10	7	9	10	10	10	8	9	8	9	3	2	10	9	10
Right Bank	8	2	9	10	10	10	8	10	9	9	9	3	6	9	7	10
Total Score	**159**	**166**	**167**	**183**	**193**	**188**	**177**	**163**	**180**	**178**	**156**	**107**	**115**	**136**	**163**	**182**

Notes:

Green Shading = Optimal habitat score
Blue Shading = Suboptimal habitat score
Yellow Shading = Marginal habitat score
Red Shading = Poor habitat score

Table 2.0 Classification and Ranking Methodology for Habitat Parameters Using Rapid Bioassessment Protocols - Standard Mine -July 2006

Habitat Characteristic	Description	Optimal	Suboptimal	Marginal	Poor
Epifaunal Substrate/ Available Cover	Relative quantity and variety of natural structures in the stream, such as cobble (riffles), large rocks, fallen trees, logs and branches, and undercut banks, available as refugia, feeding, or sites for spawning and nursery functions of aquatic organisms.	Score: 16-20 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 a stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	Score: 11-15 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).	Score: 6-10 20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Score: 0-5 Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
Embeddedness	The extent to which rocks (gravel, cobble, and boulders) and snags are covered or sunken into the silt, sand, or mud of the stream bottom.	Score: 16-20 Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Score: 11-15 Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Score: 6-10 Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Score 0-5 Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
Velocity/Depth Regime	Patterns of velocity (slow-deep, slow-shallow, fast-deep, fast-shallow).	Score: 16-20 All four velocity/depth regimes present. Slow is <0.3 meters/second, deep is >0.5 meters.	Score: 11-15 Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes)	Score: 6-10 Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low)	Score: 0-5 Dominated by 1 velocity/depth regime (usually slow-deep).
Sediment Deposition	Measure of the amount of sediment that has accumulated in pools and the changes that have occurred to the stream bottom as a result of deposition.	Score: 16-20 Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Score: 11-15 Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Score: 6-10 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.	Score: 0-5 Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
Channel Flow Status	Degree to which the channel is filled with water.	Score: 16-20 Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Score: 11-15 Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Score: 6-10 Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Score: 0-5 Very little water in channel and mostly present as standing pools.
Channel Alteration	Measure of large-scale changes in the shape of the stream channel (i.e., for flood control or irrigation, etc.).	Score: 16-20 Channelization or dredging absent or minimal; stream with normal pattern.	Score: 11-15 Some channelization present, usually in areas of bridge abutments; evidence of past channelization (i.e., dredging over 20 years ago) may be present, but recent channelization is not present.	Score: 6-10 Channelization may be extensive; embankments or shoring structures present on both banks; and 40-80% of stream reach channelized and disrupted.	Score: 0-5 Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
Frequency of Riffles or Bends	Measure of the sequence of riffles and thus the heterogeneity occurring in a stream.	Score: 16-20 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.	Score: 11-15 Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Score: 6-10 Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15-25.	Score 0-5 Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio >25.
Bank Stability	Measure of whether the stream banks are eroded or have the potential for erosion (i.e., steep banks, etc.)	Score: 9-10 each bank Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Score: 6-8 each bank Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Score: 3-5 each bank Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Score: 0-2 each bank Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing 60-100% of bank has erosional scars.
Vegetative Protection	Measure of the amount of vegetative protection afforded to the stream bank and the near-stream portion of the riparian zone.	Score: 9-10 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.	Score: 6-8 each bank 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.	Score: 3-5 each bank 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.	Score: 0-2 each bank 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.
Riparian Vegetative Zone Width	Measure of the width of natural vegetation from the edge of the stream bank out through the riparian zone.	Score: 9-10 each bank Width of riparian zone >18 meters; human activities (i.e., parking lots, road beds, clear-cuts, lawns, or crops) have not impacted zone.	Score: 6-8 each bank Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Score: 3-5 each bank Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Score: 0-2 each bank Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.

Scoring Totals:
Optimal: 155-200
Suboptimal: 102-154
Marginal: 49-101
Poor: 0-48

Photographs

Coal-00

Coal-05

Coal-10

Coal-Opp2




Coal-15




Coal-20

Coal-25

SP-00

SP-01

Elk-00

 

Elk-05

Elk-06

Elk-08

Elk-10

Elk-29

Cop-01

 

Appendix

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

STREAM NAME Coal Creek	LOCATION Coal-OU
STATION #________ RIVERMILE________	STREAM CLASS
LAT ____________ LONG ____________	RIVER BASIN
STORET #	AGENCY ESAT
INVESTIGATORS S Auer, J Coleman	
FORM COMPLETED BY S. Auer	DATE ______ TIME ______ 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 16	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 18	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 15	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 15	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 10	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)

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 16	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 17	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 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (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 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (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 8 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Parameters to be evaluated broader than sampling reach

Total Score 159

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

STREAM NAME Coal Creek	LOCATION SA ~~[illegible]~~ Co. 1-C5
STATION #_____ RIVERMILE_____	STREAM CLASS
LAT _____ LONG _____	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS S. [illegible] Sal[illegible]	
FORM COMPLETED BY S. A[illegible]	DATE [illegible] TIME 2:30 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 18	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 18	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 18	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 13	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 17	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 17	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 7 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (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 9 (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 10 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 166

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

STREAM NAME Coal Creek	LOCATION Coal-10
STATION #______ RIVERMILE______	STREAM CLASS
LAT ______ LONG ______	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS [illegible]	
FORM COMPLETED BY [illegible]	DATE [illegible] TIME [illegible] AM PM — REASON FOR SURVEY

Parameters to be evaluated in sampling reach

<table>
<tr><th rowspan="2">Habitat Parameter</th><th colspan="4">Condition Category</th></tr>
<tr><th>Optimal</th><th>Suboptimal</th><th>Marginal</th><th>Poor</th></tr>
<tr><td>1. Epifaunal Substrate/ Available Cover</td><td>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).</td><td>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).</td><td>20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.</td><td>Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.</td></tr>
<tr><td>SCORE 18</td><td>20 19 18 17 16</td><td>15 14 13 12 11</td><td>10 9 8 7 6</td><td>5 4 3 2 1 0</td></tr>
<tr><td>2. Embeddedness</td><td>Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.</td><td>Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.</td><td>Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.</td><td>Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.</td></tr>
<tr><td>SCORE 18</td><td>20 19 18 17 16</td><td>15 14 13 12 11</td><td>10 9 8 7 6</td><td>5 4 3 2 1 0</td></tr>
<tr><td>3. Velocity/Depth Regime</td><td>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.)</td><td>Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).</td><td>Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).</td><td>Dominated by 1 velocity/ depth regime (usually slow-deep).</td></tr>
<tr><td>SCORE 12</td><td>20 19 18 17 16</td><td>15 14 13 12 11</td><td>10 9 8 7 6</td><td>5 4 3 2 1 0</td></tr>
<tr><td>4. Sediment Deposition</td><td>Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.</td><td>Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.</td><td>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.</td><td>Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.</td></tr>
<tr><td>SCORE 18</td><td>20 19 18 17 16</td><td>15 14 13 12 11</td><td>10 9 8 7 6</td><td>5 4 3 2 1 0</td></tr>
<tr><td>5. Channel Flow Status</td><td>Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.</td><td>Water fills >75% of the available channel; or <25% of channel substrate is exposed.</td><td>Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.</td><td>Very little water in channel and mostly present as standing pools.</td></tr>
<tr><td>SCORE 18</td><td>20 19 18 17 16</td><td>15 14 13 12 11</td><td>10 9 8 7 6</td><td>5 4 3 2 1 0</td></tr>
</table>

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 11	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 18	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 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (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 10 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 10 (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 7 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 107

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

STREAM NAME Coal Creek	LOCATION Coal - CPP 2
STATION # ______ RIVERMILE ______	STREAM CLASS
LAT ______ LONG ______	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS S. Auer J. Coleman	
FORM COMPLETED BY S. Auer	DATE 7/17/06 TIME 2:40 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 19	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 19	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 18	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 19	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 16	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 19	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 14	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 10 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 10 (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 10 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 10 (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 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 183

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

STREAM NAME Coal Creek	LOCATION Coal 15	
STATION # ________ RIVERMILE ________	STREAM CLASS	
LAT ____________ LONG ____________	RIVER BASIN	
STORET #	AGENCY	
INVESTIGATORS S. Aue, J. Colanni		
FORM COMPLETED BY S. Aue	DATE 7/11/14 TIME 1345 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 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 19	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 18	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 19	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 19	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 19	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	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 19	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 10 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 10 (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 10 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 10 (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 10 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 193

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

STREAM NAME Coal Creek	LOCATION Coal-20
STATION #_______ RIVERMILE_______	STREAM CLASS
LAT _______ LONG _______	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS S. Auer, J. Coleman	
FORM COMPLETED BY S. Auer	DATE 7/27/06 TIME 1450 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	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 19	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 15	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 19	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 17	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	Condition Category: Suboptimal	Condition Category: Marginal	Condition Category: 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 19	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 19	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 10 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 10 (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 10 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 10 (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 10 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 188

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

STREAM NAME Coal Creek	LOCATION Coal 25
STATION # ____ RIVERMILE ____	STREAM CLASS
LAT ____ LONG ____	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS [illegible]	
FORM COMPLETED BY S. [illegible]	DATE [illegible] TIME [illegible] 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 19	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 15	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 18	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 15	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 18	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	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 18	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 8 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 8 (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 10 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 10 (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 10 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 177

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

STREAM NAME Elk Creek	LOCATION Elk-00
STATION #________ RIVERMILE________	STREAM CLASS
LAT __________ LONG __________	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS	
FORM COMPLETED BY	DATE 7/17/06 TIME 4:15 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 14	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 19	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 13	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 19	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 4	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 19	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 18	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 8 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 8 (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 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (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 8 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 163

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

STREAM NAME Elk Creek	LOCATION Elk-C5
STATION # ______ RIVERMILE ______	STREAM CLASS
LAT ______ LONG ______	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS S. Hunter, J. Calamari	
FORM COMPLETED BY S. Hunter	DATE 7/18/06 TIME 7:35 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 19	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 19	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 10	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 19	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 16	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	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 19	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 10 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 10 (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 10 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 10 (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 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 180

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

STREAM NAME Elk Creek	LOCATION ELK 06
STATION # ________ RIVERMILE ________	STREAM CLASS
LAT ____________ LONG ____________	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS	
FORM COMPLETED BY	DATE 7/18/04 TIME [illegible] 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 19	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 18	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 15	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 19	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 17	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	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 19	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 7 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 10 (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 7 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 10 (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 8 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 178

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

STREAM NAME ~~[illegible]~~ Elk Creek	LOCATION 5'E-08
STATION #________ RIVERMILE________	STREAM CLASS
LAT ____________ LONG ____________	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS	
FORM COMPLETED BY	DATE 7/18/06 TIME 1:35 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 17	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 19	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 15	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 16	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 8	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 19	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 18	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 5 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 5 (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 7 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 7 (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 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 156

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

STREAM NAME Elk Creek	LOCATION Elk -10
STATION #______ RIVERMILE______	STREAM CLASS
LAT______ LONG______	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS S. Auer J. Eckert	
FORM COMPLETED BY S. Auer	DATE 7/25/[illegible] TIME 0[illegible] 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 6	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 18	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 12	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 ~~[illegible]~~	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 13	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 8	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 15	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 13	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 5 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 4 (RB)	Right Bank 10 9	8 7 6	5 SA 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 3 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 4 (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 3 (LB)	Left Bank 10 9	8 7 6	5 4 3 SA	2 1 0
SCORE 3 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 107

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

STREAM NAME Elk Creek	LOCATION EIK-29
STATION #________ RIVERMILE________	STREAM CLASS High
LAT ____________ LONG ____________	RIVER BASIN
STORET #	AGENCY CSAT
INVESTIGATORS JC / SA	
FORM COMPLETED BY J Calann:	DATE _______ TIME _______ 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 10	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	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 9	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	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 9	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	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 7	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. 5A	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 2 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 3 (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 3 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 4 (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 2 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 6 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 115

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

STREAM NAME [illegible]	LOCATION [illegible]
STATION # ______ RIVERMILE ______	STREAM CLASS
LAT ______ LONG ______	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS [illegible]	
FORM COMPLETED BY [illegible]	DATE [illegible] TIME [illegible] 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 13	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 6	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 9	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 6	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 16	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 18	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 9	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 10 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 10 (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 10 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 10 (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 10 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 136

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

STREAM NAME Shaid's Gulch	LOCATION [illegible]	
STATION # ________ RIVERMILE ________	STREAM CLASS	
LAT ____________ LONG ____________	RIVER BASIN	
STORET #	AGENCY	
INVESTIGATORS [illegible]		
FORM COMPLETED BY [illegible]	DATE [illegible] TIME [illegible] 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 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 19	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 18	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 10	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 14	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 16	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 18	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 18	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 7 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 8 (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 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 10 (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 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 7 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 163

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

STREAM NAME Splain Branch	LOCATION SP 01
STATION # ______ RIVERMILE ______	STREAM CLASS
LAT ______ LONG ______	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS S. Auer, J. Colman	
FORM COMPLETED BY S. Auer	DATE 7/17/06 TIME 1525 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	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 19	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 10	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	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 15	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	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 18	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 10 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 10 (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 10 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 10 (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 10 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 182

Stream Habitat Characteristics Data Summary

September 2006

Standard Mine
Gunnison County, Colorado

Prepared For:
United States Environmental Protection Agency, Region 8
Ecosystem Protection and Remediation – Program Support

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September 2006

Introduction

This data summary was prepared in support of ongoing investigation activities occurring at the Standard Mine, located in Gunnison County, Colorado and includes an evaluation of the aquatic biological communities observed in the Coal Creek watershed that was performed in September 2006. Biological communities are affected by habitat quality as well as water and streambed-sediment quality. Stream habitat assessment is therefore an important means of determining physical factors affecting biological communities that may influence overall habitat impacts observed during investigation activities. The Environmental Protection Agency's Rapid Bioassessment Protocols (RBPs)(Barbour 1999) were used to separate water-quality effects from habitat-influenced effects on biological communities at 16 locations along Coal Creek, Elk Creek, and a reference site in Splain's Gulch.

The RBPs include a descriptive, visual-based habitat assessment for riffle-run dominated streams. Habitat conditions were determined using RBPs that were applicable to high gradient streams prevalent in the watershed, and included the following characteristics: epifaunal substrate, embeddedness, velocity/depth regime, sediment deposition, channel flow status, channel alteration, frequency of riffles, bank stability, vegetative protection, and riparian vegetative zone width. Scores for each habitat characteristic were totaled and compared to the reference station to provide a final habitat ranking. Specific scores associated with each of the habitat parameters are included in Table 1.0. Table 2.0 includes the classification and ranking methodology for habitat parameters used in the RBPs.

Locations selected for habitat assessments are listed in Table 1.0 and are the same as those selected for aquatic macroinvertebrate sampling during the July 2006 Standard Mine sampling event (ESAT 2006). Scoring sheets for each site are included in the appendix to this data summary. A brief description is given below for each of the 16 stations.

Site Summaries

Coal-00 RBP Habitat Score = 153 – Suboptimal

This site is located on Coal Creek upstream from the confluence of Coal Creek. A 100 meter reach was assessed from a pedestrian bridge (not included in the assessment) upstream along the creek. Residences were located along both creek banks, however significant bank alteration was not observed. Overall flow along the reach was quite low, resulting in a marginal score for Channel Flow Status. The reach scored either optimal or suboptimal for the remaining parameters, resulting in a suboptimal overall score.

Coal-05 RBP Habitat Score = 144 – Suboptimal

This site is located on Coal Creek approximately 50 meters downstream of the Keystone Mine Waste Water Treatment Facility discharge. A 100 meter reach was assessed from the point of discharge confluence extending downstream. The majority of parameters scored optimal or suboptimal, with two marginal scores (Sediment Deposition and Embeddedness), and one poor score (Riparian Vegetative Zone Width for the right bank). Sediment deposition was noted at various locations along the reach, which appeared to originate at the Keystone Mine discharge confluence. Some erosion was observed along the left bank. The right bank scored poor for Riparian Vegetative Zone Width due to the close proximity of a highway embankment, resulting in a limited riparian area. Overall the reach received a suboptimal score.

Coal-10 RBP Habitat Score = 171 – Optimal

This site is located approximately 50 meters upstream of the Keystone Mine Waste Water Treatment Facility discharge. A 100 meter reach was assessed from the point of discharge confluence extending upstream. All parameters scored either optimal or suboptimal, with an optimal overall score. The Town of Crested Butte water intake is located within this reach, and included a man-made earthen water diversion. This resulted in less varied depth/flow regime as well as a lower score for Channel Alteration.

Coal-Opp2 RBP Habitat Score = 172 – Optimal

This site is located downstream of the Iron Fen outfall. A 100 meter reach was assessed extending downstream from the farthest downstream Iron Fen outfall location. All parameters scored in the optimal range, with only one parameter falling in the suboptimal range. Frequency of Riffles or Bends scored in the mid-suboptimal range due to the existence of beaver ponds, which increased the depth regime in several areas and ultimately removed some riffle habitat. Overall the reach received an optimal score.

Coal-15 RBP Habitat Score = 182 – Optimal

This site is located approximately 100 meters downstream of the Elk Creek confluence. A 100 meter reach was assessed from the point of confluence extending downstream. All parameters for this site scored in the optimal range, with the exception of Frequency of Bends or Riffles and right bank Vegetative Protection (primarily due to lower flow levels). Note that this site received the highest habitat score for areas assessed during this event (along with SP-01 Reference).

Coal-20 RBP Habitat Score = 180 – Optimal

This site is located approximately 50 meters upstream from the Elk Creek confluence. A 100 meter reach was assessed that extended from the point of confluence upstream. All habitat parameters scored optimal, with only one parameter scoring in the suboptimal range (Velocity/Depth Regime). The overall score for this reach was optimal, and was the second highest scoring reach assessed during this event.

Coal-25 RBP Habitat Score = 163 – Optimal

This site is located downstream from the Ruby/Anthracite drainage confluence, and is the farthest upstream location assessed along Coal Creek during this event. A man-made culvert exists in the vicinity of this sampling location. A 100 meter reach was assessed from the culvert (not included in the assessment) extending upstream. Habitat parameters scored either optimal or suboptimal. Suboptimal scores were given due to limited flow regimes (due to lower flow which also impacted Frequency of Riffles or Bends), areas of sloughing along the left and right banks, and a limited riparian zone width due to the close proximity of the county road located adjacent to the right bank. Overall the reach received an optimal score.

Elk-00 RBP Habitat Score = 168 – Optimal

This site is located along Elk Creek, approximately 100 meters upstream from the confluence with Coal Creek. There is a man-made culvert in the vicinity of the sampling location. A 100 meter reach was assessed from the culvert (not included in the assessment) extending upstream along Elk Creek. Habitat parameters scored in the optimal, suboptimal, and marginal ranges. Suboptimal scores were recorded primarily due to limited flow regimes (shallow regimes). Due to the steep upland influence relatively close to the creek, the riparian width was limited on the left bank. A marginal score was recorded for Channel Flow Status due to low streamflow, resulting in exposed epifaunal substrate. Overall the reach received an optimal score.

Elk-05 RBP Habitat Score = 178 – Optimal

This site is located along Elk Creek approximately 50 meters downstream from the confluence of a series of small drainages. A 100 meter reach was assessed starting from the lowermost drainage extending downstream. Habitat parameters all scored optimal, with the exception of Velocity/Depth Regime, which scored marginal. This was due to the presence of only shallow flow regimes (fast-shallow and slow-shallow) with no significant deep flow regimes. Overall the site received an optimal score.

Elk-06 RBP Habitat Score = 168 – Optimal

This site is located upstream from the confluence of a series of small drainages along Elk Creek. For this site, a 100 meter reach was assessed starting from the uppermost drainage extending upstream. Habitat parameters all scored optimal, suboptimal, or marginal. Marginal scores were given due to the presence of only 3 out of 4 possible velocity/depth regimes which may have increased bank instability in areas (suboptimal scores). In addition, due to the steep upland terrain defining the left bank of this reach, the riparian zone width was less than 15 meters. Overall this reach received an optimal score.

Elk-08 RBP Habitat Score = 149 – Suboptimal

This site is located just downstream of the confluence of the Copley Lake outfall along Elk Creek. For this site, a 100 meter reach was assessed starting from the outfall moving in a downstream direction. Habitat scores for this reach ranged from marginal to optimal. Marginal scores were given in the areas of Velocity/Depth Regime as well as Channel Flow Status, primarily due to reduced flow. Signs of erosion were noted between 30 and 60% of the total left and right bank areas, thus contributing to overall bank instability. Bank Instability (both banks) and Vegetative Protection (both banks) received suboptimal scores due to signs of erosion as well as patchy vegetative cover. Overall the reach received a score in the suboptimal range.

Elk-10 RBP Habitat Score = 82 – Marginal

This site is located along Elk Creek approximately 30 meters below the Standard Mine tailings impoundment. A 100 meter reach was assessed from the base of the impoundment extending downstream. Habitat parameter scores for this reach ranged from poor to optimal. Poor scores were given due to the prevalence sediment (thus increasing embeddedness) which may have been due to removal activities taking place at upstream locations. In addition, basal bedrock was observed along a significant portion of the reach, resulting in limited available epifaunal substrate (suboptimal score). The presence of bedrock along the stream bottom also resulted in the absence of deep flow regimes. Due to the location of the impoundment just upstream of the reach, and the presence of human fill activity noted along the reach, vegetative cover and riparian areas were impaired. This also contributed to the prevalence of bank instability throughout the reach. In addition, only 25 to 75% of the existing channel was filled with water, resulting in exposure of the limited riffle substrate. Overall the reach received a score in the marginal range. Note that this was the lowest score given to a reach during this event.

Elk-29 RBP Habitat Score = 125 – Suboptimal

This site is located along Elk Creek upstream of the main Standard Mine workings level, below the confluence of several small drainages. A 100 meter reach was assessed from the base of the lowest drainage extending downstream. Habitat scores for this reach ranged from poor to optimal. A poor score was given due to limited areas of riffle primarily a result of the presence of basal bedrock. This also resulted in limited epifaunal substrate and the presence of only shallow depth regimes. In addition, flow in the channel was low. Significant eroded or "raw" areas were observed along the left bank throughout the reach, with obvious signs of sloughing. Marginal scores were given to both the left and right banks due to lack of significant stabilizing vegetative cover in the sloughed areas, though no significant sedimentation along the streambed was noted. Overall the reach received a score on the low end of the suboptimal range. Note that this reach received the third lowest score.

Cop-01 RBP Habitat Score = 113 – Suboptimal

This site is located downstream from Copley Lake (along the Copley Lake outfall flow) before the confluence with Elk Creek. A 100 meter reach was assessed starting at the culvert (located where the outfall crosses the access road adjacent to Elk Creek; not included in the reach), extending upstream towards Copley Lake. Habitat scores for this reach ranged from poor to optimal. Poor scores were given due to extremely low flow within the reach, which impacted the present velocity/depth regimes as well as reduced riffle areas. Marginal scores were given due to significant areas of sedimentation which resulted in an increase in overall embeddedness. Overall the reach received a score in the lower end of the suboptimal range. Note that this site received the second lowest score.

SP-00 RBP Habitat Score = 162 – Optimal

This site is located at the base of Splain's Gulch, just before the confluence with Clear Creek. A 100 meter reach was assessed from the point of confluence extending upstream. Habitat scores for this reach ranged from marginal to optimal. A marginal score was given due to the absence of deep flow regimes as well as limited flow within the channel. Areas of sedimentation were also observed in some areas, which resulted in a suboptimal score for Sediment Deposition. Overall the reach received an optimal score.

SP-01 RBP Habitat Score = 182 – Optimal

This site is located along the upper portion of Splain's Gulch, just upstream of the Splain's Gulch Road crossing. A 100 meter reach was assessed from the road crossing (not included in the assessment) extending upstream. Scores for this site ranged from marginal to optimal. A marginal score was given due to the absence of deep flow regimes (similar to SP-00). The remaining scores were all in the optimal range. Overall the reach received an optimal score. Note that this site received the highest score for areas assessed during this event (in addition to Coal-15).

Conclusions

Overall habitat conditions throughout the watershed were marginal (Elk-10), suboptimal (Coal-00, Coal-05, Elk-08, Elk-29, and Cop-01), and optimal (remaining sites). The primary reason for scores that were less than optimal was lower streamflows in the watershed. This resulted in limited velocity/depth regimes, as well as lower scores for channel flow status. These factors, combined with the presence of human fill activities, were significant contributors to the marginal designation for Elk-10.

Tables

Table 1.0 Habitat Assessment Scores - Standard Mine - September 2006

	Habitat Assessment Scores															
Habitat Parameter	**Coal-00**	**Coal-05**	**Coal-10**	**Coal-Opp2**	**Coal-15**	**Coal-20**	**Coal-25**	**Elk-00**	**Elk-05**	**Elk-06**	**Elk-08**	**Elk-10**	**Elk-29**	**Cop-01**	**SP-00**	**SP-01 Reference**
Epifaunal Substrate/ Available Cover	18	19	19	19	19	19	18	18	19	19	18	15	10	16	19	20
Embeddedness	18	9	18	18	18	17	17	19	19	19	16	3	19	7	18	20
Velocity/Depth Regime	13	14	19	19	19	15	14	14	10	10	10	10	9	4	10	10
Sediment Deposition	18	9	18	16	19	18	16	18	19	18	16	5	20	7	15	20
Channel Flow Status	8	14	16	17	14	16	18	8	16	16	8	8	9	5	10	17
Channel Alteration	12	19	13	17	19	19	19	19	20	18	19	11	19	19	19	20
Frequency of Riffles or Bends	18	18	17	15	18	19	14	18	18	19	18	11	5	5	18	19
Bank Stability																
Left Bank	9	6	8	9	9	9	7	9	9	6	6	3	3	8	10	9
Right Bank	8	8	9	9	9	9	7	9	10	8	6	3	5	7	9	9
Vegetative Protection																
Left Bank	9	8	9	9	10	10	9	9	10	9	7	3	4	9	7	10
Right Bank	9	8	9	7	10	10	9	9	10	9	7	4	4	9	8	10
Riparian Vegetative Zone Width																
Left Bank	6	10	7	9	10	10	8	8	9	9	9	3	9	9	10	9
Right Bank	7	2	9	8	8	9	7	10	9	8	9	3	9	8	9	9
Total Score	**153**	**144**	**171**	**172**	**182**	**180**	**163**	**168**	**178**	**168**	**149**	**82**	**125**	**113**	**162**	**182**

Notes:

Green Shading = Optimal habitat score
Blue Shading = Suboptimal habitat score
Yellow Shading = Marginal habitat score
Red Shading = Poor habitat score

Table 2.0 Classification and Ranking Methodology for Habitat Parameters Using Rapid Bioassessment Protocols - Standard Mine -September 2006

Habitat Characteristic	Description	Optimal	Suboptimal	Marginal	Poor
Epifaunal Substrate/ Available Cover	Relative quantity and variety of natural structures in the stream, such as cobble (riffles), large rocks, fallen trees, logs and branches, and undercut banks, available as refugia, feeding, or sites for spawning and nursery functions of aquatic organisms.	Score: 16-20 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 a stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	Score: 11-15 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).	Score: 6-10 20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Score: 0-5 Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
Embeddedness	The extent to which rocks (gravel, cobble, and boulders) and snags are covered or sunken into the silt, sand, or mud of the stream bottom.	Score: 16-20 Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Score: 11-15 Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Score: 6-10 Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Score 0-5 Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
Velocity/Depth Regime	Patterns of velocity (slow-deep, slow-shallow, fast-deep, fast-shallow).	Score: 16-20 All four velocity/depth regimes present. Slow is <0.3 meters/second, deep is >0.5 meters.	Score: 11-15 Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes)	Score: 6-10 Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low)	Score: 0-5 Dominated by 1 velocity/depth regime (usually slow-deep).
Sediment Deposition	Measure of the amount of sediment that has accumulated in pools and the changes that have occurred to the stream bottom as a result of deposition.	Score: 16-20 Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Score: 11-15 Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Score: 6-10 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.	Score: 0-5 Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
Channel Flow Status	Degree to which the channel is filled with water.	Score: 16-20 Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Score: 11-15 Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Score: 6-10 Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Score: 0-5 Very little water in channel and mostly present as standing pools.
Channel Alteration	Measure of large-scale changes in the shape of the stream channel (i.e., for flood control or irrigation, etc.).	Score: 16-20 Channelization or dredging absent or minimal; stream with normal pattern.	Score: 11-15 Some channelization present, usually in areas of bridge abutments; evidence of past channelization (i.e., dredging over 20 years ago) may be present, but recent channelization is not present.	Score: 6-10 Channelization may be extensive; embankments or shoring structures present on both banks; and 40-80% of stream reach channelized and disrupted.	Score: 0-5 Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
Frequency of Riffles or Bends	Measure of the sequence of riffles and thus the heterogeneity occurring in a stream.	Score: 16-20 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.	Score: 11-15 Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Score: 6-10 Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15-25.	Score 0-5 Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio >25.
Bank Stability	Measure of whether the stream banks are eroded or have the potential for erosion (i.e., steep banks, etc.)	Score: 9-10 each bank Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Score: 6-8 each bank Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Score: 3-5 each bank Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Score: 0-2 each bank Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing 60-100% of bank has erosional scars.
Vegetative Protection	Measure of the amount of vegetative protection afforded to the stream bank and the near-stream portion of the riparian zone.	Score: 9-10 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.	Score: 6-8 each bank 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.	Score: 3-5 each bank 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.	Score: 0-2 each bank 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.
Riparian Vegetative Zone Width	Measure of the width of natural vegetation from the edge of the stream bank out through the riparian zone.	Score: 9-10 each bank Width of riparian zone >18 meters; human activities (i.e., parking lots, road beds, clear-cuts, lawns, or crops) have not impacted zone.	Score: 6-8 each bank Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Score: 3-5 each bank Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Score: 0-2 each bank Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.

Scoring Totals:
Optimal: 155-200
Suboptimal: 102-154
Marginal: 49-101
Poor: 0-48

Photographs

Coal-00

Coal-05

Coal-10

Coal-Opp2

Coal-15

Coal-20

Coal-25

SP-00

SP-01

 

Elk-00

Elk-05

Elk-06




Elk-08

Elk-10

Elk-29

Cop-01

Appendix

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

STREAM NAME Coal Creek	LOCATION Coal.00
STATION # ____ RIVERMILE ____	STREAM CLASS
LAT ____ LONG ____	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS S. Auer, J. Colosky	
FORM COMPLETED BY S. Auer	DATE 9/11/02 TIME 1010 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 ~~19~~ 18	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 18	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 13	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 18	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 8	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 12	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 18	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 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 8 (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 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (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 6 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 7 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score ________

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

STREAM NAME Coal Creek	LOCATION Coal Creek Coal-05
STATION # ____ RIVERMILE ____	STREAM CLASS
LAT ____ LONG ____	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS S. Auer, J. Carlson	
FORM COMPLETED BY	DATE 8/11/06 TIME 1720 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 19	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 9	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 14	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 9	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 14	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 19	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 18	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 6 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 8 (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 8 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 8 (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 10 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 2 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score ________

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

STREAM NAME Coal Creek	LOCATION Coal 10
STATION # ________ RIVERMILE ________	STREAM CLASS
LAT ____________ LONG ____________	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS S Auer, S Calamari	
FORM COMPLETED BY S. Auer	DATE 7/11/06 TIME 1735 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 19	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 18	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 19	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 18	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 16	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Dredging Activities Recently on lower portion

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 13	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 17	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 8 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (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 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (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 7 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score __________

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

STREAM NAME Coal Creek	LOCATION Coal [illegible]	
STATION # ______ RIVERMILE ______	STREAM CLASS	
LAT ______ LONG ______	RIVER BASIN	
STORET #	AGENCY	
INVESTIGATORS		
FORM COMPLETED BY	DATE 7/12/02 TIME 0850 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 19	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 18	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 19	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 16	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 17	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 17	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 15	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 7 (LB)	Left Bank 10 (9)	8 7 6	5 4 3	2 1 0
SCORE 9 (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 9 (LB)	Left Bank 10 (9)	8 7 6	5 4 3	2 1 0
SCORE 7 (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 9 (LB)	Left Bank 10 (9)	8 7 6	5 4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	(8) 7 6	5 4 3	2 1 0

Total Score ________

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

STREAM NAME Coal Creek	LOCATION Coal-15
STATION # ________ RIVERMILE ________	STREAM CLASS
LAT ____________ LONG ____________	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS S. Auer, J. Coleman	
FORM COMPLETED BY S. Auer	DATE 9/12/06 TIME 0810 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 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 19	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 18 ~~19~~	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 19	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 19	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 14	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 19	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 18	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 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (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 10 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 10 (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 10 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score ________

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

STREAM NAME Coal Creek	LOCATION Coal-20
STATION # ________ RIVERMILE ________	STREAM CLASS
LAT ____________ LONG ____________	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS S. Auer J. Colaiani	
FORM COMPLETED BY S Auer	DATE ______ TIME 0830 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 19	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 17	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 15	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. 9	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 19 18	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 16	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 19	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 19	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 9 (LB)	Left Bank 10 (9)	8 7 6	5 4 3	2 1 0
SCORE 9 (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 10 (LB)	Left Bank (10) 9	8 7 6	5 4 3	2 1 0
SCORE 10 (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 10 (LB)	Left Bank (10) 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 (9)	8 7 6	5 4 3	2 1 0

Total Score __________

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

STREAM NAME Coal Creek	LOCATION Coal .
STATION #________ RIVERMILE________	STREAM CLASS
LAT ____________ LONG ____________	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS S. Ahern J. Calvin	
FORM COMPLETED BY S. Ahern	DATE 11/17/04 TIME 0740 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 18	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 17	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 14	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 16	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 18	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 19	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 14	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 7 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 7 (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 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (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 8 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 7 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score ________

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

STREAM NAME Elk Cr.	LOCATION	
STATION # ________ RIVERMILE ________	STREAM CLASS	
LAT ________ LONG ________	RIVER BASIN	
STORET #	AGENCY	
INVESTIGATORS S. A[illegible], J. C[illegible]		
FORM COMPLETED BY S. A[illegible]	DATE 8/11/06 TIME 1155 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 18	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 19	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 14	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 18	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 8	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 19	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 18	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 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (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 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (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 8 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score ________

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

STREAM NAME	LOCATION Elk-05
STATION # ________ RIVERMILE ________	STREAM CLASS
LAT ________ LONG ________	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS S. Auer J. Cahoon	
FORM COMPLETED BY S. Auer	DATE 09/11/06 TIME 1220 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 19	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 19	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 10	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 19	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 16	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	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 18	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 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 10 (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 10 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 10 (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 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score ________

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

STREAM NAME	LOCATION 27K 06
STATION #________ RIVERMILE________	STREAM CLASS
LAT ________ LONG ________	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS S. Auer J. Calmon	
FORM COMPLETED BY S. Auer	DATE 9/1/06 TIME 1240 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 19	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 19	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 10	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 18	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 16	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. SA	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 ~~15~~ SA	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 18	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 19	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 6 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 8 (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 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (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 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score ________

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

STREAM NAME Elk Creek	LOCATION Elk Cr	
STATION # ________ RIVERMILE ________	STREAM CLASS	
LAT ________ LONG ________	RIVER BASIN	
STORET #	AGENCY	
INVESTIGATORS J. Auer, T. Colanni		
FORM COMPLETED BY J. Auer	DATE 7/11/06 TIME ________ 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 18	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 16	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 10	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 16	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 8	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 19	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 18	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 ~~7~~ 6 (LB)	Left Bank 10 9	8 ~~7~~ 6	5 4 3	2 1 0
SCORE ~~7~~ 6 (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 7 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 7 (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 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score ________

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

STREAM NAME	LOCATION Elk 10
STATION # ________ RIVERMILE ________	STREAM CLASS
LAT ________ LONG ________	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS S. Auer, J. Colanni	
FORM COMPLETED BY S. Auer	DATE 9/11/06 TIME 1410 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 15	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 3	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 10	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 5	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 8	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 11	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 11	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 3 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 3 (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 3 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 4 (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 ~~2~~ 3 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ~~2~~ 3 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score ________

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

STREAM NAME Elk Creek	LOCATION Elk 29
STATION #________ RIVERMILE________	STREAM CLASS
LAT ____________ LONG ____________	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS S. Auer T. Calkins	
FORM COMPLETED BY S. Auer	DATE 7/11/05 TIME 1440 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 10	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 19	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 9	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	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 9 ~~14~~	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 19	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 5	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 3 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 5 (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 3 (LB) 4	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 4 (RB) 4	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 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score __________

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

STREAM NAME Copley Outflow	LOCATION COP 01	
STATION # ____ RIVERMILE ____	STREAM CLASS	
LAT ____ LONG ____	RIVER BASIN	
STORET #	AGENCY	
INVESTIGATORS S. Auer, J. Calanni		
FORM COMPLETED BY S. Auer	DATE ____ TIME 1340 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 16	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 7	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 4	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 7	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 5	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 19	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 5	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 8 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 7 (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 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (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 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ~~6~~ 8 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Rec'd In House

Total Score ________

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

STREAM NAME Splains Gulch	LOCATION SP-OC
STATION #________ RIVERMILE________	STREAM CLASS
LAT ____________ LONG ____________	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS S. Auer J. Colanni	
FORM COMPLETED BY S. Auer	DATE 7/12/06 TIME 0750 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 19	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 18	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 10	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 15	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 10	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 17	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 18	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 10 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (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 10 (LB) 7	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB) 8	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 10 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score __________

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

STREAM NAME Splains Gulch	LOCATION ~~SP02~~ 5A SP-01
STATION # ________ RIVERMILE ________	STREAM CLASS
LAT ____________ LONG ____________	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS S. Herr, J. Colani	
FORM COMPLETED BY S. Herr	DATE 9/11/06 TIME 1650 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	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	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 10	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	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 17	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed. 5A	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 5A ~~19~~	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	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 19	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 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (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 10 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 10 (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 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score __________

Appendix C
Colorado Division of Wildlife Fisheries Inventory

Coal Creek Basin
1977-2006 Fisheries Inventory
Summary Reports and Photos

Daniel Brauch
Colorado Division of Wildlife
Aquatic Section
Gunnison, Colorado
October 2006

Coal Creek Watershed Sampling July 2006

Water **Coal Creek**

Date 8/17/1979

Location Just Above Crested Butte

Drainage Gunnison

Water Code 49191

Crew Weiler, Woodling"

Notes

Backpack Electrofishing single pass.

UTM Zone 13T

UTM X 327279

UTM Y 4303733

Station Length (ft) 250

Station Width (ft) 10.0

LEVEL 2 - STREAM SURVEY (2 PASS REMOVAL)

SAVE PRINT PRINT DONE

SUMMARY INFORMATION

Species	# Caught	% Catch	Min Size	Capture P	#/Mile	95% CI	#/Acre	95% CI	Lbs/Acre	95% CI
BRK	51	100	93	1.00	1077	0	889	0	0	0

LENGTH FREQUENCY RECORD (cm)

Species	0-2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18	18-20	20-22	22-24	24-26	26-28	28-30	30-32	32-34	34-36	36-38	38-40	40-42	42-44	44-46	46-48	48-50	50-52	52-54	54-56	56-58	58-60	>60
BRK						9	22	12	8																						

Water: **Coal Creek**

Date: 7/18/2006

Location: Just Above Crested Butte

Drainage: Gunnison

Water Code: 49191

Crew: Brauch, Viera"

Notes

Bank Electrofishing with 3 electrodes, samples collected for contaminants of potential concern by U.S. EPA as part of Standard Mine cleanup assessment."

UTM Zone: 13T

UTM X: 327260

UTM Y: 4303806

Station Length (ft): 412

Station Width (ft): 21.2

LEVEL 2 - STREAM SURVEY (2 PASS REMOVAL)

SAVE PRINT PRINT DONE

SUMMARY INFORMATION

Species	# Caught	% Catch	Min Size	Capture P	#/Mile	95% CI	#/Acre	95% CI	Lbs/Acre	95% CI
BRK	34	72	89	0.75	463	69	180	27	15	2
LOC	13	28	96	0.83	169	25	66	10	7	1

LENGTH FREQUENCY RECORD (cm)

Species	0-2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18	18-20	20-22	22-24	24-26	26-28	28-30	30-32	32-34	34-36	36-38	38-40	40-42	42-44	44-46	46-48	48-50	50-52	52-54	54-56	56-58	58-60	>60
BRK			6		1	8	12	4	4	1	3	1																			
LOC						3	1	3	2	4																					

Sample Location: Coal-02
Coal Creek just above Crested Butte

Water **Coal Creek**

Date 6/21/1977

Location Above Keystone Effluent

Drainage Gunnison

Water Code 39140

Crew Weiler

Notes

Backpack Electrofishing single pass.

UTM Zone 13T

UTM X 324911

UTM Y 4303942

Station Length (ft) 300

Station Width (ft) 18.0

LEVEL 2 - STREAM SURVEY (2 PASS REMOVAL)

SAVE PRINT PRINT DONE

SUMMARY INFORMATION

Species	# Caught	% Catch	Min Size	Capture P	#/Mile	95% CI	#/Acre	95% CI	Lbs/Acre	95% CI
BRK	15	100	93	1.00	264	0	121	0	0	0

LENGTH FREQUENCY RECORD (cm)

Species	0-2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18	18-20	20-22	22-24	24-26	26-28	28-30	30-32	32-34	34-36	36-38	38-40	40-42	42-44	44-46	46-48	48-50	50-52	52-54	54-56	56-58	58-60	>60
BRK						4	2	7	2																						

Water **Coal Creek**

Date 8/17/1979

Location Above Keystone Effluent

Drainage Gunnison

Water Code 39140

Crew Weiler, Woodling"

Notes

Backpack Electrofishing single pass.

UTM Zone 13T

UTM X 324911

UTM Y 4303942

Station Length (ft) 300

Station Width (ft) 12.0

LEVEL 2 - STREAM SURVEY (2 PASS REMOVAL)

SAVE PRINT PRINT DONE

SUMMARY INFORMATION

Species	# Caught	% Catch	Min Size	Capture P	#/Mile	95% CI	#/Acre	95% CI	Lbs/Acre	95% CI
BRK	39	100	93	1.00	686	0	472	0	0	0

LENGTH FREQUENCY RECORD (cm)

Species	0-2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18	18-20	20-22	22-24	24-26	26-28	28-30	30-32	32-34	34-36	36-38	38-40	40-42	42-44	44-46	46-48	48-50	50-52	52-54	54-56	56-58	58-60	>60
BRK						11	16	9	3																						

Water **Coal Creek**

Date 7/21/1987

Location Above Keystone Effluent

Drainage Gunnison

Water Code 39140

Crew Avery, Schrader, Shoemaker"

Notes

Backpack Electrofishing single pass.

UTM Zone 13T

UTM X 324911

UTM Y 4303942

Station Length (ft) 322

Station Width (ft) 19.3

LEVEL 2 - STREAM SURVEY (2 PASS REMOVAL)

SAVE PRINT PRINT DONE

SUMMARY INFORMATION

Species	# Caught	% Catch	Min Size	Capture P	#/Mile	95% CI	#/Acre	95% CI	Lbs/Acre	95% CI
BRK	22	85	93	1.00	361	0	154	0	0	0
CRN	1	4	48	1.00	16	0	7	0	0	0
LOC	3	12	90	1.00	49	0	21	0	0	0

LENGTH FREQUENCY RECORD (cm)

Species	0-2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18	18-20	20-22	22-24	24-26	26-28	28-30	30-32	32-34	34-36	36-38	38-40	40-42	42-44	44-46	46-48	48-50	50-52	52-54	54-56	56-58	58-60	>60
BRK				1		2	6	6	4		3	1																			
CRN							1																								
LOC							2	1																							

Water **Coal Creek**

Date 7/18/2006

Location Above Keystone Effluent

Drainage Gunnison

Water Code 39140

Crew Brauch, Viera et.al."

Notes

Bank Electrofishing with 3 electrodes, samples collected for contaminants of potential concern by U.S. EPA as part of Standard Mine cleanup assessment."

UTM Zone 13T

UTM X 324449

UTM Y 4303718

Station Length (ft) 300

Station Width (ft) 22.2

LEVEL 2 - STREAM SURVEY (2 PASS REMOVAL)

SAVE PRINT PRINT DONE

SUMMARY INFORMATION

Species	# Caught	% Catch	Min Size	Capture P	#/Mile	95% CI	#/Acre	95% CI	Lbs/Acre	95% CI
BRK	25	96	63	0.82	452	50	168	19	17	2
LOC	1	4	90	1.00	18	0	7	0	0	0

LENGTH FREQUENCY RECORD (cm)

Species	0-2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18	18-20	20-22	22-24	24-26	26-28	28-30
BRK		1	2	1	3	1	1	5	6	5	1	2			
LOC								1							

Species	30-32	32-34	34-36	36-38	38-40	40-42	42-44	44-46	46-48	48-50	50-52	52-54	54-56	56-58	58-60	>60
BRK																
LOC																

Sample Location: Coal-10
Coal Creek above Keystone Effluent

Water **Coal Creek**

Location Below Elk Creek

Drainage Gunnison

Crew Weiler, Woodling"

Notes

Backpack electrofishing, single pass."

Date 8/17/1977

Water Code 39140

UTM Zone 13T

UTM X 321388

UTM Y 4302592

Station Length (ft) 300

Station Width (ft) 10.0

LEVEL 2 - STREAM SURVEY (2 PASS REMOVAL)

SAVE PRINT PRINT DONE

SUMMARY INFORMATION

Species	# Caught	% Catch	Min Size	Capture P	#/Mile	95% CI	#/Acre	95% CI	Lbs/Acre	95% CI
BRK	134	100	100	1.00	2358	0	1946	0	0	0

LENGTH FREQUENCY RECORD (cm)

Species	0-2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18	18-20	20-22	22-24	24-26	26-28	28-30	30-32	32-34	34-36	36-38	38-40	40-42	42-44	44-46	46-48	48-50	50-52	52-54	54-56	56-58	58-60	>60
BRK						34	55	25	17		2	1																			

Water **Coal Creek**

Date 7/18/2006

Location Below Elk Creek

Drainage Gunnison

Water Code 39140

Crew Brauch, Viera et.al."

Notes

Bank Electrofishing with 3 electrodes, samples collected for contaminants of potential concern by U.S. EPA as part of Standard Mine cleanup assessment."

UTM Zone 13T

UTM X 321509

UTM Y 4302607

Station Length (ft) 300

Station Width (ft) 15.6

LEVEL 2 - STREAM SURVEY (2 PASS REMOVAL)

SAVE PRINT PRINT DONE

SUMMARY INFORMATION

Species	# Caught	% Catch	Min Size	Capture P	#/Mile	95% CI	#/Acre	95% CI	Lbs/Acre	95% CI
BRK	78	100	63	0.82	1416	83	749	44	54	3

LENGTH FREQUENCY RECORD (cm)

Species	0-2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18	18-20	20-22	22-24	24-26	26-28	28-30	30-32	32-34	34-36	36-38	38-40	40-42	42-44	44-46	46-48	48-50	50-52	52-54	54-56	56-58	58-60	>60
BRK					18	14	15	18	2	4	5	2																			

Sample Location: Coal-15
Coal Creek below Elk Creek

Water **Coal Creek**

Date 6/21/1977

Location .3 M above conf. with Splains Gulch

Drainage Gunnison

Water Code 39140

Crew Weiler

Notes

Backpack Electrofishing single pass.

UTM Zone 13T

UTM X 320409

UTM Y 4302568

Station Length (ft) 140

Station Width (ft) 10.0

LEVEL 2 - STREAM SURVEY (2 PASS REMOVAL)

SAVE PRINT PRINT DONE

SUMMARY INFORMATION

Species	# Caught	% Catch	Min Size	Capture P	#/Mile	95% CI	#/Acre	95% CI	Lbs/Acre	95% CI
BRK	18	100	93	1.00	679	0	560	0	0	0

LENGTH FREQUENCY RECORD (cm)

Species	0-2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18	18-20	20-22	22-24	24-26	26-28	28-30	30-32	32-34	34-36	36-38	38-40	40-42	42-44	44-46	46-48	48-50	50-52	52-54	54-56	56-58	58-60	>60
BRK				1		8	4	5	1																						

Water **Coal Creek**

Date 8/17/1979

Location .3 M above conf. with Splains Gulch

Drainage Gunnison

Water Code 39140

Crew Weiler, Woodling"

Notes

Backpack Electrofishing single pass.

UTM Zone 13T

UTM X 320409

UTM Y 4302568

Station Length (ft) 300

Station Width (ft) 8.0

LEVEL 2 - STREAM SURVEY (2 PASS REMOVAL)

SAVE PRINT PRINT DONE

SUMMARY INFORMATION

Species	# Caught	% Catch	Min Size	Capture P	#/Mile	95% CI	#/Acre	95% CI	Lbs/Acre	95% CI
BRK	57	100	93	1.00	1003	0	1035	0	0	0

LENGTH FREQUENCY RECORD (cm)

Species	0-2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18	18-20	20-22	22-24	24-26	26-28	28-30	30-32	32-34	34-36	36-38	38-40	40-42	42-44	44-46	46-48	48-50	50-52	52-54	54-56	56-58	58-60	>60
BRK				10		7	30	14	5		1																				

Water	**Coal Creek**
Date	7/19/2006
Location	.3 M above conf. with Splains Gulch
Drainage	Gunnison
Water Code	39140
Crew	Brauch, Oulton et.al."
UTM Zone	13T
UTM X	320552
UTM Y	4302576
Station Length (ft)	300
Station Width (ft)	10.8

Notes

Backpack Electrofishing, samples collected for contaminants of potential concern by U.S. EPA as part of Standard Mine cleanup assessment."

LEVEL 2 - STREAM SURVEY (2 PASS REMOVAL)

SAVE PRINT PRINT DONE

SUMMARY INFORMATION

Species	# Caught	% Catch	Min Size	Capture P	#/Mile	95% CI	#/Acre	95% CI	Lbs/Acre	95% CI
BRK	19	100	63	0.89	337	23	257	17	32	2

LENGTH FREQUENCY RECORD (cm)

Species	0-2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18	18-20	20-22	22-24	24-26	26-28	28-30	30-32	32-34	34-36	36-38	38-40	40-42	42-44	44-46	46-48	48-50	50-52	52-54	54-56	56-58	58-60	>60
BRK		1	2		2	2	2	5	2	2	3		1																		

Sample Location: Coal-25E
Coal Creek .3M above confluence with Splains Gulch




Water **Coal Creek**

Date 7/17/2006

Location Below Ohio Creek turnoff upstream of wooden bridge

Drainage Gunnison

Water Code 39140

Crew Brauch, Viera, Dillingham, et.al."

Notes

Backpack Electrofishing, samples collected for contaminants of potential concern by U.S. EPA as part of Standard Mine cleanup assessment."

UTM Zone 13T

UTM X 319052

UTM Y 4302431

Station Length (ft) 300

Station Width (ft) 7.6

LEVEL 2 - STREAM SURVEY (2 PASS REMOVAL)

SAVE PRINT PRINT DONE

SUMMARY INFORMATION

Species	# Caught	% Catch	Min Size	Capture P	#/Mile	95% CI	#/Acre	95% CI	Lbs/Acre	95% CI
BRK	32	100	63	0.73	604	105	656	114	81	14

LENGTH FREQUENCY RECORD (cm)

Species	0-2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18	18-20	20-22	22-24	24-26	26-28	28-30	30-32	32-34	34-36	36-38	38-40	40-42	42-44	44-46	46-48	48-50	50-52	52-54	54-56	56-58	58-60	>60
BRK		1	3		3	6	2	3	8	6	3	1																			

Sample Location: Coal-25
Coal Creek below Ohio Creek Turnoff Upstream of Wooden Bridge

Water **Elk Creek**

Date 6/21/1977

Location Just above C.R. 12

Drainage Gunnison

Water Code 38166

Crew Weiler

Notes

Backpack Electrofishing, single pass.

UTM Zone 13T

UTM X 321316

UTM Y 4302718

Station Length (ft) 100

Station Width (ft) 4.0

LEVEL 2 - STREAM SURVEY (2 PASS REMOVAL)

SAVE PRINT PRINT DONE

SUMMARY INFORMATION

Species	# Caught	% Catch	Min Size	Capture P	#/Mile	95% CI	#/Acre	95% CI	Lbs/Acre	95% CI
BRK	7	100	93	1.00	370	0	762	0	0	0

LENGTH FREQUENCY RECORD (cm)

Species	0-2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18	18-20	20-22	22-24	24-26	26-28	28-30	30-32
BRK								2	3		2					

Species	32-34	34-36	36-38	38-40	40-42	42-44	44-46	46-48	48-50	50-52	52-54	54-56	56-58	58-60	>60
BRK															

Water **Elk Creek**

Date 7/18/2006

Location Just above C.R. 12

Drainage Gunnison

Water Code 38166

Crew Brauch, Vera et.al."

Notes

Backpack Electrofishing, samples collected for contaminants of potential concern by U.S. EPA as part of Standard Mine cleanup assessment."

UTM Zone 13T

UTM X 321319

UTM Y 4302704

Station Length (ft) 150

Station Width (ft) 6.5

LEVEL 2 - STREAM SURVEY (2 PASS REMOVAL)

SAVE PRINT PRINT DONE

SUMMARY INFORMATION

Species	# Caught	% Catch	Min Size	Capture P	#/Mile	95% CI	#/Acre	95% CI	Lbs/Acre	95% CI
BRK	4	100	63	1.00	141	0	179	0	11	0

LENGTH FREQUENCY RECORD (cm)

Species	0-2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18	18-20	20-22	22-24	24-26	26-28	28-30	30-32	32-34	34-36	36-38	38-40	40-42	42-44	44-46	46-48	48-50	50-52	52-54	54-56	56-58	58-60	>60
BRK							2	2																							

Sample Location: Elk-00
Elk Creek just above C.R. 12

Water **Elk Creek**

Date 7/18/2006

Location .1 M above C.R. 12

Drainage Gunnison

Water Code 38166

Crew Brauch, Vera et.al."

Notes

Backpack Electrofishing, no fish seen or taken, additional .5 mile surveyed visually and no fish seen."

UTM Zone 13T

UTM X 321161

UTM Y 4302836

Station Length (ft) 300

Station Width (ft) 7.2

LEVEL 2 - STREAM SURVEY (2 PASS REMOVAL)

SAVE PRINT PRINT DONE

SUMMARY INFORMATION

Species	# Caught	% Catch	Min Size	Capture P	#/Mile	95% CI	#/Acre	95% CI	Lbs/Acre	95% CI

LENGTH FREQUENCY RECORD (cm)

Species	0-2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18	18-20	20-22	22-24	24-26	26-28	28-30	30-32	32-34	34-36	36-38	38-40	40-42	42-44	44-46	46-48	48-50	50-52	52-54	54-56	56-58	58-60	>60

Sample Location: Elk-01
Elk Creek .1M above C.R.12

Water **Elk Creek**

Date 7/19/2006

Location 300' Below Copley Lake Outflow

Drainage Gunnison

Water Code 38166

Crew Brauch et.al.

Notes

Backpack Electrofishing, no fish seen or taken."

UTM Zone 13T

UTM X 319835

UTM Y 4304151

Station Length (ft) 300

Station Width (ft) 8.8

LEVEL 2 - STREAM SURVEY (2 PASS REMOVAL)

SAVE PRINT PRINT DONE

SUMMARY INFORMATION

Species	# Caught	% Catch	Min Size	Capture P	#/Mile	95% CI	#/Acre	95% CI	Lbs/Acre	95% CI

LENGTH FREQUENCY RECORD (cm)

Species	0-2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18	18-20	20-22	22-24	24-26	26-28	28-30	30-32	32-34	34-36	36-38	38-40	40-42	42-44	44-46	46-48	48-50	50-52	52-54	54-56	56-58	58-60	>60

Sample Location: Elk-08
Elk Creek 300 ft. below Copley Lake Outflow





LEVEL 2 - STREAM SURVEY (2 PASS REMOVAL)

SAVE PRINT PRINT DONE

Water: **Splains Gulch**

Date: 7/17/2006

Location: Above confluence with Coal Creek

Drainage: Gunnison

Water Code: 49254

Crew: Brauch, Viera, Dillingham, et.al."

Notes:

Backpack Electrofishing, samples collected for contaminants of potential concern by U.S. EPA as part of Standard Mine cleanup assessment."

UTM Zone: 13T

UTM X: 320929

UTM Y: 4302485

Station Length (ft): 300

Station Width (ft): 7.6

SUMMARY INFORMATION

Species	# Caught	% Catch	Min Size	Capture P	#/Mile	95% CI	#/Acre	95% CI	Lbs/Acre	95% CI
BRK	35	100	63	0.84	630	49	684	53	46	4

LENGTH FREQUENCY RECORD (cm)

Species	0-2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18	18-20	20-22	22-24	24-26	26-28	28-30	30-32	32-34	34-36	36-38	38-40	40-42	42-44	44-46	46-48	48-50	50-52	52-54	54-56	56-58	58-60	>60
BRK				1	4	5	11	6	5	2	1																				

Sample Location: SP-00
Splains Gulch above Confluence with Coal Creek




Water **Splains Gulch**

Date 7/17/2006

Location Below F.R. 885 Crossing

Drainage Gunnison

Water Code 49254

Crew Brauch, Viera, Dillingham, et.al."

Notes

Backpack Electrofishing, samples collected for contaminants of potential concern by U.S. EPA as part of Standard Mine cleanup assessment."

UTM Zone 13T

UTM X 321011

UTM Y 4301192

Station Length (ft) 300

Station Width (ft) 8.2

LEVEL 2 - STREAM SURVEY (2 PASS REMOVAL)

SAVE PRINT PRINT DONE

SUMMARY INFORMATION

Species	# Caught	% Catch	Min Size	Capture P	#/Mile	95% CI	#/Acre	95% CI	Lbs/Acre	95% CI
BRK	17	100	100	0.94	299	10	301	10	25	1

LENGTH FREQUENCY RECORD (cm)

Species	0-2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18	18-20	20-22	22-24	24-26	26-28	28-30	30-32	32-34	34-36	36-38	38-40	40-42	42-44	44-46	46-48	48-50	50-52	52-54	54-56	56-58	58-60	>60
BRK					1		9	3	4	1																					

Sample Location: SP-01
Splains Gulch below F.R. 885 Crossing

Appendix D
Standard Mine Aquatic Toxicity Testing Report 2006
Standard Mine Sediment Toxicity Testing Report 2006

Aquatic Toxicity Testing Report – Standard Mine
Revision 0

Prepared for:

United States Environmental Protection Agency, Region 8
Ecosystem Protection and Remediation – Program Support
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Acronym List

ºC	degrees Celsius
mL	milliliter
DO	dissolved oxygen
EPA	Environmental Protection Agency
ESAT	Environmental Services Assistance Team
LC50	50% lethal concentration
MHRW	Moderately Hard Reconstituted Water
SAP	Sampling and Analysis Plan
SI	Site Inspection
SOP	Standard Operating Procedure

1.0 Introduction

A 96-hour static renewal toxicity test was performed at the Environmental Protection Agency (EPA) Region 8 Laboratory to determine the acute toxicity of site water collected from drainages associated with the Standard Mine, located in Gunnison County, Colorado. As a quality assurance measure a simultaneous reference toxicity test was performed using Moderately Hard Reconstituted Water (MHRW) spiked with zinc sulfate. All tests were performed using rainbow trout (*Oncorynchus mykiss*), with an evaluation endpoint of mortality. This toxicity test report includes a brief background of the Standard Mine area, materials and methods, testing results, a discussion of results, and supporting references.

1.1 Background

The Standard Mine was part of the Ruby Mining District located in Gunnison County, Colorado. Mining activity initially began at the Standard Mine in or around 1874, with the most significant operations beginning in 1931. Operations included the mining of lead, zinc, silver, and gold until 1966, when the mine was abandoned.

The mine consists of many open, unmarked adits and shafts, giving access to 8,400 feet of mine workings on 6 levels. The former mine is near a popular hiking trail and has no access restrictions. Wastes at this mining site are estimated to be 53,560 cubic yards of waste rock and 29,340 cubic yards of mill tailings as well as seasonably variable amounts of water flowing out of the adits. Additionally, the USFS portion of land contains a non-engineered surface impoundment made entirely of highly mineralized waste rock. The unlined impoundment was built to collect metal laden acid mine drainage containing cadmium, copper, lead, and zinc. There is evidence of overflow and seepage through the impoundment into Elk Creek, which runs directly adjacent to the mine. Elk Creek feeds into Coal Creek, which is a drinking water supply for the town of Crested Butte, approximately four miles downstream from the former mine.

In 1999 a two-phase Site Inspection (SI) was conducted of the Ruby Mining District. Phase I was conducted in June 1999 to assess the environmental conditions during the high stream flow regime and phase II was conducted September 1999 to assess the environmental conditions during the low stream flow regime. The 1999 SI was limited to surface water since, according to the United States Geological Survey, there are no extensive aquifer systems associated with the Ruby Mining District (reference?).

SI results revealed elevated concentrations of the following metals: aluminum, antimony, arsenic, beryllium, cadmium, cobalt, copper, iron, lead, nickel, thallium, and zinc from total metals analyses of the surface waters from Coal Creek and its tributaries. SI results were confirmed by subsequent investigations performed in 2005 and 2006, which, in addition to metals impacted surface water, also identified metals impacted sediments in Elk Creek and Coal Creek, though to a lesser extent.

1.2 Objective

The objective of this toxicity test was to support the ecological risk assessment being performed as a part of site assessment activities currently underway at the Standard Mine. Mortality results will be incorporated into a site-wide Baseline Ecological Risk Assessment which will be used in the remediation decision making process for the site.

2.0 Materials and Methods

This section outlines the materials and methods employed for testing purposes, including surface water collection procedures, water preparation and delivery, test organisms, food preparation, and test conditions. General test methodologies and testing criteria followed EPA protocol (EPA 2002) and are included in Table 2.0-1.

2.1 Surface Water Collection

Surface water was collected during the July 2006 sampling event in accordance with the 2006 Sampling and Analysis Plan/Quality Assurance Project Plan (SAP) for the Standard Mine (ESAT 2006). Surface water was collected from locations along Coal Creek, Elk Creek, Copley Lake outflow, and Splain's Gulch using multiple one-gallon cubitainers for each site. After collection, samples were transported to the Region 8 Laboratory and placed in a 4^{o}C cooler for preservation until test initiation. Since dedicated cubitainers were used for each site, equipment decontamination was not needed during sample collection.

2.2 Water Preparation and Renewal

MHRW used for reference toxicity testing was prepared in accordance with Smith et al. (1997). MHRW preparation included adding 50 grams of calcium sulfate, 50 grams of calcium carbonate, 30 grams of magnesium sulfate, 96 grams of sodium bicarbonate, and 4 grams of potassium chloride to the laboratory stainless steel batch tank containing 1,000 liters of deionized water. The batch tank was continuously aerated once the MHRW was prepared and for the duration of the reference toxicity test. Water quality was measured to verify that the following parameters had been met: hardness between 90 and 100 milligrams per liter (mg/L), alkalinity between 50 and 70 mg/L, conductivity between 330 and 360 millisiemens/centimeter, and pH between 7.8 and 8.2 (USEPA 2002).

MHRW (reference toxicity test) and site water were renewed on a daily basis. One renewal was considered achieved when at least 90% of the water in each test chamber was replaced (measured volumetrically). Site water used for testing was allowed to warm to 12^{o}C before water renewal. Water in each test chamber was held constant by using water chillers and a water bath setup.

2.3 Test Organisms

O. mykiss specimens obtained from Trout Lodge, Inc. (located in Sumner, Washington) were used for site water and reference toxicity testing. Once received at the Region 8 Laboratory organisms were held in a holding tank for approximately 48 hours (while still in the shipping bag) for temperature and water quality acclimation. While in the holding tank, water temperature was allowed to equilibrate to 12^{o}C, equivalent to the testing temperature. Note that the organisms were cultured and shipped using MHRW; therefore water quality acclimation was not considered a substantial stress concern for organisms. However, in order to reduce the potential of stress to the organisms, once temperature equilibration was complete the shipping bag was opened to allow a small amount of MHRW to mix with the shipping water. This procedure was repeated several times through the course of one day until laboratory MHRW and shipping water were well mixed. At the time of testing organisms were 15-30 days post yolk sac absorption and were uniform in size.

2.4 Food Preparation

Organisms were fed a combination of brine shrimp (Artemia nauplii) and starter trout chow obtained from Nelson's Silver Cup, Inc. in accordance with EPA methodology (USEPA 2002). Brine shrimp was prepared using techniques specified in Quality Control Protocol Procedure for Culturing of Brine Shrimp (Artemia nauplii) used for feeding during acute aquatic toxicity testing (USEPA 2002).

2.5 Test Procedures

The following sections include the procedures employed for the site water toxicity test and reference toxicity tests.

2.5.1 Site Water Toxicity Test

Site water used for testing purposes was obtained from the following nine locations along Coal Creek, Elk Creek, Splain's Gulch, and the Copley Lake outflow: Coal-15, Coal-20, SP-00 (reference site), Elk-00, Elk-05, Elk-06, Elk-08, Elk-10, and Cop-01. One duplicate sample was collected from Elk-10. For quality control purposes a control using MHRW was also tested. Testing chambers consisted of 1-liter glass beakers which were placed in a water bath to maintain a temperature of 12^{o}C throughout the experiment. Four replicates were tested for each location, including the control. Testing criteria specified in Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms (EPA 2002) were followed (Table 2.5-1).

Prior to test initiation a total of 8 organisms were added to each testing chamber using a small dip net. For site waters, a total of 4 replicate chambers were used, with 8 organisms per chamber, and a total of 32 organisms for each specific site. While the organisms were in the dip net they were quickly counted to verify that the correct number was being added to each chamber. In order to reduce the accumulation of metabolic wastes, organisms were not fed for 24 hours prior to test initiation.

As stated above, testing took place over a 96 hour period, with one water renewal occurring each day. For the duration of the test, water quality was measured daily for dissolved oxygen, pH, conductivity, and temperature. On the day of test initiation and test completion water chemistries were also measured for alkalinity and hardness. Organism mortality was also observed and recorded on a daily basis. Any dead organisms were removed from each test chamber on a daily basis. Appendix A includes water chemistry and mortality data sheets for the site water toxicity test. Surface water samples were collected and analyzed for total metals and dissolved metals using EPA

Method 6010/6020. Results are included in Table 2.5-2. For total metals and dissolved metals all units are expressed in micorgrams per liter (ug/L).

2.5.2 Reference Toxicity Test

As a quality assurance step, a reference aquatic toxicity test was performed using *O. mykiss* simultaneously with the site water toxicity test. For testing purposes MHRW was spiked with zinc sulfate heptahydrate using a serial dilution approach that ranged from 100% (327 milligrams per liter [mg/L]) to 6.25% (31.4 mg/L). Zinc concentrations were verified in the analytical laboratory using EPA Method 6010/6020. The reference aquatic toxicity test was performed using the same methodologies outlined in Section 2.5.1 (Site Water Toxicity Test) with one exception, 10 organisms per test chamber with a total of 4 replicates for each concentration were used. Mortality data for the reference toxicity test are included in Appendix B. Laboratory determined zinc concentrations for the reference aquatic toxicity test are included in Table 2.5-2.

3.0 Results

This section presents results for the surface water toxicity testing and reference aquatic toxicity testing. This section also addresses any issues or unforeseen conditions encountered during the testing period.

3.1 Site Water Toxicity Test

Water quality parameters were consistent throughout the site water toxicity test and are listed in Appendix A. Dissolved oxygen typically was seen above 6.0 mg/L, although in test chambers from Coal-20 and Elk-05 dissolved oxygen dropped to 4.21 mg/L and 5.97 mg/L respectively. Average test chamber temperatures were maintained within +/- 1^{o}C of the target test temperature (12 ^{o}C).

Daily mortality numbers were evaluated at the end of the test to determine site water toxicity to the test organisms (Appendix A and Figure 3.1-1). Results showed little or no mortality at Cop-01 (0% mortality), Coal-15 (3% mortality), Coal-20 (13% mortality), and SP-00 (16% mortality). Elk Creek showed the most organism mortality with values ranging from 66% (Elk-00) to 100% (Elk-08, Elk-10, and Elk-10D). Elk-05 and Elk-06 had mortality values of 84% and 81% respectively. The control used in this experiment showed greater than 90% survival overall, which met performance criteria.

3.2 Reference Toxicity Test

Water quality parameters were similar in all testing chambers and water chemistries fell within acceptable ranges for temperature, dissolved oxygen, pH, and conductivity for the reference toxicity test (Appendix B and Figure 3.1-2). No mortality was observed in the 6.25% (31 ug/L of zinc), 12.5% (50 ug/L of zinc), and 25% (97 ug/L of zinc) dilutions. 45% mortality was observed in the 50% dilution (225 ug/L of zinc), and 93% mortality was observed in the 100% dilution (327 of ug/L). For the control, 3% mortality (1 death) was observed. The Trimmed Spearman Karber method (Hamilton 1977) was used to calculate an LC50 value as well as upper and lower confidence levels. The LC50 value for the reference toxicity test was 214 ug/L with an upper confidence level of 240 ug/L and a lower confidence level of 191 ug/L.

4.0 Discussion

Results of the site specific surface water toxicity test indicated that the sites along Elk Creek were acutely toxic to *O. mykiss* over a 96 hour time period. Specifically, the upper reaches of Elk Creek that were nearest the mine (Elk-10, Elk-10D, Elk-08) each had 100% organism mortality. Substantial mortality was also observed farther down the Elk Creek drainage with Elk-06 and Elk-05, with each site showing organism mortality greater than 80%. Acute toxicity was also observed just before the Elk Creek confluence with Coal Creek at Elk-00 (63% mortality). The remaining sites (SP-00, Coal-20, Coal-15, and Cop-01) did not show substantial toxicity to the test species. Results of the reference toxicity test were supportive of the site water toxicity test (Table 2.5-2). Zinc concentrations observed at the Elk Creek locations (acutely toxic to the test organisms) ranged from 588 ug/L (Elk-00) to 4,400 ug/L (Elk-10), all above the LC50 for zinc determined from the reference toxicity test. The remaining sites (not acutely toxic to the test organisms) all had zinc concentrations ranging from non-detect (SP-00 and Coal-20) to 200 (Coal-15), below the reference toxicity test LC50 for zinc.

5.0 References

U.S. Environmental Protection Agency. October 2002. “Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms”

Hamilton, M.A., R.C. Russo, and R.V. Thurston. 1977. Trimmed Spearman-Karber method for estimating median lethal concentrations in toxicity bioassays. Env.Sci. Tech. 11(7): 714-719

Environmental Services Assistance Team. 2006. Sampling and Analysis Plan/Quality Assurance Project Plan, 2006 Sampling Events, Standard Mine, Gunnison Colorado

Tables

Table 2.5-1
Test Conditions

Test Type	Static non -renewal, static renewal, or flow through
Test Duration	24,48, hour
Temperature	12°C +/- 1°C (Temp must not deviate more than 3°C during test
Light Quality	Ambient Laboratory Illumination
Light Intensity	50-100 ft-c
Photo Period	16h:8d
Test Chamber Size	Based on Loading
Test Solution Volume	1L
Renewal of Test Solutions	
Age of Test Organisms	Rainbow Trout (15-30 days after yolk sac absorption)
No. organisms per chamber	10 for effluent and receiving waters
No. Replicate Chambers per Concentration	2 for effluent, 4 for receiving
No. Organisms per concentration	20 for effluent tests, 40 for receiving
Feeding Regime	Feeding not required
Test Chamber Cleaning	Cleaning not Required
Test Solution Aeration	None, unless DO concentration falls below 6.0 mg/L, rate should not exceed 100 bubbles per minute

Table 2.5-2 Analytical Results for Surface Water

Dissolved Metals (ug/L)

Location	Aluminum	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Nickel	Potassium	Selenium	Silica (SiO2)	Silver	Sodium	Vanadium	Zinc
Coal-15	<50.0U	<5.00U	22.8	<1.00U	<1.00U	18500J	<1.00U	<1.00U	1.78J	83.6J	<5.00U	2400J	15	<2.00U	578J	<10.0U	6730	<2.00U	2460J	<2.00U	200
Coal-20	<100UD	<10.0UD	25.1D	<2.00UD	<2.00UD	12600D	<2.00UD	<2.00UD	<2.00UD	134JD	<10.0UD	2420D	6.63JD	<4.00UD	<400UD	<20.0UD	6000D	<4.00UD	2350D	<4.00UD	<10.0UD
Elk-00	<100UD	<10.0UD	16.7JD	<2.00UD	2.98JD	25600D	<2.00UD	<2.00UD	4.31JD	<100UD	<10.0UD	1800JD	31.1D	<4.00UD	559JD	<20.0UD	7140D	<4.00UD	2370D	<4.00UD	588D
Elk-05	<100UD	13.6JD	17.2JD	<2.00UD	3.38JD	24900D	<2.00UD	<2.00UD	4.71JD	<100UD	<10.0UD	1780JD	52.8D	4.10JD	568JD	<20.0UD	7070D	<4.00UD	2380D	<4.00UD	652D
Elk-06	<100UD	<10.0UD	17.5JD	<2.00UD	3.17JD	24500D	<2.00UD	<2.00UD	5.13JD	<100UD	<10.0UD	1750JD	51.6D	<4.00UD	578JD	<20.0UD	7050D	<4.00UD	2300D	<4.00UD	646D
Elk-08	<100UD	<10.0UD	10.8JD	<2.00UD	10.9D	25300D	<2.00UD	<2.00UD	11.0D	<100UD	<10.0UD	2220D	436D	<4.00UD	687JD	<20.0UD	6280D	<4.00UD	2120D	<4.00UD	2050D
Elk-10	107JD	<10.0UD	13.5JD	<2.00UD	25.0D	24700D	<2.00UD	2.71JD	28.0D	<100UD	24.8JD	2520D	1310D	4.14JD	829JD	<20.0UD	6250D	<4.00UD	1920JD	<4.00UD	4400D
Elk-10D	106JD	<10.0UD	13.2JD	<2.00UD	24.8D	24200D	<2.00UD	2.52JD	26.9D	<100UD	22.3JD	2480D	1290D	<4.00UD	689JD	<20.0UD	6160D	<4.00UD	1890JD	<4.00UD	4350D
Cop-01	<100UD	<10.0UD	5.42JD	<2.00UD	<2.00UD	5140D	<2.00UD	<2.00UD	<2.00UD	316JD	<10.0UD	614JD	43.4D	<4.00UD	<400UD	<20.0UD	1310D	<4.00UD	1160JD	<4.00UD	10.5JD
SP-00	<100UD	<10.0UD	14.0JD	<2.00UD	<2.00UD	9560D	<2.00UD	<2.00UD	<2.00UD	<100UD	<10.0UD	1860JD	<2.00UD	<4.00UD	<400UD	<20.0UD	9140D	<4.00UD	2900D	<4.00UD	<10.0UD
Control	<100UD	<10.0UD	<4.00UD	<2.00UD	<2.00UD	17400D	<2.00UD	<2.00UD	<2.00UD	<100UD	<10.0UD	15100D	<2.00UD	<4.00UD	2530D	<20.0UD	<100UD	<4.00UD	33000D	<4.00UD	<10.0UD
Blank	<100UD	<10.0UD	<4.00UD	<2.00UD	<2.00UD	<100UD	<2.00UD	<2.00UD	<2.00UD	<100UD	<10.0UD	<400UD	<2.00UD	<4.00UD	<400UD	<20.0UD	<100UD	<4.00UD	<400UD	<4.00UD	<10.0UD
Ref 6.25	<100UD	<10.0UD	<4.00UD	<2.00UD	<2.00UD	17700D	<2.00UD	<2.00UD	2.27JD	<100UD	<10.0UD	15300D	<2.00UD	<4.00UD	2550D	<20.0UD	<100UD	<4.00UD	33500D	<4.00UD	31.4JD
Ref 6.25D	<100UD	<10.0UD	<4.00UD	<2.00UD	<2.00UD	18000D	<2.00UD	<2.00UD	<2.00UD	<100UD	<10.0UD	15600D	<2.00UD	<4.00UD	2640D	<20.0UD	<100UD	<4.00UD	34100D	<4.00UD	31.1JD
Ref 12.5	<100UD	11.5JD	<4.00UD	<2.00UD	<2.00UD	17800D	<2.00UD	<2.00UD	2.14JD	<100UD	<10.0UD	15400D	<2.00UD	<4.00UD	2510D	21.4JD	<100UD	<4.00UD	33700D	<4.00UD	50.0D
Ref 25	<100UD	<10.0UD	<4.00UD	<2.00UD	<2.00UD	17800D	<2.00UD	<2.00UD	<2.00UD	<100UD	<10.0UD	15500D	<2.00UD	<4.00UD	2580D	<20.0UD	<100UD	<4.00UD	33800D	<4.00UD	97.0D
Ref 50	<100UD	<10.0UD	<4.00UD	<2.00UD	<2.00UD	18000D	<2.00UD	<2.00UD	2.05JD	<100UD	<10.0UD	15600D	<2.00UD	<4.00UD	2570D	24.7JD	<100UD	<4.00UD	34100D	<4.00UD	225D
Ref 100	<100UD	<10.0UD	<4.00UD	<2.00UD	<2.00UD	16900D	<2.00UD	<2.00UD	3.26JD	<100UD	<10.0UD	14500D	<2.00UD	<4.00UD	2600D	<20.0UD	<100UD	<4.00UD	33600D	<4.00UD	327D
Ref Control	<100UD	<10.0UD	<4.00UD	<2.00UD	<2.00UD	18200D	<2.00UD	<2.00UD	<2.00UD	<100UD	<10.0UD	15700D	<2.00UD	<4.00UD	2660D	<20.0UD	<100UD	<4.00UD	34400D	<4.00UD	<10.0UD

Total Metals (ug/L)

Location	Aluminum	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Nickel	Potassium	Selenium	Silica (SiO2)	Silver	Sodium	Vanadium	Zinc	Hardness (mg/L)
Coal-15	56.1J	<5.00U	22	<1.00U	1.03J	15000	<1.00U	<1.00U	2.95J	124J	<5.00U	1920	15.9	<2.00U	401J	14.7J	5820	<2.00U	2020	<2.00U	182	56
Coal-20	55.7J	9.60J	24.4	<1.00U	<1.00U	10800	<1.00U	<1.00U	2.33J	163J	<5.00U	2030	8.35	<2.00U	425J	<10.0U	5280	<2.00U	2040	<2.00U	<5.00U	41D
Elk-00	<50.0U	5.34J	16.9	<1.00U	3.13J	24500	<1.00U	<1.00U	3.04J	<50.0U	<5.00U	1660	32.7	<2.00U	449J	<10.0U	7260	3.11J	2130	<2.00U	587	71D
Elk-05	<50.0U	12.1J	17.4	<1.00U	3.48J	23800	<1.00U	<1.00U	3.69J	<50.0U	<5.00U	1670	54	<2.00U	429J	<10.0U	7300	2.19J	2060	<2.00U	652	70D
Elk-06	<50.0U	8.38J	17.6	<1.00U	3.43J	23800	<1.00U	<1.00U	3.38J	<50.0U	<5.00U	1670	54.5	<2.00U	433J	<10.0U	7350	<2.00U	2080	<2.00U	654	68D
Elk-08	84.8J	6.27J	11	<1.00U	11.5	24400	<1.00U	<1.00U	12.6	154J	14.6J	2070	457	2.13J	477J	<10.0U	6510	<2.00U	1850	<2.00U	2100	72D
Elk-10	138J	<5.00U	13.6	<1.00U	26.1	23800	<1.00U	2.25J	32.3	153J	36.6	2380	1350	4.62J	572J	<10.0U	6590	<2.00U	1610	<2.00U	4540	72D
Elk-10D	202	7.33J	13.8	<1.00U	26.7	24400	<1.00U	2.47J	39.5	252	58.9	2450	1380	4.64J	523J	<10.0U	6740	<2.00U	1650	<2.00U	4640	71D
Cop-01	101J	7.71J	5.84J	<1.00U	<1.00U	4760	<1.00U	<1.00U	1.10J	791	<5.00U	557J	75.3	<2.00U	<200U	<10.0U	1360	<2.00U	903J	<2.00U	<5.00U	15D
SP-00	<50.0U	<5.00U	13.5	<1.00U	<1.00U	8330	<1.00U	<1.00U	<1.00U	<50.0U	<5.00U	1610	<1.00U	<2.00U	<200U	<10.0U	8740	<2.00U	2540	<2.00U	<5.00U	32D
Control	<50.0U	9.63J	<2.00U	<1.00U	<1.00U	15800	<1.00U	<1.00U	<1.00U	<50.0U	<5.00U	13400	<1.00U	<2.00U	2180	<10.0U	<50.0U	3.72J	29200	<2.00U	<5.00U	106D
Blank	<50.0U	<5.00U	<2.00U	<1.00U	<1.00U	<50.0U	<1.00U	<1.00U	<1.00U	<50.0U	<5.00U	<200U	<1.00U	<2.00U	<200U	<10.0U	<50.0U	<2.00U	<200U	<2.00U	<5.00U	<0.6UD
Ref 6.25	<50.0U	<5.00U	<2.00U	<1.00U	<1.00U	16400	<1.00U	<1.00U	<1.00U	<50.0U	<5.00U	13900	<1.00U	<2.00U	2340	<10.0U	<50.0U	2.75J	30800	<2.00U	25.4	107D
Ref 6.25D	<50.0U	<5.00U	<2.00U	<1.00U	<1.00U	16200	<1.00U	<1.00U	<1.00U	<50.0U	<5.00U	13800	<1.00U	<2.00U	2360	<10.0U	<50.0U	3.80J	30500	<2.00U	25.6	109D
Ref 12.5	<50.0U	7.50J	<2.00U	<1.00U	<1.00U	16100	<1.00U	<1.00U	<1.00U	<50.0U	<5.00U	13700	<1.00U	<2.00U	2280	<10.0U	<50.0U	3.91J	30200	<2.00U	47.4	108D
Ref 25	<50.0U	7.41J	<2.00U	<1.00U	<1.00U	16200	<1.00U	<1.00U	<1.00U	<50.0U	<5.00U	13800	<1.00U	<2.00U	2260	<10.0U	<50.0U	3.07J	30400	<2.00U	94.5	108D
Ref 50	278	6.18J	<2.00U	<1.00U	<1.00U	14800	<1.00U	<1.00U	<1.00U	<50.0U	<5.00U	12000	<1.00U	<2.00U	1880	<10.0U	<50.0U	2.47J	26200	<2.00U	156	109D
Ref 100	<50.0U	<5.00U	<2.00U	<1.00U	<1.00U	16500	<1.00U	<1.00U	1.14J	<50.0U	<5.00U	14000	<1.00U	<2.00U	2420	<10.0U	<50.0U	2.92J	30900	<2.00U	336	102D
Ref Control	<50.0U	<5.00U	<2.00U	<1.00U	<1.00U	16100	<1.00U	<1.00U	<1.00U	<50.0U	<5.00U	13600	<1.00U	<2.00U	2310	<10.0U	<50.0U	4.14J	30100	<2.00U	7.68J	110D

Notes:
U - indicates analyte not detected (result is reported as less than the method detection limit)
J - indicates result is an estimated value (refer to analytical data package narrative for a discussion)
D - indicates sample was diluted (method detection limit will be approximately 2X higher in these samples)
mg/L - milligrams per liter
ug/L - micrograms per liter

Figures

Figure 3.1-1   Standard Mine Site Water Toxicity Test - Mortality

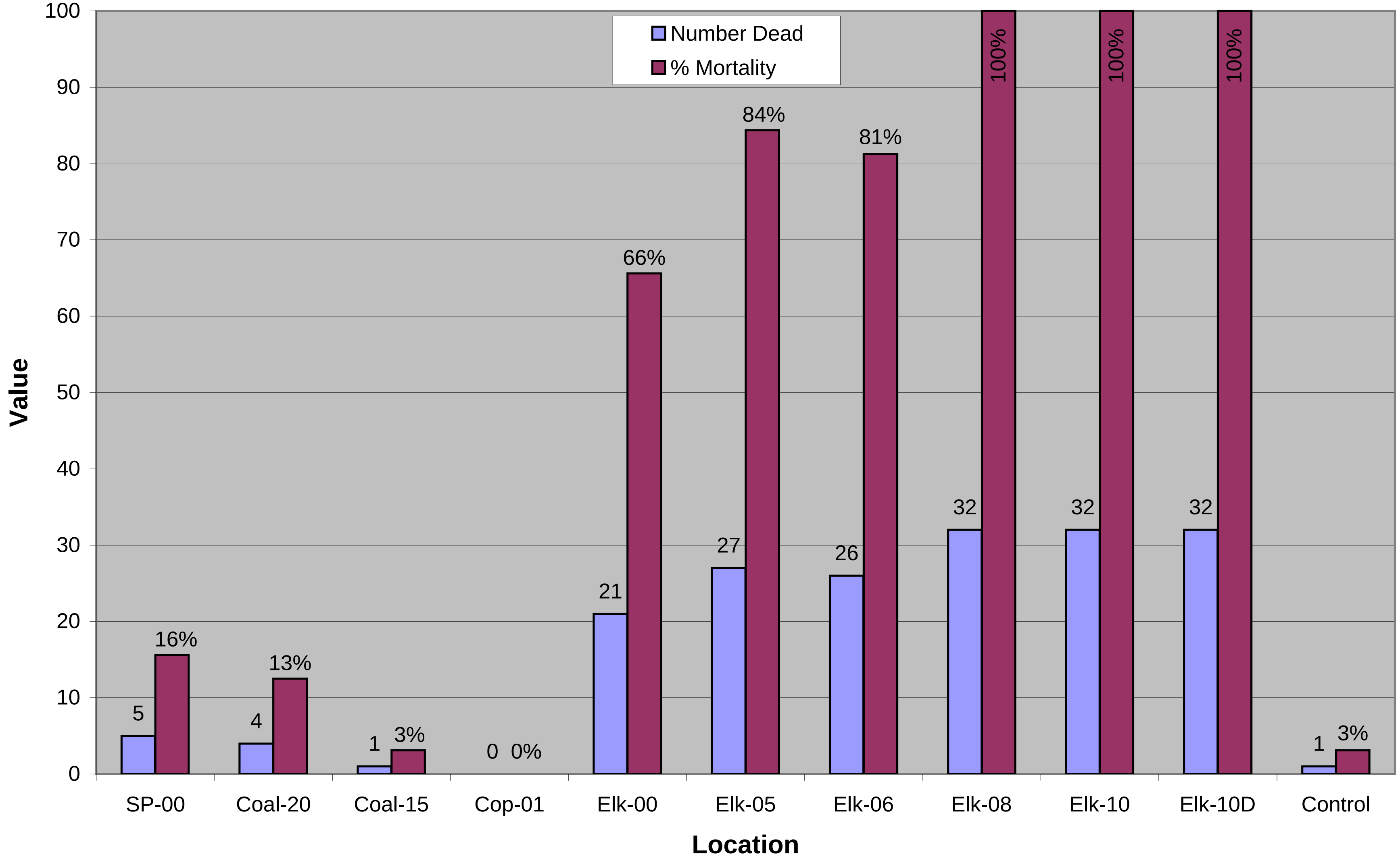
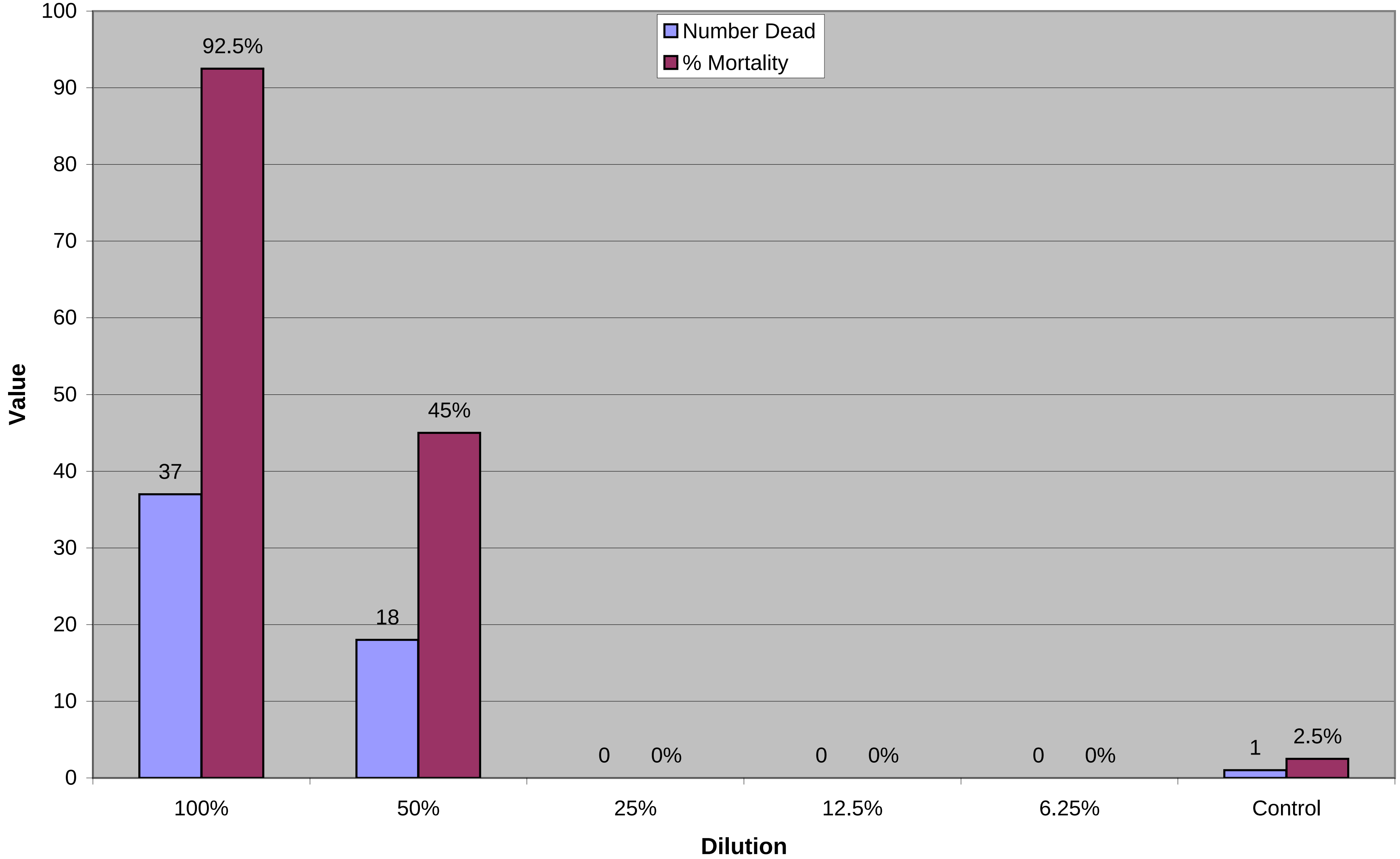


Figure 3.1-2   Reference Toxicity Test - Mortality



Appendix A - Standard Mine Site Water Toxicity Test - Test Data

Site ID	Test Day	Temp. (°C)	D.O. (mg/L)	pH	Alkalinity	Hardness	Conductivity	Number Dead	Total Number Dead	% Mortality
SP-00-01	Day 0	11.35	7.27	7.66			43.3	0		
	Day 1	11.79	7.62	7.56			51.5	0		
	Day 2	11.62	7.59	7.6			52	0		
	Day 3	12.06	6.83	7.5			52.4	0		
	Day 4	12.45	6.15	7.34	35	21.2	51.1	0		
SP-00-02	Day 0	10.35	7.68	7.62			43	0		
	Day 1	11.81	6.53	7.61			50.2	0		
	Day 2	11.82	6.41	7.62			51.6	0		
	Day 3	11.77	6.84	7.49			54	0		
	Day 4	12.02	6.47	7.31	35	21.2	52.9	0		
									5	16%
SP-00-03	Day 0	10.02	7.76	7.62			43.1	0		
	Day 1	11.84	7.81	7.54			55.2	5		
	Day 2	11.92	7.01	7.61			54.3	0		
	Day 3	11.69	7.45	7.54			48.3	0		
	Day 4	12.07	6.41	7.39	35	21.2	46.3	0		
SP-00-04	Day 0	9.86	7.32	7.59			43.2	0		
	Day 1	11.94	7.4	7.59			44.1	0		
	Day 2	11.9	6.71	7.6			55.2	0		
	Day 3	11.77	7.24	7.53			54.8	0		
	Day 4	11.89	6.59	7.49	35	21.2	51.5	0		
Coal-20-01	Day 0	11.12	7.24	7.49			59.6	0		
	Day 1	11.89	6.25	7.31			67.6	0		
	Day 2	11.92	6.03	7.42			69.6	0		
	Day 3	11.76	6.31	7.35			68.4	0		
	Day 4	11.79	6.1	7.24	30	37.2	67.1	0		
Coal-20-02	Day 0	10.14	7.32	7.53			60	0		
	Day 1	11.72	4.21	7.48			70.3	4		
	Day 2	11.86	6.58	7.63			72.2	0		
	Day 3	11.67	7.05	7.43			72	0		
	Day 4	11.78	6.21	7.29	30	37.2	65.4	0		
									4	13%
Coal-20-03	Day 0	9.85	7.94	7.56			60.4	0		
	Day 1	11.59	6.1	7.24			70.1	0		
	Day 2	11.61	6.25	7.28			71.2	0		
	Day 3	11.65	6.01	7.25			71.5	0		
	Day 4	11.73	6.81	7.25	30	37.2	68.7	0		
Coal-20-04	Day 0	9.79	8.01	7.59			60.5	0		
	Day 1	11.64	6.14	7.25			70.7	0		
	Day 2	11.64	6.03	7.29			71.7	0		
	Day 3	11.7	6.1	7.39			73.6	0		
	Day 4	11.75	6.5	7.26	30	37.2	69	0		

Appendix A - Standard Mine Site Water Toxicity Test - Test Data

Site ID	Test Day	Temp. (◦C)	D.O. (mg/L)	pH	Alkalinity	Hardness	Conductivity	Number Dead	Total Number Dead	% Mortality
Coal-15-01	Day 0	10.19	8.08	7.32			79.1	0		
	Day 1	11.66	7.02	7.25			87.8	0		
	Day 2	11.72	7	7.31			88.6	1		
	Day 3	11.88	7.52	7.28			88.6	0		
	Day 4	11.65	6.95	7.27	33	40	85	0		
Coal-15-02	Day 0	9.71	8.07	7.42			78.8	0		
	Day 1	11.53	6.31	7.3			87.4	0		
	Day 2	11.65	6.27	7.48			88.1	0		
	Day 3	11.69	6.45	7.23			92.3	0		
	Day 4	11.64	6.68	7.27	33	40	87.9	0		
									1	3%
Coal-15-03	Day 0	9.77	8.04	7.45			78.4	0		
	Day 1	11.54	6.26	7.27			87.7	0		
	Day 2	11.58	6.72	7.31			86.4	0		
	Day 3	11.65	6.33	7.21			92	0		
	Day 4	11.69	6.02	7.21	33	40	88.6	0		
Coal-15-04	Day 0	9.67	8.03	7.52			78.8	0		
	Day 1	11.57	6.29	7.29			86.9	0		
	Day 2	11.61	6.72	7.32			87	0		
	Day 3	11.67	6.75	7.23			91.6	0		
	Day 4	11.58	6.27	7.24	33	40	87.5	0		
Cop-01-01	Day 0	10.68	7.72	7.39			20.7	0		
	Day 1	11.64	6.47	7.47			31.7	0		
	Day 2	11.68	6.21	7.49			32.2	0		
	Day 3	11.91	6.81	7.25			32	0		
	Day 4	11.88	6.04	7.21	18	12.4	28.3	0		
Cop-01-02	Day 0	10.07	7.45	7.34			20.9	0		
	Day 1	11.58	6.1	7.27			30.7	0		
	Day 2	11.62	6.54	7.38			31.6	0		
	Day 3	11.75	6.62	7.41			32	0		
	Day 4	11.7	6.67	7.42	18	12.4	28.5	0		
									0	0%
Cop-01-03	Day 0	9.92	7.26	7.25			20.9	0		
	Day 1	11.57	6.3	7.16			31	0		
	Day 2	11.62	6.47	7.21			32.2	0		
	Day 3	11.72	6.07	7.01			33.8	0		
	Day 4	11.84	6.06	7.05	18	12.4	29.2	0		
Cop-01-04	Day 0	9.75	7.53	7.23			20.8	0		
	Day 1	11.57	6.37	7.1			29.3	0		
	Day 2	11.5	6.8	7.21			31.6	0		
	Day 3	11.71	6.43	6.95			29.8	0		
	Day 4	11.82	6.3	7.01	18	12.4	27.3	0		

Appendix A - Standard Mine Site Water Toxicity Test - Test Data

Site ID	Test Day	Temp. (◦C)	D.O. (mg/L)	pH	Alkalinity	Hardness	Conductivity	Number Dead	Total Number Dead	% Mortality
Elk-00-01	Day 0	10.67	7.72	7.01			112.9	0		
	Day 1	11.6	6.55	6.85			125.8	0		
	Day 2	11.63	6.54	7			127.1	4		
	Day 3	11.97	7.07	7.01			122.2	1		
	Day 4	12.05	6.4	7.09	35	58	114.7	0		
Elk-00-02	Day 0	10.06	8.14	7.14			113.4	0		
	Day 1	11.57	6.25	6.99			124.9	0		
	Day 2	11.6	7.02	6.73			126.6	4		
	Day 3	11.77	7.44	7.21			124.7	0		
	Day 4	11.67	6.16	7.19	35	58	119.2	0		
									21	66%
Elk-00-03	Day 0	9.79	8.1	7.22			114.1	0		
	Day 1	11.55	6.42	7.07			125.8	0		
	Day 2	11.62	6.96	7			124.3	5		
	Day 3	11.33	6.96	7.34			125	0		
	Day 4	11.48	6.43	7.48	35	58	118	0		
Elk-00-04	Day 0	9.87	7.68	7.31			113.5	0		
	Day 1	11.57	6.01	7.07			124.9	4		
	Day 2	11.68	6.93	7.02			126.1	2		
	Day 3	11.77	7.2	7.43			123.7	1		
	Day 4	11.49	6.81	7.52	35	58	116.5	0		
Elk-05-01	Day 0	10.94	7.83	7.22			108	0		
	Day 1	11.6	6.44	7.15			122.5	1		
	Day 2	11.59	7.62	7.11			123.7	7		
	Day 3	11.75	7.04	7.62			116.9	0		
	Day 4				34	56.8		0		
Elk-05-02	Day 0	10.16	7.97	7.31			109.5	0		
	Day 1	11.54	6.1	7.1			121.8	2		
	Day 2	11.58	5.97	7.06			121.6	5		
	Day 3							1		
	Day 4				34	56.8		0		
									27	84%
Elk-05-03	Day 0	9.86	8.16	7.35			111	0		
	Day 1	11.51	6.11	7.2			121.2	2		
	Day 2	11.62	6.03	7.11			122.2	2		
	Day 3	11.72	7.04	7.58			117.1	1		
	Day 4	11.77	6.04	7.41	34	56.8	113	0		
Elk-05-04	Day 0	9.74	8.16	7.39			111.6	0		
	Day 1	11.54	6.65	7.23			122.9	1		
	Day 2	11.68	6.17	7.75			123.9	5		
	Day 3	11.75	7.12	7.57			116	0		
	Day 4	11.75	7.09	7.42	34	56.8	112.9	0		

Appendix A - Standard Mine Site Water Toxicity Test - Test Data

Site ID	Test Day	Temp. (◦C)	D.O. (mg/L)	pH	Alkalinity	Hardness	Conductivity	Number Dead	Total Number Dead	% Mortality
Elk-06-01	Day 0	10.64	8.33	7.06			109.7	0		
	Day 1	11.58	6.71	7.29			122.5	2		
	Day 2	11.69	7.21	7.19			123.4	5		
	Day 3	11.79	7.33	7.63			114	0		
	Day 4	11.81	7.4	7.46	33	54	111.6	0		
Elk-06-02	Day 0	10.03	8.09	7.29			110	0		
	Day 1	11.56	6.76	7.29			122.4	2		
	Day 2	11.84	6.02	7.77			123.9	4		
	Day 3	11.75	7.04	7.61			117.2	1		
	Day 4	11.47	7.03	7.45	33	54	114	0		
									26	81%
Elk-06-03	Day 0	10.28	7.91	7.37			110.1	0		
	Day 1	11.55	6.76	7.23			122.1	1		
	Day 2	11.86	7.25	7.31			123.3	7		
	Day 3	12.04	6.55	7.47			128.6	0		
	Day 4				33	54		0		
Elk-06-04	Day 0	10.05	7.66	7.41			110.4	0		
	Day 1	11.54	6.56	7.31			124.1	0		
	Day 2	11.74	6.8	7.37			124.4	3		
	Day 3	11.8	6.82	7.36			121.8	1		
	Day 4	11.74	7.01	7.44	33	54	117.4	0		
Elk-08-01	Day 0	10.47	7.75	7.11			125.1	0		
	Day 1	11.54	6.87				139.1	6		
	Day 2	11.72	6.96	7.22			143.2	2		
	Day 3							0		
	Day 4				22.5	53.2		0		
Elk-08-02	Day 0	10.25	7.42	7.19			124.8	0		
	Day 1	11.58	7.4	7.22			140.8	6		
	Day 2	11.69	7.02	7.32			142.1	2		
	Day 3							0		
	Day 4				22.5	53.2		0		
									32	100%
Elk-08-03	Day 0	9.84	7.54	7.26			126.1	0		
	Day 1	11.52	7.23	7.25			140.2	7		
	Day 2	11.62	7.01	7.3			141.2	1		
	Day 3							0		
	Day 4				22.5	53.2		0		
Elk-08-04	Day 0	9.86	7.42	7.31			125.7	0		
	Day 1	11.53	7.36	7.26			141.1	7		
	Day 2	11.7	7.02	7.32			142.8	1		
	Day 3							0		
	Day 4				22.5	53.2		0		

Appendix A - Standard Mine Site Water Toxicity Test - Test Data

Site ID	Test Day	Temp. (◦C)	D.O. (mg/L)	pH	Alkalinity	Hardness	Conductivity	Number Dead	Total Number Dead	% Mortality
Elk-10-01	Day 0	10.86	7.73	6.97			136.7	0		
	Day 1	11.56	7.21	7.14			154.1	8		
	Day 2							0		
	Day 3							0		
	Day 4				11.25	64		0		
Elk-10-02	Day 0	10.11	7.75	7.02			138.5	0		
	Day 1	11.56	7.38	7.17			153.2	8		
	Day 2							0		
	Day 3									
	Day 4				11.25	64		0		
									32	100%
Elk-10-03	Day 0	9.95	7.66	7.06			138.4	0		
	Day 1	11.49	7.37	7.14			154.1	8		
	Day 2							0		
	Day 3							0		
	Day 4				11.25	64		0		
Elk-10-04	Day 0	10.03	7.65	7.08			138.3	0		
	Day 1	11.56	7.32	7.15			154.2	8		
	Day 2							0		
	Day 3							0		
	Day 4				11.25	64		0		
Elk-10D-01	Day 0	11.59	7.5	6.95			136.9	0		
	Day 1	11.79	7.5	7.2			148.5	8		
	Day 2							0		
	Day 3							0		
	Day 4				11.5	64		0		
Elk-10D-02	Day 0	10.01	7.85	7.01			138.6	0		
	Day 1	11.69	7.68	7.2			153.5	8		
	Day 2							0		
	Day 3							0		
	Day 4				11.5	64		0		
									32	100%
Elk-10D-03	Day 0	10.08	7.83	7.03			138.6	0		
	Day 1	11.55	7.59	7.2			155.6	8		
	Day 2							0		
	Day 3							0		
	Day 4				11.5	64		0		
Elk-10D-04	Day 0	10.11	7.61	7.06			138.4	0		
	Day 1	11.56	7.56	7.2			157.8	8		
	Day 2							0		
	Day 3							0		
	Day 4				11.5	64		0		

Appendix A - Standard Mine Site Water Toxicity Test - Test Data

Site ID	Test Day	Temp. (◦C)	D.O. (mg/L)	pH	Alkalinity	Hardness	Conductivity	Number Dead	Total Number Dead	% Mortality
Control-01	Day 0	11.08	7.46	7.59			266.6	0		
	Day 1	11.93	6.41	7.53			275.4	0		
	Day 2	11.87	6.38	7.71			277.2	0		
	Day 3	11.97	6.65	7.43			271.9	0		
	Day 4	11.89	6.49	7.57	55	83.6	274.2	0		
Control-02	Day 0	10.17	7.72	7.78			270.6	0		
	Day 1	11.71	6.65	7.58			278	0		
	Day 2	11.79	6.59	7.62			277.8	0		
	Day 3	11.84	6.43	7.56			273.5	0		
	Day 4	11.79	6.24	7.61	55	83.6	275.7	0		
									1	3%
Control-03	Day 0	10.28	7.76	7.92			269.6	0		
	Day 1	11.53	6.59	7.59			278.2	1		
	Day 2	11.68	6.51	7.62			278.2	0		
	Day 3	11.78	6.42	7.61			275.1	0		
	Day 4	11.71	6.37	7.64	55	83.6	277.2	0		
Control-04	Day 0	10.57	7.59	7.99			270.9	0		
	Day 1	11.63	6.43	7.57			277.7	0		
	Day 2	11.62	6.47	7.61			276.9	0		
	Day 3	11.84	6.61	7.62			274.3	0		
	Day 4	11.75	6.27	7.68	55	83.6	275.9	0		

Notes:

Test start date was July 21, 2006.

◦C - degrees celsius

mg/L - milligrams per liter

Appendix B - Standard Mine Reference Toxicity Test - Test Data

Dilution	Test Day	Temp. (◦C)	D.O. (mg/L)	pH	Alkalinity	Hardness	Conductivity	Number Dead	Total Number Dead	% Mortality
100-1	Day 0	13.79	6.87	8.09			273.7	0		
	Day 1	8.96	7.13	7.69			273.4	2		
	Day 2	11.21	6.51	7.82			273.4	5		
	Day 3	11.27	7.04	7.8			261.7	2		
	Day 4	11.41	7.46	8.05	56	86	266.1	0		
100-2	Day 0	14.19	6.63	8.1			270.3	0		
	Day 1	8.91	6.91	7.62			273.1	1		
	Day 2	11.22	6.93	7.81			273.3	7		
	Day 3	11.31	7.2	7.85			273.2	2		
	Day 4	11.47	8.03	8	56	86	267.9	0		
									37	93%
100-3	Day 0	13.63	6.62	8.13			272.5	0		
	Day 1	8.91	7.23	7.67			273.4	3		
	Day 2	11.27	6.97	7.32			270.6	6		
	Day 3	11.37	7.07	7.87			272.4	0		
	Day 4	11.48	7.57	8	56	86	255.3	0		
100-4	Day 0	13.51	6.93	8.13			271.4	0		
	Day 1	8.95	6.22	7.68			262.1	0		
	Day 2	11.76	6.56	7.35			204.5	8		
	Day 3	11.27	6.98	7.9			272.4	1		
	Day 4	11.44	7.71	8.06	56	86	273.5	0		
50-1	Day 0	13.65	6.51	8.15			272.7	0		
	Day 1	8.64	6.27	7.64			264.3	0		
	Day 2	11.2	6.9	7.64			271.6	4		
	Day 3	11.2	6.83	7.68			272.4	2		
	Day 4	11.05	7.59	7.89	57.25	86.4	273.4	0		
50-2	Day 0	13.84	7.05	8.14			272.9	0		
	Day 1	8.67	6.93	7.62			261.1	0		
	Day 2	11.68	6.31	7.74			271.3	1		
	Day 3	11.25	6.81	7.65			272.1	1		
	Day 4	11.87	7.35	7.85	57.25	86.4	273.7	0		
									18	45%
50-3	Day 0	13.53	6.56	8.13			270.1	0		
	Day 1	8.59	7.01	7.51			268.1	0		
	Day 2	11.73	6.32	7.61			273.2	1		
	Day 3	11.49	7	7.71			267.2	1		
	Day 4	11.64	7.12	7.78	57.25	86.4	273.7	1		
50-4	Day 0	13.42	7.18	8.13			274.6	0		
	Day 1	8.64	6.56	7.61			273.1	1		
	Day 2	11.9	7.02	7.87			271.4	5		
	Day 3	11.21	7.09	7.8			256.9	0		
	Day 4	11.65	7.8	7.43	57.25	86.4	273.7	1		

Appendix B - Standard Mine Reference Toxicity Test - Test Data

Dilution	Test Day	Temp. (◦C)	D.O. (mg/L)	pH	Alkalinity	Hardness	Conductivity	Number Dead	Total Number Dead	% Mortality
25-1	Day 0	14.05	6.06	8.15			271.5	0		
	Day 1	8.51	6.21	7.73			270.7	0		
	Day 2	11.87	7.43	7.74			271.8	0		
	Day 3	11.48	6.79	7.69			271	0		
	Day 4	11.41	7.35	7.82	58	80.8	273.3	0		
25-2	Day 0	13.55	6.49	8.17			271.7	0		
	Day 1	8.59	7.04	7.53			264.1	0		
	Day 2	11.46	6.9	7.5			271.2	0		
	Day 3	11.25	6.67	7.61			271.1	0		
	Day 4	11.69	6.95	7.74	58	80.8	273.3	0		
									0	0%
25-3	Day 0	13.53	6.8	8.17			272	0		
	Day 1	8.49	7.01	7.51			249.1	0		
	Day 2	11.52	7.61	7.65			269.5	0		
	Day 3	11.21	7.41	7.75			234.7	0		
	Day 4	11.86	7.2	7.73	58	80.8	271.4	0		
25-4	Day 0	13.35	6.63	8.17			270.3	0		
	Day 1	8.56	7.1	7.87			257.3	0		
	Day 2	11.02	7.12	7.86			268.4	0		
	Day 3	11.89	7.06	7.71			242.2	0		
	Day 4	10.96	7.83	7.73	58	80.8	265.9	0		
12.5-1	Day 0	13.44	6.96	8.17			272	0		
	Day 1	8.4	6.03	7.6			268.2	0		
	Day 2	11.45	5.98	7.53			271.1	0		
	Day 3	11.7	6.77	7.6			259.6	0		
	Day 4	10.94	7.33	7.81	58.25	81.6	268.4	0		
12.5-2	Day 0	13.6	6.62	8.18			270.8	0		
	Day 1	8.57	6.42	7.54			271	0		
	Day 2	11.89	7.4	7.81			271.4	0		
	Day 3	11.64	7.24	7.72			270.3	0		
	Day 4	11.84	7.28	7.47	58.25	81.6	265.2	0		
									0	0%
12.5-3	Day 0	13.85	6.58	8.18			272.3	0		
	Day 1	8.41	6.21	7.61			268.4	0		
	Day 2	11.76	7.57	7.85			271.1	0		
	Day 3	11.42	7.39	7.77			271.4	0		
	Day 4	11.55	7.48	7.73	58.25	81.6	272.4	0		
12.5-4	Day 0	13.47	6.41	8.17			272.3	0		
	Day 1	8.49	6.02	7.57			238.3	0		
	Day 2	11.78	7.02	7.55			272	0		
	Day 3	11.49	6.23	7.66			271.1	0		
	Day 4	10.91	6.86	7.79	58.25	81.6	263.8	0		

Appendix B - Standard Mine Reference Toxicity Test - Test Data

Dilution	Test Day	Temp. (◦C)	D.O. (mg/L)	pH	Alkalinity	Hardness	Conductivity	Number Dead	Total Number Dead	% Mortality
6.25-1	Day 0	13.42	6.83	8.15			272.1	0		
	Day 1	NA	NA	NA				0		
	Day 2	11.47	6.55	7.57			270.8	0		
	Day 3	11.84	7.07	7.59			271.2	0		
	Day 4	10.89	7.61	7.34	57.5	81.2	272.1	0		
6.25-2	Day 0	13.54	6.63	8.13			272.4	0		
	Day 1	8.39	7.45	7.69			273.7	0		
	Day 2	12.02	7.25	7.82			272.7	0		
	Day 3	11.21	6.01	7.5			271.8	0		
	Day 4	10.95	7.2	7.74	57.5	81.2	269.7	0		
									0	0%
6.25-3	Day 0	13.76	6.89	8.17			270.6	0		
	Day 1	8.59	6.25	7.62			272.3	0		
	Day 2	11.51	6.03	7.58			271.9	0		
	Day 3	11.69	6.12	7.55			271.4	0		
	Day 4	11.5	6.4	7.69	57.5	81.2	272.4	0		
6.25-4	Day 0	13.57	6.88	8.13			270.5	0		
	Day 1	8.44	6.41	7.61			272.1	0		
	Day 2	11.96	7.01	7.75			271	0		
	Day 3	11.65	7.54	7.69			271	0		
	Day 4	10.82	7.83	7.72	57.5	81.2	272.3	0		
Control-1	Day 0	13.2	7.29	8.13			270.6	0		
	Day 1	8.83	6.75	7.59			271	0		
	Day 2	11.84	7.85	7.28			270.8	0		
	Day 3	12.94	6.1	7.45			267.7	0		
	Day 4	10.94	7.35	7.8	58	83.6	273	0		
Control-2	Day 0	14.14	6.95	8.17			271.1	0		
	Day 1	8.9	6.27	7.54			272.1	0		
	Day 2	11.8	7.01	7.38			271.8	0		
	Day 3	11.38	6.55	7.47			272.6	0		
	Day 4	10.9	6.01	7.59	58	83.6	273.6	0		
									1	3%
Control-3	Day 0	13.97	7.36	8.17			270.3	0		
	Day 1	8.71	6.01	7.53			272.3	1		
	Day 2	11.54	7	7.57			271.3	0		
	Day 3	11.27	6.86	7.49			271.5	0		
	Day 4	10.91	6.46	7.6	58	83.6	259.9	0		
Control-4	Day 0	13.51	6.84	8.13			272	0		
	Day 1	8.63	6.1	7.55			234.1	0		
	Day 2	11.62	6.81	7.48			270.7	0		
	Day 3	11.46	6.87	7.5			267.3	0		
	Day 4	10.84	6.84	7.64	58	83.6	244.8	0		

Notes:

Test start date was July 21, 2006.

◦C - degrees celsius

mg/L - milligrams per liter

Sediment Toxicity Testing Report – Standard Mine
Revision 0

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Acronym List

WBS	West Bearskin Sediment
ºC	degrees Celsius
mL	milliliter
DO	dissolved oxygen
XRF	X-Ray Fluorescence Spectroscopy
EPA	Environmental Protection Agency
ESAT	Environmental Services Assistance Team
LC50	50% lethal concentration
MHRW	Moderately Hard Reconstituted Water
ORD	Office of Research and Development
SAP	Sampling and Analysis Plan
SI	Site Inspection
SOP	Standard Operating Procedure
YCT	Yeast, Cerophyl, and Trout Chow

1.0 Introduction

A 10-day flow through sediment toxicity test was conducted at the Environmental Protection Agency (EPA) Region 8 Laboratory to determine the acute toxicity of sediments collected from drainages associated with the Standard Mine, located in Gunnison County, Colorado. As a quality assurance measure a reference toxicity test was performed using control sediments provided by the EPA Office of Research and Development (ORD) Laboratory in Duluth, Minnesota prior to testing site sediments. All tests were conducted on the amphipod *Hyalella azteca* (*H. azteca*), with evaluation endpoints of growth and mortality. This toxicity test report includes a brief background of the Standard Mine area, materials and methods, testing results, a discussion of results, and supporting references.

1.1 Background

The Standard Mine was part of the Ruby Mining District located in Gunnison County, Colorado. Mining activity initially began at the Standard Mine in or around 1874, with the most significant operations beginning in 1931. Operations included the mining of lead, zinc, silver, and gold until 1966, when the mine was abandoned.

The mine consists of many open, unmarked adits and shafts, giving access to 8,400 feet of mine workings on 6 levels. The former mine is near a popular hiking trail and has no access restrictions. Wastes at this mining site are estimated to be 53,560 cubic yards of waste rock and 29,340 cubic yards of mill tailings as well as seasonably variable amounts of water flowing out of the adits. Additionally, the USFS portion of land contains a non-engineered surface impoundment made entirely of highly mineralized waste rock. The unlined impoundment was built to collect metal laden acid mine drainage from tailings piles containing cadmium, copper, lead, and zinc. There is evidence of overflow and seepage through the impoundment into Elk Creek, which runs directly into Elk Creek, and runs adjacent to the mine. Elk Creek feeds into Coal Creek, which is a drinking water supply for the town of Crested Butte.

In 1999 a two-phase Site Inspection (SI) was conducted of the Ruby Mining District. Phase I was conducted in June 1999 to assess the environmental conditions during the high stream flow regime and phase II was conducted September 1999 to assess the environmental conditions during the low stream flow regime. The 1999 SI was limited to surface water since, according to the United States Geological Survey, there are no extensive aquifer systems associated with the Ruby Mining District (reference).

SI results revealed elevated concentrations of the following metals: aluminum, antimony, arsenic, beryllium, cadmium, cobalt, copper, iron, lead, nickel, thallium, and zinc from total metals analyses of the surface waters from Coal Creek and its tributaries. SI results were confirmed by subsequent investigations performed in 2005 and 2006, which, in addition to metals impacted surface water, also identified metals impacted sediments in Elk Creek and Coal Creek, to a lesser extent.

1.2 Objective

The objective of this series of toxicity tests was to support the ecological risk assessment being performed as a part of site assessment activities currently underway at the Standard Mine. Growth and mortality results will be incorporated into a site-wide Baseline Ecological Risk Assessment which will be used in the remediation decision making process for the site.

2.0 Materials and Methods

This section outlines the materials and methods employed for testing purposes, including sediment collection procedures, water preparation and delivery, test organisms, food preparation, and test conditions. General test methodologies followed EPA methodology (EPA 2000) and are further discussed below. General testing criteria are included in Table 2.0-1, and Appendix A includes a photolog of the testing setup.

2.1 Sediment Collection

Site sediment was collected during the July 2006 sampling event in accordance with the 2006 Sampling and Analysis Plan/Quality Assurance Project Plan (SAP) for the Standard Mine (ESAT 2006). Sediment was collected from locations along Coal Creek and Elk Creek using a Teflon hand trowel from a depth of 0 to 6 inches. Due to limited sediment volume observed in the field, composite samples were collected from approximately 20 meter reach of stream at each location. Sediment samples were stored in wide mouth 500 milliliter plastic containers and placed on ice. Excess overlying water was decanted from each sample while retaining sediment material. Once received at the Region 8 Laboratory, sediment samples were placed in a 4^{o}C cooler for preservation. Sample collection equipment was decontaminated in accordance with the SAP (ESAT 2006).

2.2 Water Preparation and Delivery

Moderately hard reconstituted water (MHRW) was prepared in accordance with Smith et al (1997). MHRW preparation included adding 50 grams of calcium sulfate, 50 grams of calcium carbonate, 30 grams of magnesium sulfate, 96 grams of sodium bicarbonate, and 4 grams of potassium chloride to the laboratory stainless steel batch tank containing 1,000 liters of deionized water. The batch tank was continuously aerated during the toxicity tests. Water quality was measured to verify the following parameters had been met: hardness between 90 and 100 milligrams per liter (mg/L), alkalinity between 50 and 70 mg/L, conductivity between 330 and 360 millisiemens/centimeter, and pH between 7.8 and 8.2 (USEPA 2000). MHRW was delivered at a rate of two volumes per day for each test chamber using the Wall Pump (a piston type pump that delivers water at a low flow rate). Appendix A includes photographs of the Wall Pump.

2.3 Test Organisms

The amphipod *H. azteca* was used for sediment toxicity testing purposes. *H. azteca* specimens were obtained from the EPA ORD Laboratory and shipped to the Region 8 Laboratory prior to test initiation. Once received, organisms were held at the Region 8 Laboratory for approximately 48 hours in a holding tank (while still in the shipping bag) for temperature and water quality acclimation to 22^{o}Celsius (^{o}C), which is equivalent to the testing temperature. Note that the *H. azteca* were cultured at the ORD Laboratory and shipped using MHRW water, therefore water acclimation was not considered a substantial stress concern for the organisms. However, in order to reduce the potential of stress to the organisms, once temperature equilibration was complete the shipping bag was opened to allow a small amount of MHRW to mix with the shipping water. This procedure was repeated several times through the course of one day until laboratory MHRW and shipping water were well mixed. The holding tank was aerated gently and additional MHRW was added to allow further acclimation of the organisms. At the time of testing organisms were approximately 7 to 10 days old.

2.4 Food Preparation

Organisms were fed a yeast, cerophyl, and Trout Chow (YCT) mixture on a daily basis. YCT was prepared by adding 5 grams of Trout Chow to 1 liter of deionized water followed by homogenization in a blender. After homogenization the mixture was poured into a 2 liter separatory funnel, aerated, and allowed to digest for one week at room temperature. At the end of the digestion period solid material was allowed to settle out for one hour. After the solid material had settled out, the supernatant was collected using 110 mesh Nitex screen. A yeast solution was prepared by adding 5 grams of dry yeast to 1 liter deionized water followed by mixing. A cerophyl solution was prepared by adding 5 grams of alfalfa pellets to 1 liter of deionized water followed by homogenization in a blender. Equal parts of yeast, Trout Chow (supernatant), and cerophyl solutions were then added to a beaker and homogenized in a blender. The YCT mixture was then stored in a freezer or refrigerator until use. YCT stored in a refrigerator was used within two weeks of storage. Feed dry weights are included in Table 2.5-1 for the site sediment test and Table 2.5-2 for the reference toxicity test.

2.5 Test Procedures

The following sections include the procedures employed for the site sediment and reference toxicity tests.

2.5.1 Site Sediment Toxicity Test

Site sediment was obtained from the following six locations along Elk Creek, Coal Creek, Splain's Gulch, and the Copley Lake outflow: Elk-00, Elk-08, Coal-15, Coal-20, SP-00, and Cop-01. Duplicate samples were obtained from Elk-08 and Cop-01. For quality assurance purposes testing was also performed on positive and negative sediment controls in conjunction with site sediment testing. Testing chambers consisted of 300 milliliter beakers which were filled with 100 milliliters of sediment and 175 milliliters of overlying MHRW. Four replicates were tested for each location, including the positive (spiked with zinc sulfate) and negative controls (not spiked). Testing chambers were placed in a water bath to maintain constant temperatures of 22^{o}C during the experiment (Appendix A).

After removal from the holding tank a total of 10 organisms were added to each testing chamber using a pipette and/or Nitex screen. Prior to placement into the testing chambers the organisms were placed into a disposable weigh boat for count verification. Once the count had been verified, organisms were transferred to the test chambers just below the air-water interface. An additional 40 organisms were removed from the holding tank and dried for 24 hours in order to determine a representative dry weight per organism prior to testing.

As stated above, testing took place over a 10 day period. Overlying water quality (MHRW) was measured daily for dissolved oxygen and temperature. On the day of test initiation and test completion overlying water alkalinity, hardness, conductivity, and pH were recorded. Appendix B includes water chemistry data sheets for the site sediment test. Organisms were fed 1 milliliter of prepared YCT per each test chamber on a daily basis. At the conclusion of the test organisms were removed from the sediment (referred to as "picking") using deionized water and a sieve and/or Nitex screen. Prior to test initiation personnel that were going to be involved with picking organisms from the sediment were required to demonstrate proficiency at the activity by capturing at least 90% of organisms placed into a "practice" sediment. Only personnel that were able to capture at least 90% of organisms from practice sediment were allowed to participate at test conclusion. Once the organisms were removed from the test chambers they were placed in aluminum weigh boats and surviving organisms were counted. After counting the organisms were dried in an oven for 24 hours so that a post-test weight could be obtained and evaluated for growth. Table 2.5.3 shows survival, mortality, and weight data for the sediment toxicity test.

Sediment and porewater samples were collected and analyzed for total metals concentrations using EPA Method 8260 and 6010/6020 respectively. Analytical data for porewater are listed in Table 2.5-4 and sediment analytical data are listed in Table 2.5-5.

2.5.2 Reference Sediment Toxicity Test

As a quality assurance step, a reference sediment toxicity test was performed using *H. azteca* prior to initiation of the site sediment toxicity test. Sediment used for the reference toxicity test was West Bearskin Sediment provided by the EPA ORD Laboratory. The reference sediment was spiked with zinc sulfate heptahydrate (JT Baker, Lot Y06H13, formula weight 287.56, CAS No: 7446-20-0), using a serial dilution approach that ranged from 4,188 milligrams per kilogram dry weight (mg/kg) to 565 mg/kg dry weight. Sediment zinc concentrations were analyzed with X-Ray Fluorescence Spectroscopy and verified in the analytical laboratory using EPA Method 6010/6020. The reference sediment toxicity test was performed using the same methodologies outlined in Section 2.5.1 (Site Sediment Toxicity Test). Table 2.5-6 shows survival and weight data for the reference toxicity test. Laboratory determined zinc concentrations for the reference sediment toxicity test are included in Table 2.5-4.

3.0 Results

This section presents results for the site sediment toxicity testing and reference sediment toxicity testing. This section also addresses any issues or unforeseen conditions encountered during the testing period.

3.1 Site Sediment Toxicity Testing

Sediments collected from the Elk Creek and Coal Creek drainages appeared similar in their general makeup, with samples described as primarily inorganic with coarse, nonuniform particles. As might be expected percent moisture values for samples collected from Elk Creek and Coal Creek were relatively low, with values ranging from 17% (Elk-00) to 27% (SP-00). The highest percent moistures were observed in the samples collected from the Copley Lake Outfall (64%) and the sediment used for the controls (86%). As might be expected these sediments were observed to be more organic in nature with a higher concentration of fine particle sizes. Table 3.1-1 includes the sediment percent moisture calculations for the site sediment toxicity test.

Overlying water quality parameters were consistent throughout the test and are listed in Appendix B. Performance criteria were met for all test chambers. Variability in alkalinity, hardness, conductivity, and pH was generally less than 10% between test chambers (although alkalinity was slightly higher in some cases), with dissolved oxygen levels never falling below 2.5 mg/L. The overlying water temperatures did not deviate more than +/- 1^{o}C from 22^{o}C.

Surviving organisms were collected and counted at the end of the testing period. Mortality results are included in Table 2.5-3 and Figure 3.1-1. No mortality was observed in the negative or positive controls or at the reference location (SP-00). Conversely, 100% mortality was observed for each Elk Creek location. Sites along Coal Creek and the Copley Lake Outfall did not have substantial mortality, with averages for survival greater than 90% for Coal-15, Coal-20, Cop-01, and Cop-01D.

Surviving organisms were collected at the end of the test and dry weights were obtained to assess growth (Table 2.5-3 and Figure 3.1-2). A representative average *H. azteca* weight for this test was determined to be 0.015 mg/organism prior to testing (Table 2.5-1). After completion of the test, measurable growth was observed for all test locations with the exceptions of Elk-00 and Elk-08. No growth data were available for those locations due to organism mortality. The most growth was observed at Cop-01, with a post-test weight of 0.149 mg/organism (0.111 mg/organism for Cop-01D). The least amount of growth was observed in the positive control (spiked with zinc sulfate), with a post-test weight of 0.065 mg/organism. The remaining sites had post-test weights (in descending order) of 0.117 mg/organism (SP-00), 0.114 mg/organism (Coal-15), 0.095 mg/organism (negative control), and 0.086 mg/organism (Coal-20).

Porewater zinc concentrations in Elk Creek ranged from 3370 ug/L at Elk-00 to 3650 ug/L at Elk-08, zinc concentrations in Coal Creek were highest at Coal-15 (373 ug/L) and Coal 20 was substantially lower and was seen at 35.1 ug/L. The reference location SP-00 had porewater zinc levels of 57.4 ug/L, and the Copley lake outflow site Cop-01 had porewater zinc levels of 5.82 ug/L. As shown in the toxicity test 100% mortality occurred at both the Elk Ceek sites, which can be attributed to the high levels of zinc detected in the porewater from Elk Creek samples.

3.2 Sediment Reference Toxicity Test

The reference sediment used for this test were all similar in their general makeup, with samples described as primarily organic, consisting of fine particles, and uniform in consistency. Reference sediment had a density of 1.06 g/ml, no TOC (total organic carbon) or AVS (acid volatile sulfide) data were gathered prior to test initiation. As might be expected the reference sediment had relatively high percent moisture, with values ranging from 14% to 16% (Table 3.1-2). As discussed in Section 2.5.2, the reference sediment was spiked with zinc sulfate following a serial concentration approach. Analytical data included in Table 2.5-7 indicated the highest zinc concentration of spiked sediment was 4188 mg/kg and the lowest was 565 mg/kg. The 12.5% sediment sample container was broken prior to analysis so there is no associated laboratory zinc concentration.

Overlying water quality parameters were consistent throughout the reference test and are listed in Appendix C. Performance criteria were met for all test chambers. Variability in alkalinity, hardness, conductivity, and pH was generally less than 10% between test chambers (although alkalinity was slightly higher in some cases), with dissolved oxygen levels never falling below 2.5 mg/L. The overlying water temperatures did not deviate more than +/- 1^{o}C from 22^{o}C.

After completion of the test, surviving organisms were collected and counted. Mortality results are included in Table 2.5-6 and Figure 3.1-3. No mortality was observed in the control, 6.25% concentration, or 12.5% concentration. In the 25% concentration average survival was greater than 90%. For the 50% concentration 65% mortality was observed, and in the 100% concentration there was no survival. An LC50 of 1787 mg/L (with an upper confidence limit of 2047 mg/L and a lower confidence limit of 1559 mg/L) was determined using the Trimmed Spearman Karber method (Hamilton 1977).

Surviving organisms were collected at the end of testing and dry weights were obtained to assess growth. Growth results are included in Table 2.5-6 and Figure 3.1-4. A representative average H. azteca weight for this test was determined to be 0.008 mg/organism prior to testing (Table 2.5-2). After completion of the test, measurable growth was observed for all test locations with the exception of the 100% concentration. No weight data were available for that concentration due to organism mortality. Growth was lowest in the 50 % concentration with a post-test weight of 0.033 mg/organism. The most growth was observed in the 25% concentration with a post-test weight of 0.112 mg/organism. The remaining concentrations had post-test weights (in descending order) of 0.045 mg/organism (12.5% concentration), 0.043 mg/organism (6.25% concentration and the control), and 0.033 mg/organism (50% concentration).

4.0 Discussion

Results of the site sediment toxicity test indicated that the sites along Elk Creek were toxic to *H. azteca*. 97.5% to 100 % mortality was observed for those locations. Conversely, no mortality was observed at the reference location (SP-00), and very low mortality was observed the Coal Creek and Copley Lake Outfall locations, indicating site sediments are not toxic at those locations. Growth data tended to support these results, with substantial growth over pre-test conditions observed at all areas with the exception of the Elk Creek locations. Where growth occurred, it was greater than the negative control at all locations with the exception of Coal-20. However, growth at Coal-20 was less than 10% below the negative control. This indicates that the sediments were not substantially inhibiting growth at the Coal Creek, Splain's Gulch, and Copley Lake Outfall locations. The positive control (spiked with zinc sulfate) showed the lowest growth of all measurable areas, but was still substantially higher than the pre-test average weight.

Results of the reference sediment toxicity test were supportive of the site sediment test results. Zinc concentrations found at the sites along Elk Creek where 100% mortality occurred were similar to that found in the 100% concentration in the reference toxicity test where 100% mortality occurred. Concentrations of zinc ranged from 3,360 mg/L to 4,690 mg/L in Elk Creek and the concentrations in the 100% concentration for the reference test ranged from 4,188 mg/L to 4,258 mg/L.

In this study analytical results showed elevated levels of zinc in the porewater and possibly resulting in high mortality to the test organisms. Toxicity testing indicated 100% mortality for *Hyalella azteca* occurring in areas that porewater had zinc concentrations of 3370 ug/L or greater. At Coal Creek sites where porewater zinc levels were substantially lower than that of Elk Creek, mortality was not an issue but growth seemed to be less than the Copley site or the Splains Gulch sites. As shown in figure 4.0-1 and figure 4.0-2 weight of organisms decreased substantially where porewater levels were elevated and mortality increased with increasing porewater zinc levels.

5.0 References

U.S. Environmental Protection Agency. March 2000. "Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates."

Hamilton, M.A., R.C. Russo, and R.V. Thurston. 1977. Trimmed Spearman-Karber method for estimating median lethal concentrations in toxicity bioassays. Env.Sci. Tech. 11(7): 714-719

U.S. Environmental Protection Agency, November 1994, Standard Operating Procedure for Sediment Sampling, #2016

Environmental Services Assistance Team. 2006. Sampling and Analysis Plan/Quality Assurance Project Plan, 2006 Sampling Events, Standard Mine, Gunnison Colorado

Tables

Table 2.0-1 Test Conditions - Hyalella Azteca 10-Day Sediment Toxicity Testing

Parameter	Conditions
Test Type	Whole Sediment toxicity test with renewal of overlying water
Temperature	23 +/- 1 °C
Light Quality	Wide Spectrum flourescent lights
Illuminance	100 to 1000 lux
Photoperiod	16 light 8 dark
Test Chamber	300 mL beaker
Sediment Volume	100 mL
Overlying Water Volume	175 mL
Renewal of Overlying Water	2 volumes per day
Age of Organisms	7-14 day old at start of test
Number of Organisms/chamber	10
Number of Replicate	4
Feeding	YCT food fed 1.0 mL per daily to each test chamber
Aeration	None
Overlying Water	Moderately Hard Reconstituted Water
Test Chamber Cleaning	Clean screens if clogged
Overlying Water Quality	Hardness, Alkalinity, Conductivity, pH monitored at beginning and end of test, Temperature and Dissolved Oxygen monitored daily
Test Duration	10 Days
Endpoints	Survival and Growth
Test Acceptability	Minimum mean control survival of 80% and measurable growth of test organisms in the control sediment

Table 2.5-1 Organism and Feed Dry Weight Calculations - Site Sediment Toxicity Test

H. azteca dry weights: Initial

Reading	Dry Weight (g)
1	0.0006
2	0.0006
3	0.0005
4	0.0007
5	0.0005
Average	**0.00058**

Number of Organisms:	38	
Organism Weight:	1.53E-05	grams/organism
Organism Weight:	0.0153	milligrams/organism

H. azteca feed dry weight

Weigh boat:	1.308	grams
Weigh boat + 1 ml feed:	2.2809	grams
1 ml wet feed:	0.9729	grams
Weight boat + dry feed:	1.3097	grams
Dry feed :	0.0017	g/ml
Dry feed :	1.7	g/l

Table 2.5-2 Organism and Feed Dry Weight Calculations - Reference Sediment Toxicity Test

H. azteca dry weights: Initial

Reading	**Dry Weight (g)**
1	0.0004
2	0.0003
3	0.0003
4	0.0003
5	0.0003
Average	**0.00032**

Number of Organisms:	40	
Organism Weight:	8.10E-06	grams/organism
Organism Weight:	0.0081	milligrams/organism

H. azteca feed dry weight

Weigh boat:	1.3203	grams
Weigh boat + 1 ml feed:	2.3114	grams
1 ml wet feed:	0.9911	grams
Weight boat + dry feed:	1.3229	grams
Dry feed :	0.0026	g/ml
Dry feed :	2.6	g/l

Table 2.5-3 Organism Weight Data - Site Sediment Toxicity Testing - Standard Mine

Test Type:	Sediment	Weighing Date:	10/13/2006	Sample Source:	Standard Mine
Duration:	10-day	Analysts:	SA/JC	Test Start (day 0):	10/3/2006
Replicates:	Four	Drying Time:	24 hours	Test End (day 10):	10/13/2006
Organism:	H. azteca	Oven Temperature:	60C	Feed Rate/ Type:	Daily/YCT

Initial weight (mg): 0.0153

Site I.D.	Weight of Oven Dried Pan (g)	Pan + Dried Organisms (g)	Dry Organisms (g)	Number of Survivors	Mean Weight per Survivor (mg)	Sample Mean (mg)
Control-N-1	1.3082	1.3092	0.001	10	0.100	0.0950
Control-N-2	1.3084	1.3094	0.001	10	0.100	
Control-N-3	1.3206	1.3215	0.0009	10	0.090	
Control-N-4	1.2934	1.2943	0.0009	10	0.090	
Control-P-1	1.3159	1.3165	0.0006	10	0.060	0.0650
Control-P-2	1.3003	1.3010	0.0007	10	0.070	
Control-P-3	1.3058	1.3065	0.0007	10	0.070	
Control-P-4	1.3066	1.3072	0.0006	10	0.060	
Coal-15-1	1.3045	1.3058	0.0013	10	0.130	0.114
Coal-15-2	1.3071	1.308	0.0009	10	0.090	
Coal-15-3	1.3259	1.327	0.0011	9	0.122	
Coal-15-4	1.3289	1.3298	0.0009	8	0.113	
Coal-20-1	1.3076	1.3084	0.0008	9	0.089	0.0861
Coal-20-2	1.3058	1.3065	0.0007	9	0.078	
Coal-20-3	1.3217	1.3227	0.001	10	0.100	
Coal-20-4	1.3016	1.3023	0.0007	9	0.078	
Elk-00-1	1.3122			0	NA	NA
Elk-00-2	1.3099			0	NA	
Elk-00-3	1.2999			0	NA	
Elk-00-4	1.3180			0	NA	
Elk-08-1	1.2983	NA	NA	1	NA	NA
Elk-08-2	1.3099			0	NA	
Elk-08-3	1.3207			0	NA	
Elk-08-4	1.3115			0	NA	

Table 2.5-3   Organism Weight Data - Site Sediment Toxicity Testing - Standard Mine

Test Type:	Sediment	Weighing Date:	10/13/2006	Sample Source:	Standard Mine
Duration:	10-day	Analysts:	SA/JC	Test Start (day 0):	10/3/2006
Replicates:	Four	Drying Time:	24 hours	Test End (day 10):	10/13/2006
Organism:	H. azteca	Oven Temperature:	60C	Feed Rate/ Type:	Daily/YCT

Initial weight (mg): 0.0153

Site I.D.	Weight of Oven Dried Pan (g)	Pan + Dried Organisms (g)	Dry Organisms (g)	Number of Survivors	Mean Weight per Survivor (mg)	Sample Mean (mg)
Elk-08D-1	1.3015			0	NA	NA
Elk-08D-2	1.3067			0	NA	
Elk-08D-3	1.3100			0	NA	
Elk-08D-4	1.3196			0	NA	
SP-00-1	1.3080	1.3094	0.0014	10	0.140	0.117
SP-00-2	1.3079	1.3095	0.0016	10	0.160	
SP-00-3	1.3110	1.312	0.001	10	0.100	
SP-00-4	1.3061	1.3068	0.0007	10	0.070	
Cop-01-1	1.2982	1.299	0.0008	8	0.100	0.149
Cop-01-2	1.3218	1.3233	0.0015	10	0.150	
Cop-01-3	1.2952	1.2966	0.0014	9	0.156	
Cop-01-4	1.3172	1.3191	0.0019	10	0.190	
Cop-01D-1	1.3263	1.3273	0.001	10	0.100	0.111
Cop-01D-2	1.3223	1.3232	0.0009	10	0.090	
Cop-01D-3	1.2907	1.2919	0.0012	11	0.109	
Cop-01D-4	1.3134	1.3147	0.0013	9	0.144	

Table 2.5-4 Analytical Results for Porewater - Standard Mine Sediment Toxicity Test - 2006

Site Identification	Aluminum	Antimony	Arsenic	Beryllium	Cadmium	Calcium	Chromium	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Nickel	Selenium	Silica (SiO2)	Silver	Strontium	Thallium	Zinc	Hardness (mg/L)
COAL-15 PW	<50.0	<0.500	12.2	<1.00	14.6	92800	<1.00	9.27	<50.0	0.488J	12800	11000	<0.200	6.11	0.989J	7420	<0.200	824	<0.200	373	284
COAL-20 PW	<50.0	<0.500	7.23	<1.00	<0.200	69300	<1.00	1.41J	<50.0	<0.200	10800	6400	<0.200	3.81	0.821J	7230	<0.200	787	<0.200	35.1	217
CONTROL-N PW	<50.0	<0.500	1.56	<1.00	<0.200	36100	<1.00	1.75J	17200	<0.200	10300	3140	<0.200	6.27	<0.500	31900	0.467J	111	<0.200	203	132
CONTROL-P PW	<50.0	<0.500	2.03	<1.00	<0.200	60000	<1.00	1.48J	30400	<0.200	16100	5260	<0.200	11.7	<0.500	32000	<0.200	187	<0.200	883	216
COP-1 DUP PW	52.0J	<2.50	20.7	<1.00	<1.00	91500	<1.00	<1.00	4180	<1.00	10700	29900	<0.200	5.84	<2.50	3560	<1.00	574	<1.00	5.82J	272
COP-1 PW	54.4J	<2.50	25.4	<1.00	<1.00	94700	<1.00	<1.00	8420	<1.00	11100	31600	<0.200	6.5	<2.50	3660	<1.00	590	<1.00	81.8	282
ELK-00 PW	<50.0	<0.500	2.57	<1.00	90.9	116000	<1.00	62.7	<50.0	3.34	7990	7480	<0.200	10.3	1.39J	9140	<0.200	802	<0.200	3370	323
ELK-08 DUP PW	61.8J	<0.500	1.61	<1.00	31.6	52800	<1.00	24.4	194J	9	4520	873	<0.200	6.23	0.502J	8560	<0.200	306	<0.200	3640	150
ELK-08 PW	53.9J	<0.500	1.52	<1.00	32.6	52900	<1.00	24.4	168J	7.81	4560	863	<0.200	6.35	0.592J	8570	<0.200	307	<0.200	3650	151
SP-00 PW	<50.0	<0.500	1.2	<1.00	<0.200	64300	<1.00	1.12J	<50.0	<0.200	12700	5270	<0.200	3.43	0.537J	11900	<0.200	742	<0.200	57.4	213

Notes:

A "J" flag indicates anlayte was detected between the detection limit and method reporting limit and therefore is an estimate of concentration.

Results are in units of ug/L unless otherwise indicated.

Table 2.5-5 Analytical Results for Sediment - Standard Mine Sediment Toxicity Test - 2006

Site Identificaiton	Aluminum	Antimony	Arsenic	Beryllium	Cadmium	Calcium	Chromium	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Nickel	Selenium	Silica (SiO2)	Silver	Strontium	Thallium	Zinc	% Solids
COAL-15 SE	6070	<0.479	63.8J	<0.479	4.74J	2300	0.746J	20.9	16600	76.0J	2860	1320	0.036J	2.95J	<0.479	3850J	0.659J	18.7J	0.242J	671	80
COAL-20 SE	5480	1.22J	52	<0.480	0.315J	2310	1.19J	5.6	14100	22.7	2230	631	0.015	2.49	<0.480	3620	3.12J	22.9	<0.192	88.9	77
CONTROL-N SE	12900	<0.477	11.2	<0.477	0.879J	4930	35.1	81.2	48100	20.7	6220	515	0.122	48.8	2.07J	6280	0.257J	17.8	<0.191	148	14
CONTROL-P SE	12600	<0.485	10.6	<0.485	0.898J	4890	35.1	81.4	47900	20.6	6190	517	0.12	49.6	1.99J	3720	0.242J	17.5	0.231J	591	14
COP-1 DUP SE	8660	<0.988	74.2	<0.494	0.667J	3050	1.10J	6.58	23200	50	2670	1750	0.039	4.2	<0.988	5420	<0.395	22.8	<0.395	114	36
COP-1 SE	8360	<0.920	58.7	<0.460	0.639J	3550	1.39J	5.7	22000	36.8	2560	1480	0.032	3.84	<0.920	4930	<0.368	21.7	<0.368	111	36
ELK-00 SE	7900	<2.46	72.5	0.769J	25.2J	3750	<0.491	133	23400	336	2910	4230	0.002	10.6	<2.46	4630	<0.982	25.4	<0.982	3360	83
ELK-08 DUP SE	8090	<2.45	53.3	1.40J	46.2J	1860	<0.491	458	23100	1470	2530	9050	<0.0000001	10.8	<2.45	4420	<0.982	14.2	<0.982	4690	82
ELK-08 SE	7400	<2.30	55.3	1.42J	39.5J	1830	<0.459	428	24900	1280	2100	7410	0.004	9.9	<2.30	4170	1.18J	12.8	<0.918	4350	82
SP-00 SE	6550	<0.473	1.68	<0.473	<0.189	3120	1.10J	4.27	15800	9.72	2760	775	0.005	1.86	<0.473	4840	<0.189	37.5	<0.189	44.2	73

Notes:

A "J" flag indicates anlayte was detected between the detection limit and method reporting limit and therefore is an estimate of concentration.

Results are in units of mg/kg on a dry weight basis unless otherwise indicated.

Table 2.5-6 Organism Weight Data - Reference Sediment Toxicity Testing

Test Type:	Sediment	Weighing Date:	11/3/2006	Sample Source:	Spiked Sediment Ref Tox.
Duration:	10-day	Analysts:	SA/JC	Test Start (day 0):	10/24/2006
Replicates:	Four	Drying Time:	24 hours	Test End (day 10):	11/3/2006
Organism:	H. azteca	Oven Temperature:	60C	Feed Rate/ Type:	Daily/YCT

Initial weight (mg): 0.0081

Site I.D.	Weight of Oven Dried Pan (g)	Pan + Dried Organisms (g)	Dry Organisms (g)	Number of Survivors	Mean Weight per Survivor (mg)	Sample Mean (mg)
Control-1	1.3126	1.3131	0.0005	10	0.050	0.0425
Control-2	1.3149	1.3153	0.0004	10	0.040	
Control-3	1.311	1.3114	0.0004	10	0.040	
Control-4	1.3016	1.302	0.0004	10	0.040	
6.25-1	1.3095	1.3099	0.0004	10	0.040	0.0425
6.25-2	1.3197	1.3201	0.0004	10	0.040	
6.25-3	1.3054	1.3059	0.0005	10	0.050	
6.25-4	1.3067	1.3071	0.0004	10	0.040	
12.5-1	1.3074	1.3077	0.0003	10	0.030	0.045
12.5-2	1.3226	1.3232	0.0006	10	0.060	
12.5-3	1.3039	1.3044	0.0005	10	0.050	
12.5-4	1.2952	1.2956	0.0004	10	0.040	
25-1	1.3324	1.3331	0.0007	9	0.078	0.1117
25-2	1.3166	1.3182	0.0016	9	0.178	
25-3	1.3056	1.3066	0.001	9	0.111	
25-4	1.3059	1.3067	0.0008	10	0.080	
50-1	1.3221	1.3224	0.0003	6	0.050	0.033
50-2	1.3066	1.3066	0	2	0.000	
50-3	1.2952	1.2953	1E-04	4	0.025	
50-4	1.3062	1.3062	0	2	0.000	
50-2+50-4	1.3066	1.3067	1E-04	4	0.025	
100-1	1.314	NA	NA	0	NA	NA
100-2	1.3079	NA	NA	0	NA	
100-3	1.3172	NA	NA	0	NA	
100-4	1.312	NA	NA	0	NA	

Table 2.5-7 Reference Sediment Toxicity Test - Zinc Concentrations (mg/kg)

Dilution	Concentration	Units	Dry Weight	% Solids	Concentration	Units
100% Sediment Spike	4187.61	mg/kg (dry)	0.5293	16%	683.4	mg/kg (as received)
100% Sediment Spike Duplicate	4257.59	mg/kg (dry)	0.5206	14%	612.6	mg/kg (as received)
50% Sediment Spike	2029.70	mg/kg (dry)	0.505	15%	311.9	mg/kg (as received)
25% Sediment Spike	793.38	mg/kg (dry)	0.5239	15%	119.8	mg/kg (as received)
25% Sediment Spike Duplicate	817.73	mg/kg (dry)	0.5083	15%	123.1	mg/kg (as received)
12.5% Sediment Spike	NA	mg/kg (dry)	NA	NA	NA	mg/kg (as received)
6.25% Sediment Spike	564.74	mg/kg (dry)	0.5136	15%	83.9	mg/kg (as received)

Notes:

Due to sample breakage the 12.5% dilution was not analyzed. For LC50 determination the average of 6.25% and 25% dilution zinc concentrations were used.

Table 3.1-1 Site Sediment Percent Moisture Calculations

Site ID	Crucible Weight (g)	Crucible Plus Wet Sediment Weight (g)	Wet Sediment Weight (g)	Crucible Plus Dry Sediment Weight (g)	Dry Sediment Weight (g)	Percent Moisture	Average Percent Moisture	Sediment Observations
Control-1	53.03	77	23.97	55.59	2.56	89%		Fine particle size
Control-2	57.52	96.04	38.52	63.35	5.83	85%	86%	Primarily Organic
Control-3	55.52	83.58	28.06	59.76	4.24	85%		Uniform Consistency
SP-00-1	57.03	73.89	16.86	69.46	12.43	26%		Coarse particle size
SP-00-2	53.34	74.84	21.5	68.6	15.26	29%	27%	Primarily Inorganic
SP-00-3	55.07	81.98	26.91	75.1	20.03	26%		Nonuniform consistency
Cop-01-1	53.25	69.69	16.44	58.29	5.04	69%		Fine and coarse particle size
Cop-01-2	56.35	70.69	14.34	61.83	5.48	62%	64%	Organic/Nonorganic
Cop-01-3	52.83	67.78	14.95	58.7	5.87	61%		Nonuniform Consistency
Coal-15-1	54.64	74.44	19.8	70.34	15.7	21%		Coarse particle size
Coal-15-2	56.1	69.87	13.77	67.29	11.19	19%	20%	Primarily Inorganic
Coal-15-3	56.36	69.15	12.79	66.56	10.2	20%		Nonuniform consistency
Coal-20-1	55.36	71.43	16.07	67.14	11.78	27%		Coarse particle size
Coal-20-2	57.42	71.46	14.04	68.81	11.39	19%	23%	Primarily Inorganic
Coal-20-3	54.52	68.99	14.47	65.65	11.13	23%		Nonuniform consistency
Elk-00-1	54.28	76.43	22.15	72.23	17.95	19%		Coarse particle size
Elk-00-2	53.02	76.93	23.91	73.18	20.16	16%	17%	Primarily Inorganic
Elk-00-3	54.11	75	20.89	71.5	17.39	17%		Nonuniform consistency
Elk-08-1	54.7	84.61	29.91	79.69	24.99	16%		Coarse particle size
Elk-08-2	52.03	76.45	24.42	71.73	19.7	19%	18%	Primarily Inorganic
Elk-08-3	52.68	75.89	23.21	71.64	18.96	18%		Nonuniform consistency

Table 3.1-2 Reference Sediment Percent Moisture Calculations

Site ID	Crucible Weight (g)	Crucible Plus Wet Sediment Weight (g)	Wet Sediment Weight (g)	Crucible Plus Dry Sediment Weight (g)	Dry Sediment Weight (g)	Percent Moisture	Percent Solids	Actual Dry Weight Used	Sediment Observations
Bulk Sediment	53.3419	124.5527	71.2108	64.7256	11.3837	84%	16%	NA	Fine particle size Primarily Organic Uniform Consistency
R-6.25	1.2732	15.8746	14.6014	3.4424	2.1692	85%	15%	0.5136	Fine particle size Primarily Organic Uniform Consistency
R-25	1.2802	15.6131	14.3329	3.4386	2.1584	85%	15%	0.5239	Fine particle size Primarily Organic Uniform Consistency
R-25D	1.2756	17.0507	15.7751	3.657	2.3814	85%	15%	0.5083	Fine particle size Primarily Organic Uniform Consistency
R-50	1.2767	16.2112	14.9345	3.572	2.2953	85%	15%	0.5050	Fine particle size Primarily Organic Uniform Consistency
R-100	1.2896	16.9221	15.6325	3.5387	2.2491	86%	14%	0.5293	Fine particle size Primarily Organic Uniform Consistency
R-100D	1.2756	18.576	17.3004	4.0991	2.8235	84%	16%	0.5206	Fine particle size Primarily Organic Uniform Consistency

Figures

Figure 3.1-1 Site Sediment Toxicity Test - Organism Mortality

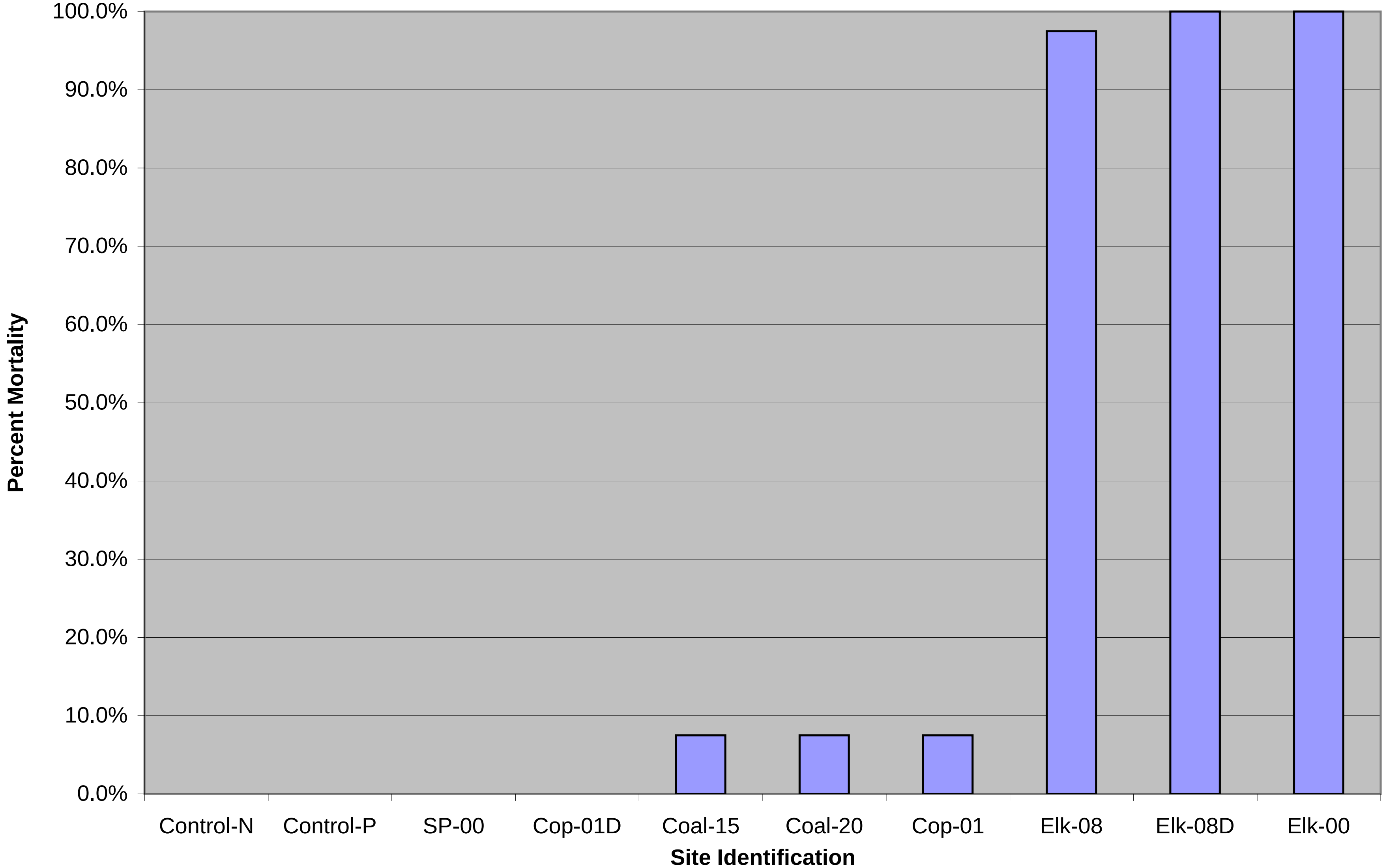


Figure 3.1-2 Site Sediment Toxicity Test - Average Organism Weight (Mean of Replicates)

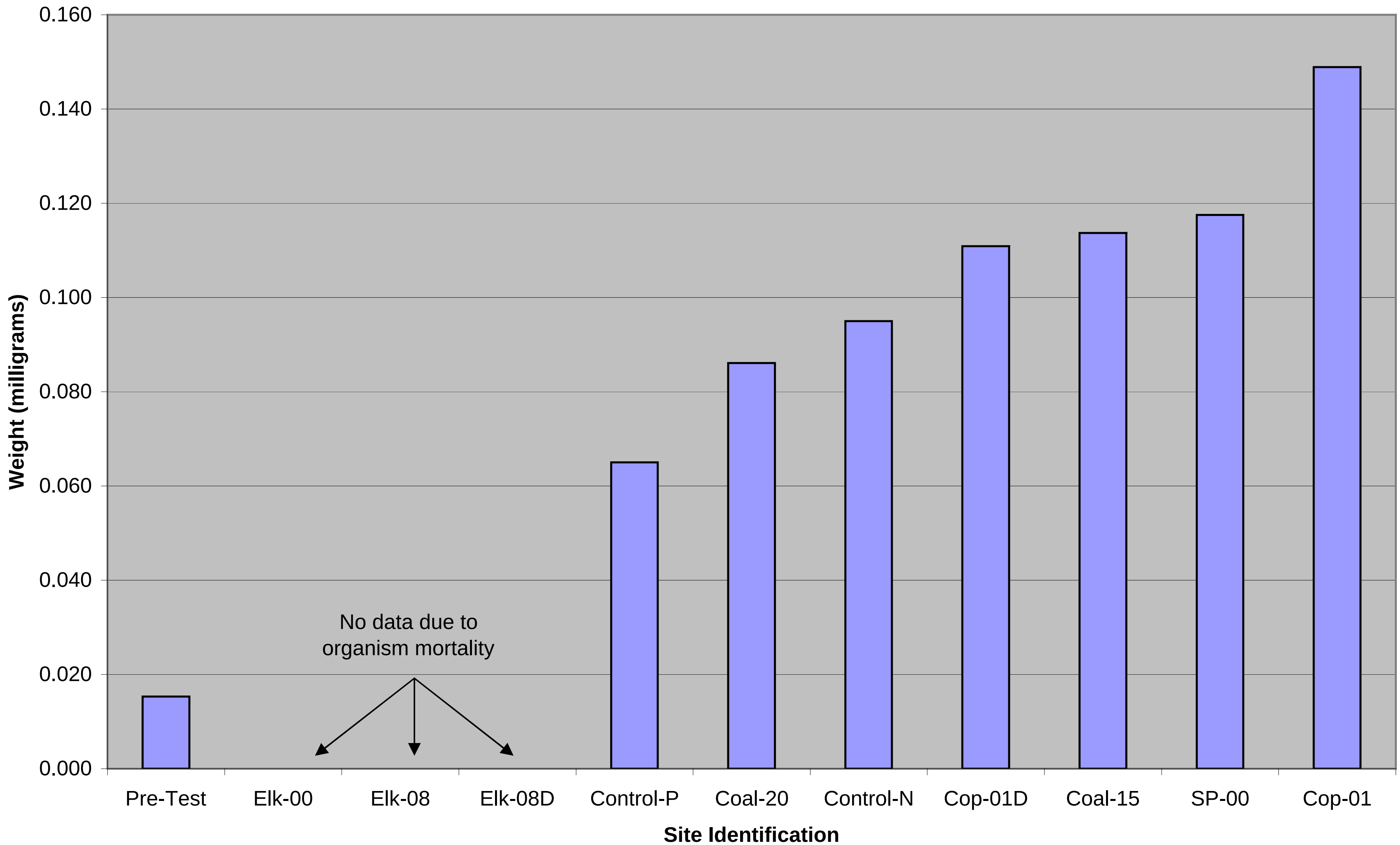


Figure 3.1-3 Reference Sediment Toxicity Test - Organism Mortality

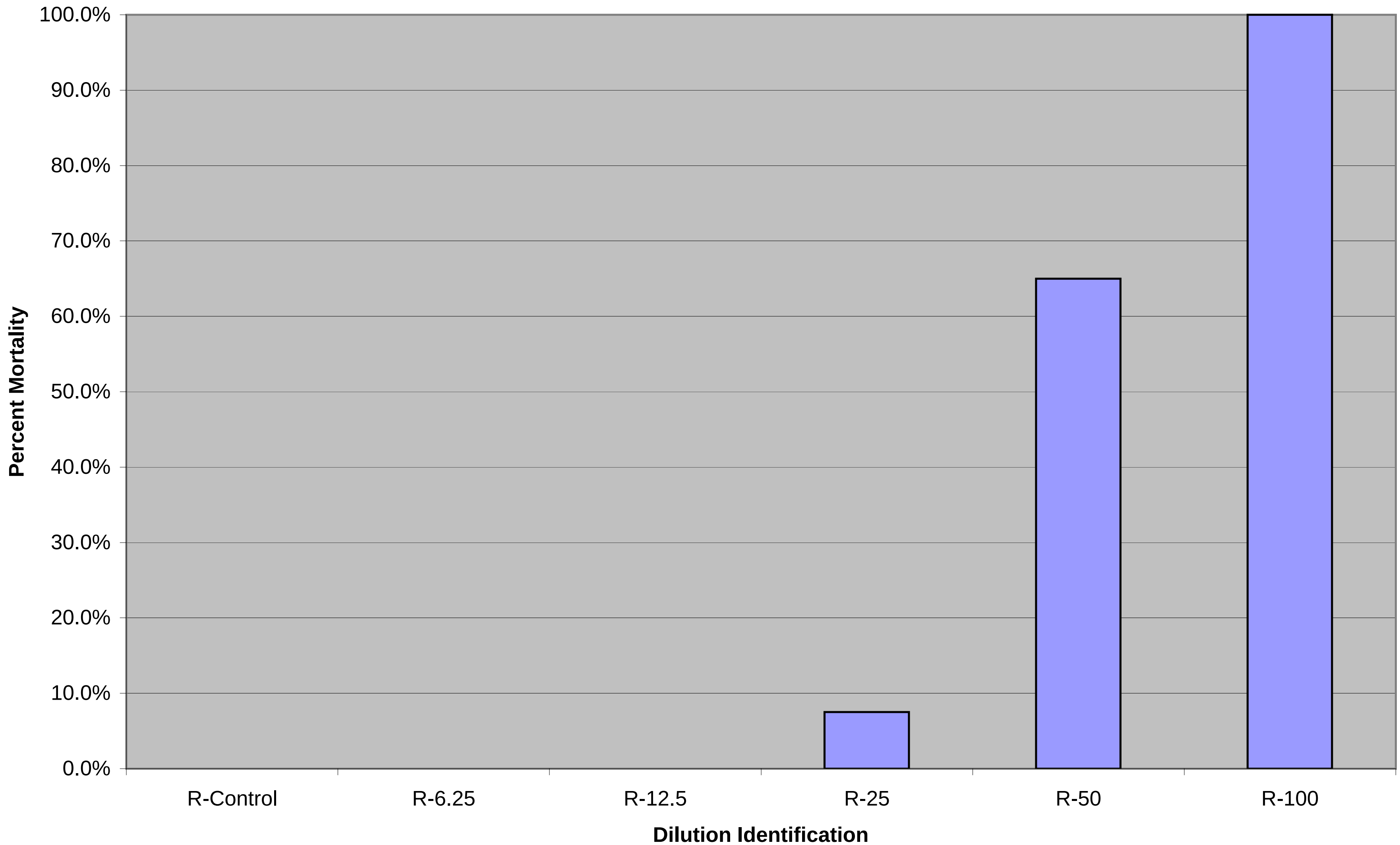


Figure 3.1-3 Reference Sediment Toxicity Test - Organism Mortality

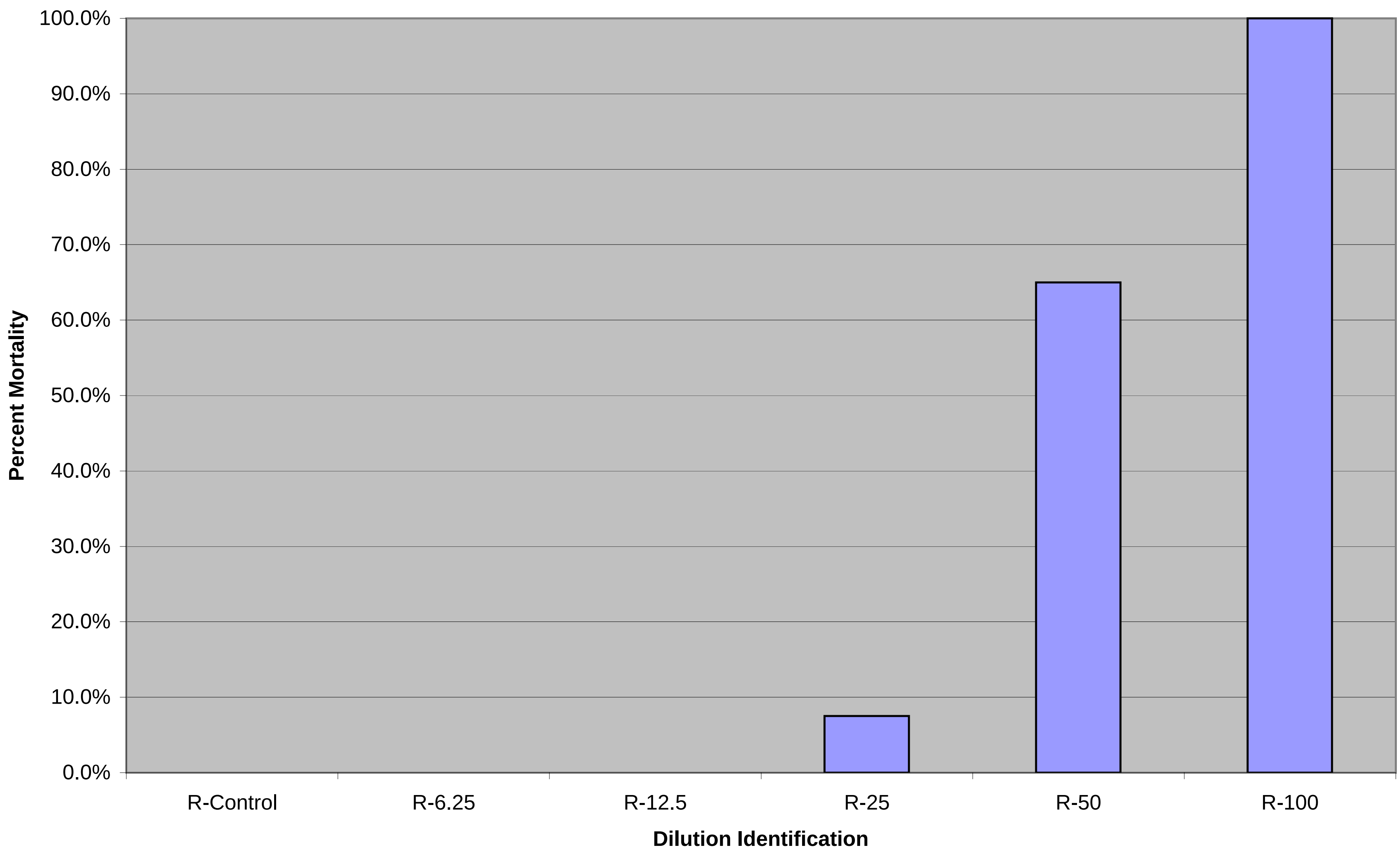
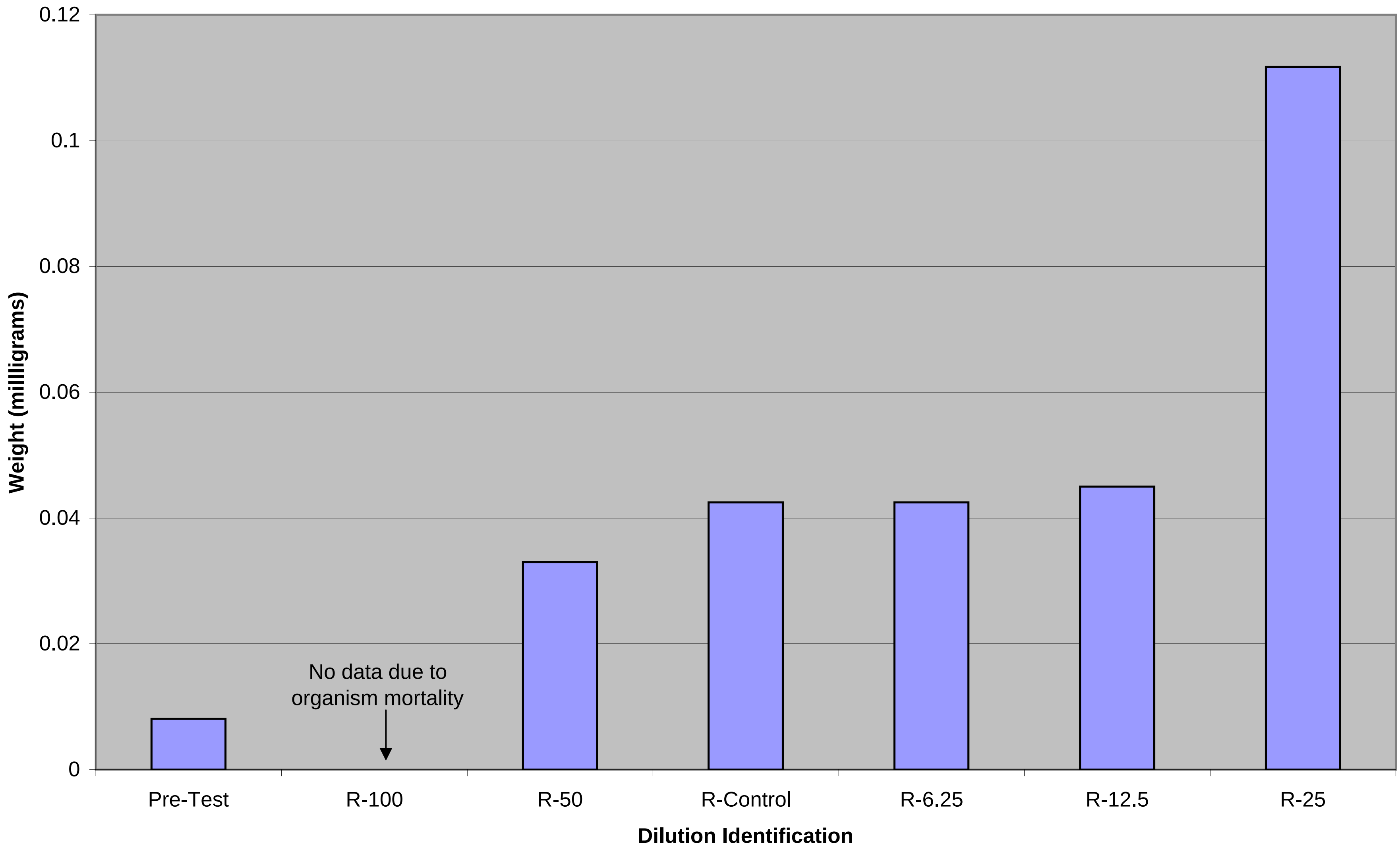
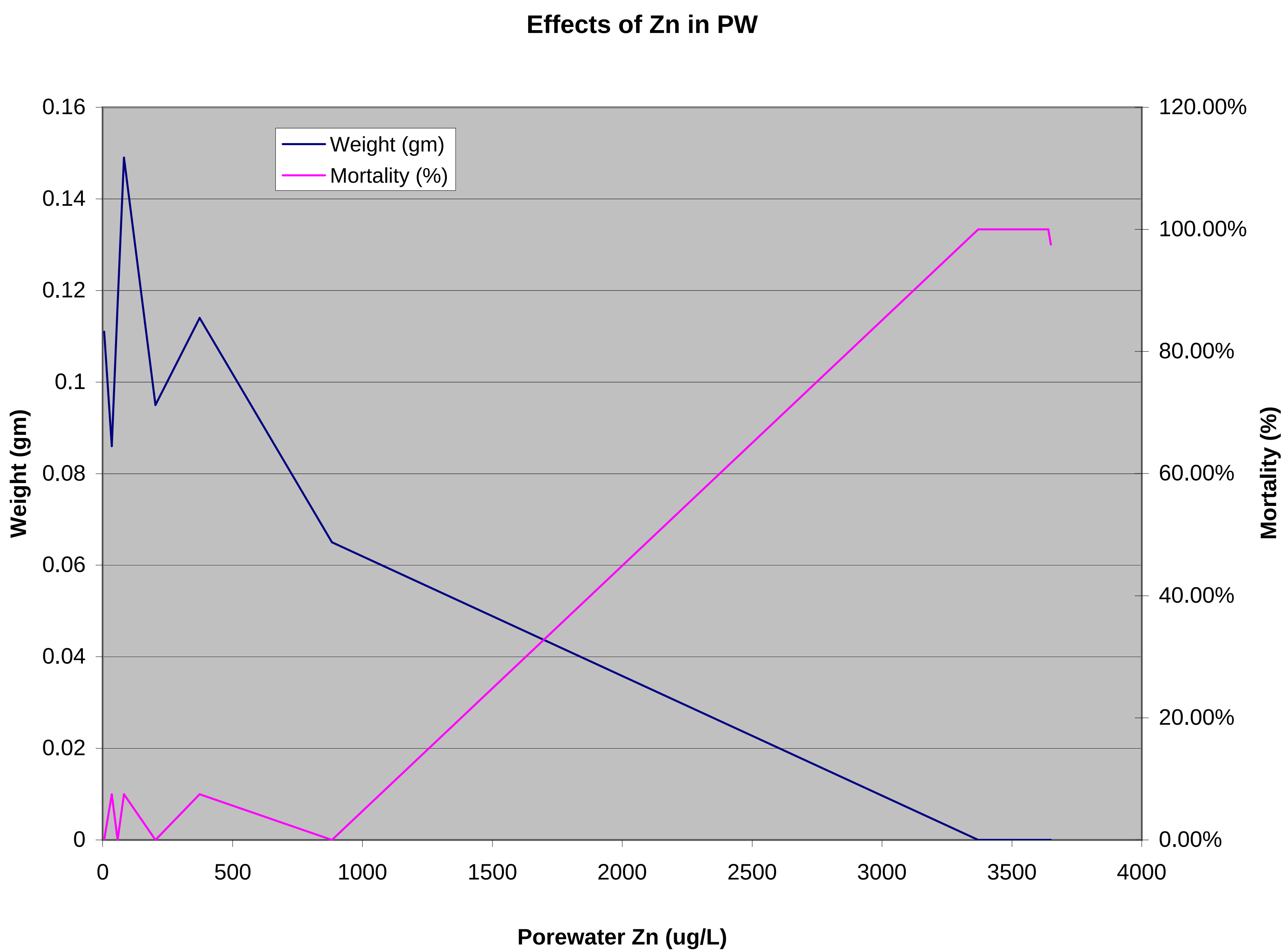


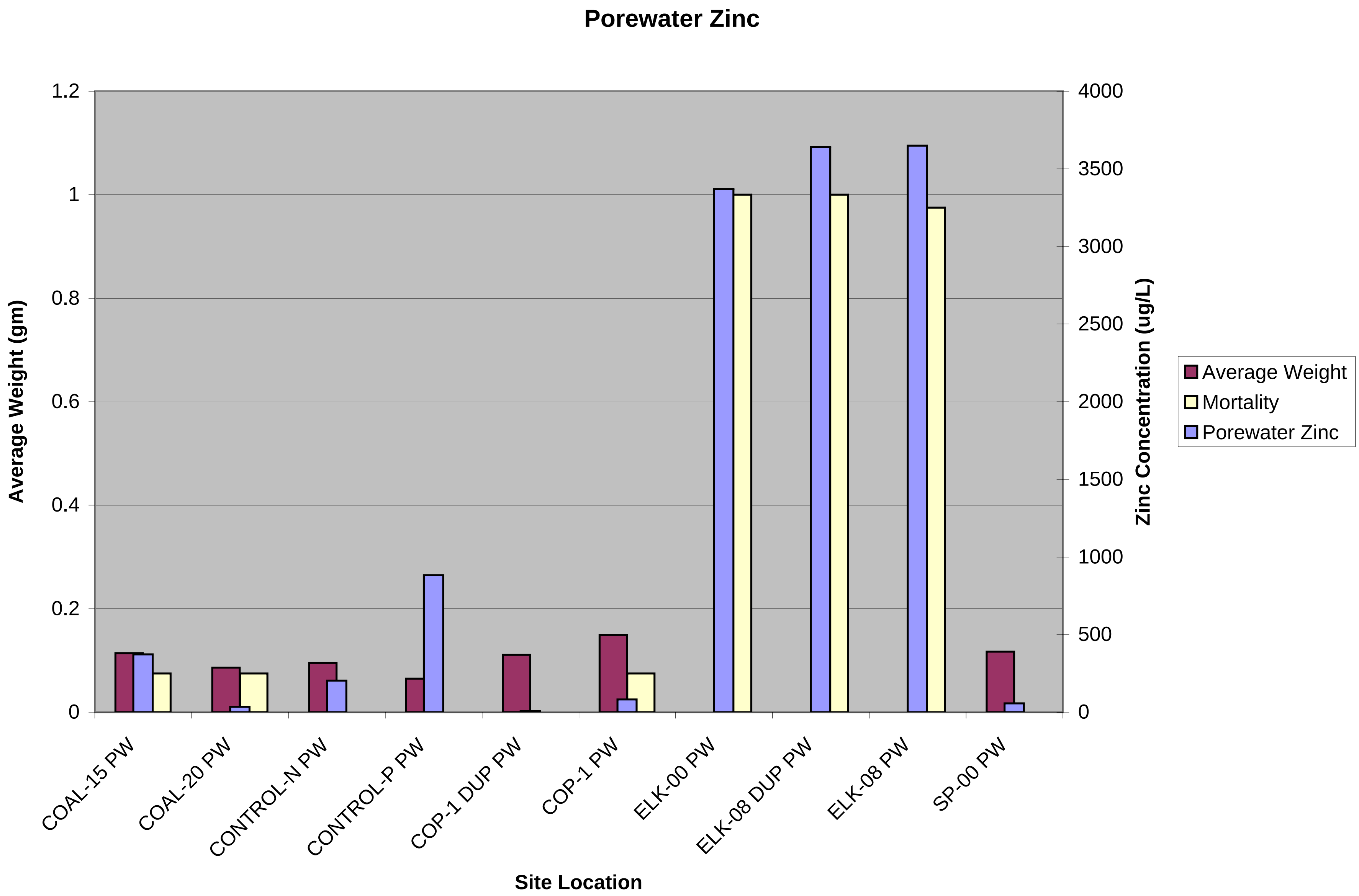
Figure 3.1-4 Reference Sediment Toxicity Test - Average Organism Weight



Effects of Zinc in Porewater
Figure 4.0-1

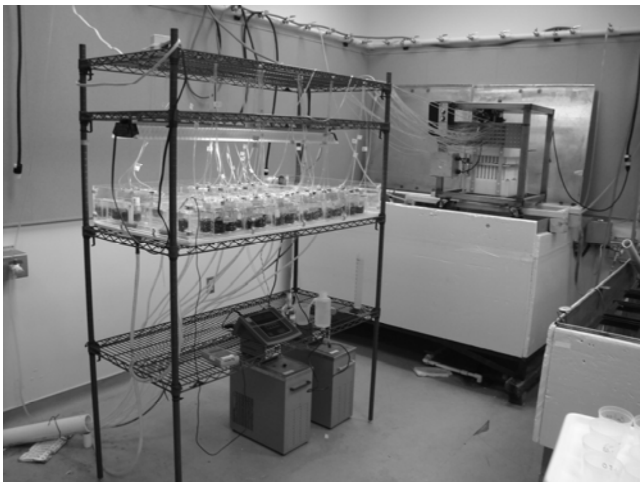


Effects of Zinc in Porewater
Figure 4.0-2

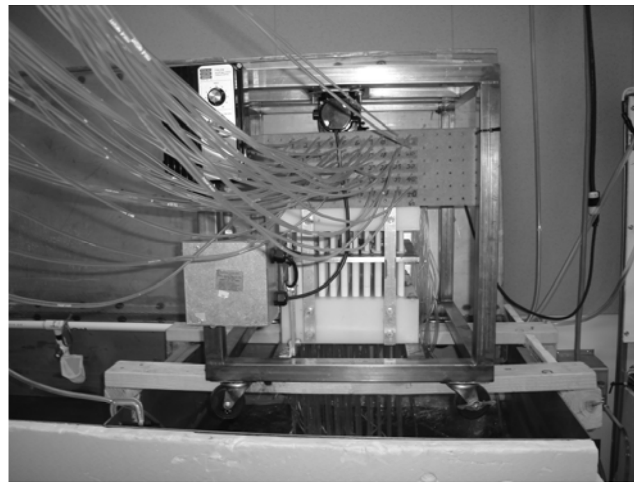


Appendix A

Sediment Toxicity Test
Setup Photos



Test Chambers/
Batch Tank/Wall Pump



Wall Pump/
Delivery System

YCT Preparation

Test Chambers/
Water Bath

Appendix B

Appendix B - Daily Water Chemistries
Site Sediment Toxicity Testing - Standard Mine

Test Type:	Sediment	Water Type:	Recon	Sample Source:	Standard Mine
Duration:	10-day	Analysts:	SA/JC	Test Start (day 0):	10/3/2006
Static/ Flow Through:	Flow Through	Test System:	Wall pump/beakers	Test End (day 10):	10/13/2006
Organism:	H. azteca	Replicates:	Four	Feed Rate/ Type:	Daily/YCT

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
Control-N-1	pH	8.1										8.2
Control-N-1	Conductivity (us/cm)	470										414
Control-N-1	D.O. (mg/L)	7.62	7.22	7.37	7.51	7.57	7.51	7.11	6.96	7.02	6.42	6.5
Control-N-1	Temp (C)	20.42	20.41	21.47	21.46	21.49	21.51	21.48	21.16	21.2	21.16	21.2
Control-N-1	Hardness	106.4										108.8
Control-N-1	Alkalinity	56.5										65
Control-N-2	pH	8.1										8.2
Control-N-2	Conductivity (us/cm)	487										422
Control-N-2	D.O. (mg/L)	7.5	7.24	7.22	7.44	7.5	7.47	6.98	6.74	6.92	6.31	6.42
Control-N-2	Temp (C)	20.47	20.68	21.46	21.55	21.62	21.53	21.51	21.26	21.35	21.05	21.15
Control-N-2	Hardness	117										109
Control-N-2	Alkalinity	59.5										62.5
Control-N-3	pH	8.1										8.2
Control-N-3	Conductivity (us/cm)	465										418
Control-N-3	D.O. (mg/L)	7.59	7.24	7.14	7.33	7.29	7.42	7.02	6.72	6.81	6.36	6.37
Control-N-3	Temp (C)	20.45	20.68	21.58	21.64	21.7	21.62	21.5	21.31	21.46	21.11	21.11
Control-N-3	Hardness	108										108
Control-N-3	Alkalinity	58.5										65
Control-N-4	pH	8.1										8.2
Control-N-4	Conductivity (us/cm)	470										422
Control-N-4	D.O. (mg/L)	7.62	7.19	7.27	7.33	7.51	7.55	7.1	6.69	6.72	6.38	6.41
Control-N-4	Temp (C)	20.49	20.69	21.31	21.66	21.82	21.9	21.62	21.29	21.35	21.06	21.1
Control-N-4	Hardness	117										107.5
Control-N-4	Alkalinity	60										65

Appendix B - Daily Water Chemistries
Site Sediment Toxicity Testing - Standard Mine

Test Type:	Sediment	Water Type:	Recon	Sample Source:	Standard Mine
Duration:	10-day	Analysts:	SA/JC	Test Start (day 0):	10/3/2006
Static/ Flow Through:	Flow Through	Test System:	Wall pump/beakers	Test End (day 10):	10/13/2006
Organism:	H. azteca	Replicates:	Four	Feed Rate/ Type:	Daily/YCT

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
Control-P-1	pH	8.1										8.1
Control-P-1	Conductivity (us/cm)	418										425
Control-P-1	D.O. (mg/L)	7.57	7.35	7.33	7.22	7.29	7.33	6.92	6.74	7.04	6.39	6.47
Control-P-1	Temp (C)	20.55	20.86	21.67	21.35	21.5	21.66	21.54	21.53	21.6	21.11	21.15
Control-P-1	Hardness	119										112
Control-P-1	Alkalinity	65										65
Control-P-2	pH	8.1										8.1
Control-P-2	Conductivity (us/cm)	404										417
Control-P-2	D.O. (mg/L)	7.48	7.3	7.23	7.34	7.38	7.33	6.97	6.7	6.93	6.39	6.25
Control-P-2	Temp (C)	20.6	20.87	21.76	21.66	21.76	21.77	21.67	21.52	21.47	21.18	21.17
Control-P-2	Hardness	118										114
Control-P-2	Alkalinity	60										60.2
Control-P-3	pH	8.1										8.1
Control-P-3	Conductivity (us/cm)	399										422
Control-P-3	D.O. (mg/L)	7.4	7.25	7.21	7.33	7.17	7.21	6.91	6.72	6.85	6.38	6.46
Control-P-3	Temp (C)	20.51	20.88	21.74	21.74	21.68	21.87	21.6	21.5	21.62	21.2	21.2
Control-P-3	Hardness	116										110
Control-P-3	Alkalinity	62										62
Control-P-4	pH	8.1										8.1
Control-P-4	Conductivity (us/cm)	399										416
Control-P-4	D.O. (mg/L)	7.51	7.27	7.26	7.35	7.27	7.31	6.99	6.77	6.59	6.35	6.7
Control-P-4	Temp (C)	20.55	20.93	21.75	21.79	21.63	21.62	21.65	21.48	21.51	21.12	21.15
Control-P-4	Hardness	118										115
Control-P-4	Alkalinity	62										65

Appendix B - Daily Water Chemistries
Site Sediment Toxicity Testing - Standard Mine

Test Type:	Sediment	Water Type:	Recon	Sample Source:	Standard Mine
Duration:	10-day	Analysts:	SA/JC	Test Start (day 0):	10/3/2006
Static/ Flow Through:	Flow Through	Test System:	Wall pump/beakers	Test End (day 10):	10/13/2006
Organism:	H. azteca	Replicates:	Four	Feed Rate/ Type:	Daily/YCT

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
Coal-15-1	pH	8.3										8
Coal-15-1	Conductivity (us/cm)	398										404
Coal-15-1	D.O. (mg/L)	7.46	7.57	7.44	7.21	7.26	7.22	7.01	6.74	6.82	6.29	6.4
Coal-15-1	Temp (C)	20.6	21.02	21.05	21.78	21.49	21.51	21.55	21.26	21.35	21.28	21.2
Coal-15-1	Hardness	118										108
Coal-15-1	Alkalinity	60										60
Coal-15-2	pH	8.3										8
Coal-15-2	Conductivity (us/cm)	384										402
Coal-15-2	D.O. (mg/L)	7.62	7.5	7.58	7.25	7.28	7.25	7.52	6.95	6.96	6.37	6.42
Coal-15-2	Temp (C)	20.58	20.98	21.74	21.85	21.96	21.88	21.8	21.5	21.43	21.18	21.19
Coal-15-2	Hardness	116										110
Coal-15-2	Alkalinity	61										62
Coal-15-3	pH	8.3										8
Coal-15-3	Conductivity (us/cm)	396										410
Coal-15-3	D.O. (mg/L)	7.57	7.49	7.45	7.25	7.3	7.41	7.3	6.96	6.99	6.2	6.47
Coal-15-3	Temp (C)	20.51	20.98	21.76	21.84	21.77	21.77	21.62	21.53	21.5	21.43	21.25
Coal-15-3	Hardness	121										112
Coal-15-3	Alkalinity	61										62
Coal-15-4	pH	8.3										8
Coal-15-4	Conductivity (us/cm)	386										416
Coal-15-4	D.O. (mg/L)	7.43	7.6	7.36	7.52	7.54	7.42	7.05	6.9	7.02	6.35	6.21
Coal-15-4	Temp (C)	20.62	20.92	21.66	21.79	21.83	21.8	21.88	21.55	21.6	21.26	21.2
Coal-15-4	Hardness	122										114
Coal-15-4	Alkalinity	62										60

Appendix B - Daily Water Chemistries
Site Sediment Toxicity Testing - Standard Mine

Test Type:	Sediment	Water Type:	Recon	Sample Source:	Standard Mine
Duration:	10-day	Analysts:	SA/JC	Test Start (day 0):	10/3/2006
Static/ Flow Through:	Flow Through	Test System:	Wall pump/beakers	Test End (day 10):	10/13/2006
Organism:	H. azteca	Replicates:	Four	Feed Rate/ Type:	Daily/YCT

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
Coal-20-1	pH	8.1										8
Coal-20-1	Conductivity (us/cm)	430										416
Coal-20-1	D.O. (mg/L)	7.62	7.21	7.42	7.28	7.35	7.41	7.22	6.83	6.8	6.4	6.39
Coal-20-1	Temp (C)	20.52	20.91	21.64	21.64	21.7	21.65	21.6	21.43	21.54	21.25	21.2
Coal-20-1	Hardness	115										112
Coal-20-1	Alkalinity	60										65
Coal-20-2	pH	8.1										8
Coal-20-2	Conductivity (us/cm)	380										420
Coal-20-2	D.O. (mg/L)	7.41	7.12	7.33	7.3	7.42	7.19	7.2	6.83	6.91	6.16	6.05
Coal-20-2	Temp (C)	20.51	20.83	21.61	21.75	21.67	21.7	21.7	21.38	21.35	21.18	21.23
Coal-20-2	Hardness	114										114
Coal-20-2	Alkalinity	60										62
Coal-20-3	pH	8.1										8
Coal-20-3	Conductivity (us/cm)	390										431
Coal-20-3	D.O. (mg/L)	7.47	7.29	7.38	7.2	7.25	7.39	7.18	7.02	7.01	6.41	6.4
Coal-20-3	Temp (C)	20.58	20.92	21.55	21.79	21.78	21.77	21.7	21.35	21.4	21.48	21.19
Coal-20-3	Hardness	118										118
Coal-20-3	Alkalinity	62										65
Coal-20-4	pH	8.1										8
Coal-20-4	Conductivity (us/cm)	390										422
Coal-20-4	D.O. (mg/L)	7.67	7.16	7.45	7.24	7.61	7.66	7.5	6.37	6.44	6.48	6.41
Coal-20-4	Temp (C)	20.49	20.7	21.52	21.75	21.55	21.59	21.43	21.34	21.39	21.4	21.22
Coal-20-4	Hardness	114										118
Coal-20-4	Alkalinity	62										62

Appendix B - Daily Water Chemistries
Site Sediment Toxicity Testing - Standard Mine

Test Type:	Sediment	Water Type:	Recon	Sample Source:	Standard Mine
Duration:	10-day	Analysts:	SA/JC	Test Start (day 0):	10/3/2006
Static/ Flow Through:	Flow Through	Test System:	Wall pump/beakers	Test End (day 10):	10/13/2006
Organism:	H. azteca	Replicates:	Four	Feed Rate/ Type:	Daily/YCT

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
Elk-00-1	pH	8.3										7.9
Elk-00-1	Conductivity (us/cm)	398										412
Elk-00-1	D.O. (mg/L)	7.29	7.56	7.58	7.27	7.29	7.31	7.45	6.98	7.01	6.47	6.46
Elk-00-1	Temp (C)	20.59	21.11	21.6	21.8	21.81	21.72	21.69	21.6	21.53	21.46	21.4
Elk-00-1	Hardness	117										120
Elk-00-1	Alkalinity	70										68
Elk-00-2	pH	8.3										7.9
Elk-00-2	Conductivity (us/cm)	412										413
Elk-00-2	D.O. (mg/L)	7.8	7.53	7.66	7.32	7.37	7.42	7.03	6.95	7	6.5	6.51
Elk-00-2	Temp (C)	20.6	21.5	21.7	21.78	21.81	21.88	21.8	21.67	21.68	21.38	21.33
Elk-00-2	Hardness	121										120
Elk-00-2	Alkalinity	70										65
Elk-00-3	pH	8.3										7.9
Elk-00-3	Conductivity (us/cm)	394										402
Elk-00-3	D.O. (mg/L)	7.35	7.58	7.63	7.37	7.56	7.54	7.51	7.02	7.08	6.46	6.42
Elk-00-3	Temp (C)	20.61	21.14	21.62	21.7	21.63	21.71	21.65	21.53	21.67	21.41	21.36
Elk-00-3	Hardness	117										118
Elk-00-3	Alkalinity	68										62.3
Elk-00-4	pH	8.3										7.9
Elk-00-4	Conductivity (us/cm)	390										421
Elk-00-4	D.O. (mg/L)	7.47	7.51	7.55	7.25	7.29	7.35	7.03	6.95	6.93	6.95	6.82
Elk-00-4	Temp (C)	20.67	21.16	21.73	21.73	21.76	21.81	21.82	21.6	21.49	21.32	21.37
Elk-00-4	Hardness	114										112
Elk-00-4	Alkalinity	70										60

Appendix B - Daily Water Chemistries
Site Sediment Toxicity Testing - Standard Mine

Test Type:	Sediment	Water Type:	Recon	Sample Source:	Standard Mine
Duration:	10-day	Analysts:	SA/JC	Test Start (day 0):	10/3/2006
Static/ Flow Through:	Flow Through	Test System:	Wall pump/beakers	Test End (day 10):	10/13/2006
Organism:	H. azteca	Replicates:	Four	Feed Rate/ Type:	Daily/YCT

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
Elk-08-1	pH	8.3										7.9
Elk-08-1	Conductivity (us/cm)	392										402
Elk-08-1	D.O. (mg/L)	7.6	7.49	7.52	7.64	7.5	7.6	7.12	6.98	7.01	6.44	6.45
Elk-08-1	Temp (C)	20.5	20.98	21.68	21.35	21.8	21.83	21.6	21.63	21.47	21.24	21.32
Elk-08-1	Hardness	115										112
Elk-08-1	Alkalinity	63										60
Elk-08-2	pH	8.3										7.9
Elk-08-2	Conductivity (us/cm)	390										403
Elk-08-2	D.O. (mg/L)	7.52	7.78	7.43	7.35	7.39	7.4	7.03	6.55	6.49	6.52	6.42
Elk-08-2	Temp (C)	20.61	21.07	21.71	21.56	21.6	21.56	21.51	21.62	21.6	21.32	21.33
Elk-08-2	Hardness	113										119
Elk-08-2	Alkalinity	63										60
Elk-08-3	pH	8.3										7.9
Elk-08-3	Conductivity (us/cm)	389										417
Elk-08-3	D.O. (mg/L)	7.51	7.65	7.41	7.28	7.22	7.35	7.48	6.93	6.85	6.58	6.4
Elk-08-3	Temp (C)	20.68	21.1	21.18	21.78	21.65	21.71	21.63	21.76	21.77	21.54	21.39
Elk-08-3	Hardness	113										115
Elk-08-3	Alkalinity	60										62
Elk-08-4	pH	8.3										7.9
Elk-08-4	Conductivity (us/cm)	390										421
Elk-08-4	D.O. (mg/L)	7.48	7.66	7.42	7.24	7.31	7.28	7.25	6.97	6.8	6.47	6.49
Elk-08-4	Temp (C)	20.62	21.08	21.81	21.77	21.69	21.6	21.67	21.65	21.7	21.47	21.37
Elk-08-4	Hardness	114										117
Elk-08-4	Alkalinity	63										65

Appendix B - Daily Water Chemistries
Site Sediment Toxicity Testing - Standard Mine

Test Type:	Sediment	Water Type:	Recon	Sample Source:	Standard Mine
Duration:	10-day	Analysts:	SA/JC	Test Start (day 0):	10/3/2006
Static/ Flow Through:	Flow Through	Test System:	Wall pump/beakers	Test End (day 10):	10/13/2006
Organism:	H. azteca	Replicates:	Four	Feed Rate/ Type:	Daily/YCT

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
Elk-08D-1	pH	8.3										7.9
Elk-08D-1	Conductivity (us/cm)	403										420
Elk-08D-1	D.O. (mg/L)	7.35	7.15	7.54	7.24	7.25	7.51	7.4	6.28	6.81	6.53	6.36
Elk-08D-1	Temp (C)	20.7	21.04	21.66	21.8	21.9	21.86	21.62	21.53	21.43	21.43	21.8
Elk-08D-1	Hardness	113										120
Elk-08D-1	Alkalinity	60										65
Elk-08D-2	pH	8.3										7.9
Elk-08D-2	Conductivity (us/cm)	397										422
Elk-08D-2	D.O. (mg/L)	7.42	7.25	7.52	7.25	7.51	7.22	7.08	7.01	7	6.55	6.42
Elk-08D-2	Temp (C)	20.68	21.11	21.83	21.92	21.81	21.86	21.52	21.72	21.54	21.53	21.42
Elk-08D-2	Hardness	117										117
Elk-08D-2	Alkalinity	63										62.5
Elk-08D-3	pH	8.3										7.9
Elk-08D-3	Conductivity (us/cm)	398										401
Elk-08D-3	D.O. (mg/L)	7.61	7.39	7.35	7.24	7.27	7.25	7.02	7.42	7.47	6.49	6.39
Elk-08D-3	Temp (C)	20.65	21.12	21.46	21.98	21.9	21.87	21.83	21.72	21.7	21.57	21.4
Elk-08D-3	Hardness	117										115
Elk-08D-3	Alkalinity	63										60
Elk-08D-4	pH	8.3										7.9
Elk-08D-4	Conductivity (us/cm)	398										417
Elk-08D-4	D.O. (mg/L)	7.82	7.45	7.43	7.25	7.46	7.51	7	6.95	7.03	6.45	6.42
Elk-08D-4	Temp (C)	21.71	21.07	21.7	21.93	21.84	21.85	21.87	21.71	21.3	21.46	21.4
Elk-08D-4	Hardness	120										117
Elk-08D-4	Alkalinity	63										60

Appendix B - Daily Water Chemistries
Site Sediment Toxicity Testing - Standard Mine

Test Type:	Sediment	Water Type:	Recon	Sample Source:	Standard Mine
Duration:	10-day	Analysts:	SA/JC	Test Start (day 0):	10/3/2006
Static/ Flow Through:	Flow Through	Test System:	Wall pump/beakers	Test End (day 10):	10/13/2006
Organism:	H. azteca	Replicates:	Four	Feed Rate/ Type:	Daily/YCT

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
SP-00-1	pH	8.3										7.9
SP-00-1	Conductivity (us/cm)	396										416
SP-00-1	D.O. (mg/L)	7.56	7.92	7.63	7.42	7.44	7.4	7.46	7.42	7.01	7.03	6.52
SP-00-1	Temp (C)	20.68	20.9	21.57	21.27	21.37	21.83	21.8	20.88	21.35	21.38	21.35
SP-00-1	Hardness	119										115
SP-00-1	Alkalinity	63										62
SP-00-2	pH	8.3										7.9
SP-00-2	Conductivity (us/cm)	397										400
SP-00-2	D.O. (mg/L)	7.6	7.65	7.4	7.21	7.19	7.24	7.02	7.37	7.41	7.01	6.93
SP-00-2	Temp (C)	20.71	20.93	21.64	21.61	21.7	21.68	21.65	21.41	21.49	21.43	21.4
SP-00-2	Hardness	116										112
SP-00-2	Alkalinity	62										65
SP-00-3	pH	8.3										7.9
SP-00-3	Conductivity (us/cm)	448										420
SP-00-3	D.O. (mg/L)	7.61	7.92	7.44	7.15	7.44	7.22	6.89	7.29	7.35	6.64	6.57
SP-00-3	Temp (C)	20.65	21.02	21.73	21.76	21.63	21.68	21.7	21.53	21.6	21.52	21.4
SP-00-3	Hardness	120										118
SP-00-3	Alkalinity	63										59
SP-00-4	pH	8.3										7.9
SP-00-4	Conductivity (us/cm)	450										416
SP-00-4	D.O. (mg/L)	7.68	7.56	7.43	7.09	7.17	7.27	6.93	7.14	7.03	6.6	6.31
SP-00-4	Temp (C)	20.6	20.04	21.84	21.9	21.81	21.81	21.82	21.58	21.48	21.5	21.51
SP-00-4	Hardness	117										115
SP-00-4	Alkalinity	63										62

Appendix B - Daily Water Chemistries
Site Sediment Toxicity Testing - Standard Mine

Test Type:	Sediment	Water Type:	Recon	Sample Source:	Standard Mine
Duration:	10-day	Analysts:	SA/JC	Test Start (day 0):	10/3/2006
Static/ Flow Through:	Flow Through	Test System:	Wall pump/beakers	Test End (day 10):	10/13/2006
Organism:	H. azteca	Replicates:	Four	Feed Rate/ Type:	Daily/YCT

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
Cop-01-1	pH	8.1										8
Cop-01-1	Conductivity (us/cm)	402										421
Cop-01-1	D.O. (mg/L)	7.62	7.26	7.29	7.44	7.51	7.31	7.17	7.24	7.01	6.45	6.51
Cop-01-1	Temp (C)	20.58	20.93	21.7	21.55	21.56	21.6	21.51	21.21	21.35	21.42	21.3
Cop-01-1	Hardness	120										115
Cop-01-1	Alkalinity	62										65
Cop-01-2	pH	8.1										8
Cop-01-2	Conductivity (us/cm)	410										417
Cop-01-2	D.O. (mg/L)	7.71	7.1	7.2	7.32	7.4	7.25	7	7.15	7.2	6.47	6.46
Cop-01-2	Temp (C)	20.55	20.9	21.6	21.83	21.77	21.65	21.52	21.35	21.4	21.38	21.32
Cop-01-2	Hardness	118										118
Cop-01-2	Alkalinity	62										63
Cop-01-3	pH	8.1										8
Cop-01-3	Conductivity (us/cm)	408										422
Cop-01-3	D.O. (mg/L)	7.7	7.21	7.5	7.18	7.3	7.32	7.12	7.06	7.22	6.51	6.52
Cop-01-3	Temp (C)	20.49	20.95	21.6	21.84	21.72	21.71	21.68	21.5	21.43	21.47	21.3
Cop-01-3	Hardness	120										121
Cop-01-3	Alkalinity	62										67
Cop-01-4	pH	8.1										8
Cop-01-4	Conductivity (us/cm)	416										413
Cop-01-4	D.O. (mg/L)	7.49	7.34	7.48	7.21	7.22	7.18	7.11	7.07	7.01	6.42	6.4
Cop-01-4	Temp (C)	20.51	20.89	21.61	21.7	21.61	21.69	21.62	21.35	21.4	21.37	21.25
Cop-01-4	Hardness	119										118
Cop-01-4	Alkalinity	60										62

Test Type:	Sediment	Water Type:	Recon	Sample Source:	Standard Mine
Duration:	10-day	Analysts:	SA/JC	Test Start (day 0):	10/3/2006
Static/ Flow Through:	Flow Through	Test System:	Wall pump/beakers	Test End (day 10):	10/13/2006
Organism:	H. azteca	Replicates:	Four	Feed Rate/ Type:	Daily/YCT

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
Cop-01D-1	pH	8.1										7.9
Cop-01D-1	Conductivity (us/cm)	418										422
Cop-01D-1	D.O. (mg/L)	7.61	7.49	7.48	7.21	7.49	7.5	7.42	6.78	6.79	6.39	6.41
Cop-01D-1	Temp (C)	20.51	20.98	21.81	21.85	21.86	21.9	21.69	21.42	21.6	21.2	21.22
Cop-01D-1	Hardness	120										112
Cop-01D-1	Alkalinity	60										60
Cop-01D-2	pH	8.1										7.9
Cop-01D-2	Conductivity (us/cm)	391										412
Cop-01D-2	D.O. (mg/L)	7.82	7.44	7.4	7.17	7.06	7.17	7.05	6.79	6.9	6.36	6.4
Cop-01D-2	Temp (C)	20.53	20.97	21.26	21.87	21.79	21.81	21.77	21.54	21.58	21.28	21.25
Cop-01D-2	Hardness	116										114
Cop-01D-2	Alkalinity	62										60
Cop-01D-3	pH	8.1										7.9
Cop-01D-3	Conductivity (us/cm)	392										416
Cop-01D-3	D.O. (mg/L)	7.71	7.47	7.43	7.25	7.3	7.26	7.22	6.96	6.91	6.34	6.31
Cop-01D-3	Temp (C)	20.51	20.95	21.79	21.84	21.85	21.8	21.7	21.58	21.55	21.31	21.17
Cop-01D-3	Hardness	114										114
Cop-01D-3	Alkalinity	62										62
Cop-01D-4	pH	8.1										7.9
Cop-01D-4	Conductivity (us/cm)	393										410
Cop-01D-4	D.O. (mg/L)	7.47	7.46	7.48	7.23	7.5	7.51	7.25	6.69	6.7	6.37	6.39
Cop-01D-4	Temp (C)	20.49	20.96	21.78	21.83	21.9	21.71	21.69	21.58	21.55	21.29	21.2
Cop-01D-4	Hardness	116										112
Cop-01D-4	Alkalinity	60										60

Appendix C

Appendix C - Water Chemistries
Reference Sediment Toxicity Testing

Test Type:	Sediment	Water Type:	Recon	Sample Source:	Spiked Sed Ref
Duration:	10-day	Analysts:	SA/JC	Test Start (day 0):	10/24/2006
Static/ Flow Through:	Flow Through	Test System:	Wall pump/beakers	Test End (day 10):	11/3/2006
Organism:	H. azteca	Replicates:	Four	Feed Rate/ Type:	Daily/YCT

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
Control-1	pH	7.78										7.9
Control-1	Conductivity (us/cm)	428										392
Control-1	D.O. (mg/L)	8.28	7.83	7.25	7.19	6.51	6.5	5.23	5.01	4.23	4.94	4.35
Control-1	Temp (C)	21.33	21.43	21.37	21.25	21.53	21.28	21.22	21.03	21.21	21.34	21.15
Control-1	Hardness	99.6										108
Control-1	Alkalinity	77.5										75

Control-2	pH	8.08										7.9
Control-2	Conductivity (us/cm)	408										390
Control-2	D.O. (mg/L)	8.25	7.94	7.42	7.11	6.24	6.31	5.27	4.99	4.03	4.8	4.33
Control-2	Temp (C)	21.25	21.5	21.41	21.28	21.42	21.4	21.25	21.27	21.3	21.43	21.21
Control-2	Hardness	96.4										109
Control-2	Alkalinity	78										74

Control-3	pH	7.82										7.9
Control-3	Conductivity (us/cm)	427										384
Control-3	D.O. (mg/L)	8.16	7.98	7.56	7.02	6.87	6.53	5.86	4.85	4.26	4.75	4.37
Control-3	Temp (C)	21.28	21.38	21.4	21.35	21.51	21.41	21.27	21.21	21.17	21.33	21.27
Control-3	Hardness	98										106
Control-3	Alkalinity	77.5										70

Control-4	pH	8.01										7.9
Control-4	Conductivity (us/cm)	410										382
Control-4	D.O. (mg/L)	8.17	8.01	7.22	6.95	6.92	6.75	5.73	4.89	4.4	4.74	4.55
Control-4	Temp (C)	21.13	21.4	21.39	21.28	21.41	21.49	21.4	21.23	21.28	21.26	21.14
Control-4	Hardness	100										104
Control-4	Alkalinity	79										70

Appendix C - Water Chemistries
Reference Sediment Toxicity Testing

Test Type:	Sediment	Water Type:	Recon	Sample Source:	Spiked Sed Ref
Duration:	10-day	Analysts:	SA/JC	Test Start (day 0):	10/24/2006
Static/ Flow Through:	Flow Through	Test System:	Wall pump/beakers	Test End (day 10):	11/3/2006
Organism:	H. azteca	Replicates:	Four	Feed Rate/ Type:	Daily/YCT

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
6.25-1	pH	7.97										7.9
6.25-1	Conductivity (us/cm)	420										388
6.25-1	D.O. (mg/L)	8.19	7.91	7.51	6.93	6.41	6.5	5.02	4.83	4.44	4.76	4.62
6.25-1	Temp (C)	21.19	21.46	21.46	21.32	21.96	21.37	21.39	21.28	21.29	21.44	21.46
6.25-1	Hardness	100										105
6.25-1	Alkalinity	80										68
6.25-2	pH	8										7.9
6.25-2	Conductivity (us/cm)	405										386
6.25-2	D.O. (mg/L)	8.18	7.91	7.86	7.11	6.73	6.71	5.11	4.83	4.47	4.72	4.59
6.25-2	Temp (C)	21.23	21.5	21.4	21.45	21.46	21.4	21.37	21.29	21.28	21.53	21.38
6.25-2	Hardness	100										110
6.25-2	Alkalinity	78										62
6.25-3	pH	8										7.9
6.25-3	Conductivity (us/cm)	415										386
6.25-3	D.O. (mg/L)	8.15	7.56	7.61	6.83	6.76	6.39	5.72	4.83	4.46	4.72	4.55
6.25-3	Temp (C)	21.23	21.49	21.37	21.53	21.36	21.46	21.42	21.21	21.28	21.59	21.24
6.25-3	Hardness	100										108
6.25-3	Alkalinity	78										64
6.25-4	pH	8										7.9
6.25-4	Conductivity (us/cm)	405										380
6.25-4	D.O. (mg/L)	8.13	7.46	7.47	6.82	6.81	6.71	5.01	4.81	4.47	4.74	4.64
6.25-4	Temp (C)	21.21	21.49	21.39	21.5	21.41	21.51	21.37	21.23	21.3	21.51	21.32
6.25-4	Hardness	94										104
6.25-4	Alkalinity	80										62

Appendix C - Water Chemistries
Reference Sediment Toxicity Testing

Test Type:	Sediment	Water Type:	Recon	Sample Source:	Spiked Sed Ref
Duration:	10-day	Analysts:	SA/JC	Test Start (day 0):	10/24/2006
Static/ Flow Through:	Flow Through	Test System:	Wall pump/beakers	Test End (day 10):	11/3/2006
Organism:	H. azteca	Replicates:	Four	Feed Rate/ Type:	Daily/YCT

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
12.5-1	pH	8										8
12.5-1	Conductivity (us/cm)	409										380
12.5-1	D.O. (mg/L)	8.11	7.44	7.37	6.89	7.01	6.72	5.01	4.84	4.56	4.66	4.56
12.5-1	Temp (C)	21.23	21.42	21.3	21.52	21.71	21.7	21.4	21.29	21.29	21.62	21.26
12.5-1	Hardness	97										108
12.5-1	Alkalinity	76										64
12.5-2	pH	8										8.1
12.5-2	Conductivity (us/cm)	410										382
12.5-2	D.O. (mg/L)	8	7.54	7.02	6.78	6.43	6.32	4.77	4.89	4.42	4.62	4.56
12.5-2	Temp (C)	21.24	21.44	21.49	21.6	21.53	21.51	21.31	21.23	21.28	21.63	21.49
12.5-2	Hardness	100										108
12.5-2	Alkalinity	80										66
12.5-3	pH	8										8
12.5-3	Conductivity (us/cm)	408										379
12.5-3	D.O. (mg/L)	8	7.43	7.71	6.81	6.49	6.5	4.92	4.81	4.42	4.65	4.56
12.5-3	Temp (C)	21.3	21.44	21.4	21.66	21.71	21.39	21.37	21.21	21.18	21.6	21.39
12.5-3	Hardness	98										106
12.5-3	Alkalinity	79										68
12.5-4	pH	8										8
12.5-4	Conductivity (us/cm)	405										379
12.5-4	D.O. (mg/L)	8.11	7.69	7.4	6.73	6.82	6.79	5.1	4.87	4.58	4.53	4.5
12.5-4	Temp (C)	21.18	21.35	21.37	21.65	21.54	21.55	21.4	21.29	21.2	21.5	21.35
12.5-4	Hardness	92.4										108
12.5-4	Alkalinity	80										70

Appendix C - Water Chemistries
Reference Sediment Toxicity Testing

Test Type:	Sediment	Water Type:	Recon	Sample Source:	Spiked Sed Ref
Duration:	10-day	Analysts:	SA/JC	Test Start (day 0):	10/24/2006
Static/ Flow Through:	Flow Through	Test System:	Wall pump/beakers	Test End (day 10):	11/3/2006
Organism:	H. azteca	Replicates:	Four	Feed Rate/ Type:	Daily/YCT

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
25-1	pH	8.1										8.1
25-1	Conductivity (us/cm)	410										383
25-1	D.O. (mg/L)	8.02	7.5	7.31	6.76	6.81	6.87	4.83	5.01	4.5	4.74	4.59
25-1	Temp (C)	21.25	21.42	21.51	21.58	21.46	21.57	21.43	21.17	21.26	21.3	21.32
25-1	Hardness	96										109
25-1	Alkalinity	76										62
25-2	pH	8.1										8.1
25-2	Conductivity (us/cm)	413										388
25-2	D.O. (mg/L)	8.26	7.62	7.52	6.74	6.71	6.27	4.97	4.92	4.6	4.7	4.67
25-2	Temp (C)	21.29	21.43	21.46	21.59	21.51	21.54	21.42	21.94	21.1	21.26	21.19
25-2	Hardness	95										108
25-2	Alkalinity	78										60
25-3	pH	8.1										8.1
25-3	Conductivity (us/cm)	410										385
25-3	D.O. (mg/L)	7.98	7.81	7.8	6.75	6.81	6.8	5.02	4.97	4.57	4.72	4.58
25-3	Temp (C)	21.24	21.62	21.54	21.5	21.37	21.4	21.35	21.05	21.22	21.23	21.22
25-3	Hardness	97										109
25-3	Alkalinity	76										64
25-4	pH	8.2										8.1
25-4	Conductivity (us/cm)	412										395
25-4	D.O. (mg/L)	7.92	7.76	7.8	6.76	6.31	6.51	5	5.12	4.56	4.74	4.6
25-4	Temp (C)	21.19	21.18	21.36	21.5	21.39	21.47	21.4	20.36	21.12	21.25	21.2
25-4	Hardness	97										106
25-4	Alkalinity	80										60

Appendix C - Water Chemistries
Reference Sediment Toxicity Testing

Test Type:	Sediment	Water Type:	Recon	Sample Source:	Spiked Sed Ref
Duration:	10-day	Analysts:	SA/JC	Test Start (day 0):	10/24/2006
Static/ Flow Through:	Flow Through	Test System:	Wall pump/beakers	Test End (day 10):	11/3/2006
Organism:	H. azteca	Replicates:	Four	Feed Rate/ Type:	Daily/YCT

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
50-1	pH	8.1										8
50-1	Conductivity (us/cm)	419										383
50-1	D.O. (mg/L)	8.01	7.83	7.02	6.86	6.5	6.6	4.91	5.06	4.57	4.8	4.6
50-1	Temp (C)	21.15	21.14	21.2	21.03	21.41	21.32	21.37	20.96	21.07	21.17	21.12
50-1	Hardness	95										107
50-1	Alkalinity	78										64
50-2	pH	8.1										8
50-2	Conductivity (us/cm)	420										382
50-2	D.O. (mg/L)	7.91	7.69	7.31	6.8	6.42	6.47	4.99	5.02	4.44	4.76	4.56
50-2	Temp (C)	21.27	21.06	21.17	21.35	21.43	21.44	21.48	20.92	21.12	21.21	21.18
50-2	Hardness	96.2										102
50-2	Alkalinity	81										61
50-3	pH	8.1										8.1
50-3	Conductivity (us/cm)	453										381
50-3	D.O. (mg/L)	8	7.78	7.78	6.75	6.4	6.05	5.02	5.01	4.24	4.7	4.54
50-3	Temp (C)	21.23	21.09	21.19	21.48	21.53	21.47	21.46	20.01	21.1	21.36	21.2
50-3	Hardness	98.4										107
50-3	Alkalinity	76										60
50-4	pH	8.1										8
50-4	Conductivity (us/cm)	426										380
50-4	D.O. (mg/L)	7.97	7.64	7.51	6.75	6.98	6.82	5.13	4.91	4.39	4.71	4.5
50-4	Temp (C)	21.15	21.16	21.3	21.23	21.81	21.18	21.54	21.12	21	21.36	21.17
50-4	Hardness	97.2										114
50-4	Alkalinity	78										60

Appendix C - Water Chemistries
Reference Sediment Toxicity Testing

Test Type:	Sediment	Water Type:	Recon	Sample Source:	Spiked Sed Ref
Duration:	10-day	Analysts:	SA/JC	Test Start (day 0):	10/24/2006
Static/ Flow Through:	Flow Through	Test System:	Wall pump/beakers	Test End (day 10):	11/3/2006
Organism:	H. azteca	Replicates:	Four	Feed Rate/ Type:	Daily/YCT

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
100-1	pH	7.9										7.9
100-1	Conductivity (us/cm)	421										383
100-1	D.O. (mg/L)	7.7	7.6	7.42	6.99	6.81	6.71	5.13	4.93	4.22	4.74	4.53
100-1	Temp (C)	21	21.43	21.39	21.29	21.23	21.47	21.55	21.25	21.36	21.51	21.44
100-1	Hardness	99.6										108
100-1	Alkalinity	74										62
100-2	pH	7.9										7.9
100-2	Conductivity (us/cm)	424										386
100-2	D.O. (mg/L)	7.61	7.55	7.31	7.1	6.26	6.22	5.01	4.89	4.43	4.7	4.56
100-2	Temp (C)	21.36	21.42	21.4	21.45	21.32	21.43	21.47	21.31	21.28	21.55	21.44
100-2	Hardness	98.6										108
100-2	Alkalinity	78										60
100-3	pH	8										7.9
100-3	Conductivity (us/cm)	422										383
100-3	D.O. (mg/L)	7.62	7.59	7.62	6.65	6.42	6.47	5.03	4.89	4.51	4.69	4.56
100-3	Temp (C)	21.43	21.45	21.5	21.59	21.48	21.5	21.51	21.26	21.28	21.5	21.34
100-3	Hardness	98.4										108
100-3	Alkalinity	77										61
100-4	pH	7.9										7.9
100-4	Conductivity (us/cm)	434										390
100-4	D.O. (mg/L)	8.05	7.75	7.6	6.64	6.1	6.09	4.75	4.94	4.5	4.66	4.59
100-4	Temp (C)	21.45	21.42	21.47	21.58	21.49	21.47	21.38	21.25	21.32	21.55	21.44
100-4	Hardness	99.6										108
100-4	Alkalinity	78										62