Fall 2012 Biannual Removal Action Monitoring Report
Blue Ledge Mine Site
Rogue River-Siskiyou National Forest
Siskiyou County, California

February 2013

ERRG Project No. 2010-084

Prepared for:

U.S. Department of Agriculture
Forest Service Region 6
Rogue River-Siskiyou National Forest

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Acronyms and Abbreviations

AMD	acid mine drainage
ASTM	ASTM International
Biannual Report	Biannual Removal Action Monitoring Report
B-IBI	Benthic Index of Biotic Integrity
$CaCO_3$	calcium carbonate
CCC	California Water Quality Standards continuous concentration criteria
DO	dissolved oxygen
EE/CA	engineering evaluation/cost analysis
EPA	U.S. Environmental Protection Agency
ERRG	Engineering/Remediation Resources Group, Inc.
LCS	laboratory control samples
LCSD	LCS duplicates
MCLs	maximum contaminant levels
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mS/cm	milliSiemens per centimeter
MS/MSD	matrix spike/matrix spike duplicate
NRWQC	National Recommended Water Quality Criteria
NTCRA	non-time-critical removal action
O&M	operation and maintenance
QA	quality assurance
QAP/OMP	Blue Ledge Mine Quality Assurance Plan/Operations and Maintenance Plan
QC	quality control
RPD	relative percent difference
RSLs	regional screening levels
SI	Site Inspection
SM	Standard Method
TDS	total dissolved solids
TSS	total suspended solids

Acronyms and Abbreviations *(continued)*

URS	URS Corporation
USFS	U.S. Forest Service
WRPs	waste rock piles
µg/L	micrograms per liter

Section 1. Introduction

Engineering/Remediation Resources Group, Inc. (ERRG) has prepared this Fall 2012 Biannual Removal Action Monitoring Report (Biannual Report) to document the results of biannual monitoring at the Blue Ledge Mine Site, in the Rogue River-Siskiyou National Forest, Siskiyou County, California (Figure 1). The non-time-critical removal action (NTCRA) was completed during two work seasons beginning on June 28, 2010 and ending on November 11, 2011. ERRG is conducting post-removal action monitoring events as part of operation and maintenance (O&M) activities under U.S. Department of Agriculture Forest Service Contract No. GS-10F-0294R, Delivery Order No. AG-0489-D-10-0126. The purpose of the post-removal action monitoring is to document environmental conditions at the Blue Ledge Mine Site to ensure the effectiveness of the NTCRA to achieve unrestricted reuse of the site.

The Blue Ledge Mine Quality Assurance Plan/Operations and Maintenance Plan (QAP/OMP) provides the framework and procedures for sampling and analysis and serves as the primary guide for integrating quality assurance (QA) and quality control (QC) procedures. As outlined in the QAP/OMP, post-removal action monitoring includes:

- **Biannual monitoring** (fall and spring), which includes collection and analysis of drinking water samples, surface water samples, and creek sediment samples.
- **Annual monitoring** (fall), which includes collection and analysis of fish tissue samples and aquatic macroinvertebrate samples.
- **Waste characterization monitoring**, which includes collection and analysis of sediment samples from the treatment basins and the leachate samples. This was conducted during the spring 2012 monitoring event and will continue as-needed.

Annual and biannual monitoring was performed on October 16, 2012 (Fall 2012). Table 1 presents the sample type, number of sample locations, and frequency of sample collection for the Fall 2012 event and future monitoring events. Data for all monitoring events are presented in Tables 2 through 9 for evaluation and comparison with the Fall 2012 data.

1.1. SITE BACKGROUND

The Blue Ledge Mine Site is an abandoned copper mine. It is located on patented and National Forest System lands in northern California, within the Rogue River-Siskiyou National Forest, approximately 3 miles south of the Oregon border (Figure 1). The approximate geographic coordinates of the mine are N 41° 57' 36" latitude, W 123º 05' 60" longitude.

The Blue Ledge Mine was discovered in 1898, and was active from 1904 until approximately 1930. At least five productive mine adits and several prospect adits were constructed as part of the mining operation. Copper, zinc, silver, and gold ores were extracted from sulfide deposits and reportedly shipped from the site to the nearby historic town of Copper (now submerged beneath the Applegate Reservoir), and then to a former smelter in Tacoma, Washington. Sulfide-rich waste rock was discarded on the hillsides below the adits, forming four waste rock piles (WRPs) (WRP-1 through WRP-4) (URS Corporation [URS], 2010b).

WRP-1 through WRP-4 covered an area of approximately 7.2 acres. The WRPs were located on steep slopes at the upper headwaters of the Joe Creek watershed (Figure 2). Joe Creek flows north to Elliott Creek, a tributary to the Middle Fork of the Applegate River. The Applegate River feeds the Applegate Reservoir. The small community of Joe Bar, California, is located downstream of the site just downstream of the confluence of Joe Creek with Elliott Creek. Over time, the waste rock eroded and leached acidity and metals to Joe Creek and Elliott Creek and locations downstream. The acidity and the dissolved metals in acid mine drainage (AMD) are harmful to aquatic and terrestrial natural resources and potentially harmful to humans (URS, 2010b).

Since 1981, a number of environmental investigations have been performed at the Blue Ledge Mine Site. Results of those investigations showed that AMD from the site had impacted surface water, stream sediments, and groundwater downgradient from the site. Results of those investigations also showed that cadmium, copper, iron, lead, and zinc were present in soil, groundwater, surface water, and sediment at concentrations that could pose a risk to humans and wildlife. During cleanup activities performed prior to the 2010-2011 NTCRA conducted by ERRG, approximately the lower 25 percent of WRP-1 was terraced and regraded to direct AMD to a drainage channel lined with limestone boulders. The goal was to stabilize the slope, reduce erosion, and passively treat the AMD. The remediation work did not significantly reduce concentrations of metals or increase the pH of AMD flowing into Joe Creek. An estimated 70,000 tons of waste rock also remained in the four WRPs at the site (URS, 2010b). During the 2010-2011 NTCRA, waste rock was moved from all four WRPs to a permanent, lined waste repository that was constructed with an impermeable cap. The objective of the NTCRA is to eliminate the exposure pathway from waste rock to humans and wildlife to achieve unrestricted reuse of the site. Annual and biannual sampling is being performed until 2015 (ERRG, 2012a) to confirm the effectiveness of the response action in achieving unrestricted reuse.

1.2. REPORT ORGANIZATION

The remainder of this report is organized as follows:

- Section 2 summarizes sampling activities conducted during the Fall 2012 Biannual Monitoring event.
- Section 3 summarizes the results of the Fall 2012 Biannual Monitoring event.

- Section 4 summarizes the data quality analysis.
- Section 5 provides conclusions based on the results of the Fall 2012 Biannual Monitoring event.
- Section 6 lists the documents and guidance used to prepare this report.

Figures and tables are presented following Section 6. This report also contains the following appendices:

- Appendix A Concentration Trend Graphs
- Appendix B Fall 2012 Laboratory Analytical Reports
- Appendix C Fall 2011 and Fall 2012 Biannual Monitoring Field Notes
- Appendix D Waste Disposal Documentation

Section 2. Sample Collection and Analysis

This section summarizes the methods used to collect and analyze samples during the Fall 2012 Biannual Monitoring event conducted on October 16, 2012. Samples were collected for drinking water, surface water, creek sediment, fish tissue, and macroinvertebrates. The samples collected for this sampling event were submitted to Apex Laboratory, LLC located in Tigard, Oregon for analysis.

As discussed in Section 1, sampling and analysis was conducted in accordance with the QAP/OMP (URS, 2010a). Please refer to the QAP/OMP for additional information on standard operating procedures, including decontamination, sample documentation, sample handling, and QC, for sampling and analysis.

2.1. DRINKING WATER SAMPLES

As specified in the QAP/OMP (URS, 2010a), sample locations were selected above and below the site near stations previously sampled during the site investigation (URS, 2009). Based on the criteria established in the QAP/OMP, drinking water samples were scheduled to be collected from the following five residences in Joe Bar, California (Figure 3):

- 462 (Bridgett's residence – creek source)
- 541 (Johan's residence – creek source)
- 12620 (Ron James' residence – well source)
- 12620 (Ron James' residence – irrigation well; well is not used for drinking water)
- 17607 (Luke's residence – well source)

Sample location 461 (Bob's residence) was eliminated from the O&M plan and replaced with 12620 irrigation well location at the request of Pete Jones, project On-Scene Coordinator of the U.S. Forest Service (USFS). The spring source piping at sample location 461 (Bob's residence) was damaged in June 2010. The cabin does not currently have a water supply and there are no plans to replace the water supply during the O&M period. ERRG collected drinking water samples from residences 462, 541, 12620 (residence and irrigation) and 17607 in Fall 2012.

In accordance with the QAP/OMP (URS, 2010a), each drinking water source was analyzed for alkalinity, sulfate, hardness, total dissolved solids (TDS), total suspended solids (TSS), and pH. A matrix spike/matrix spike duplicate (MS/MSD) sample (location 541) and a field duplicate sample (location 17607) were also collected.

Prior to collecting drinking water samples, the tap and water line were flushed for 3 to 5 minutes. The irrigation well at Ron James' residence was flushed for a total of 10 minutes as requested by Pete Jones (USFS project On-Scene Coordinator) because the source had not been used for an extended amount of time. Following flushing, sample containers were filled directly from the tap. Field parameters (pH, temperature, and specific conductivity) were measured using an electronic water quality meter that was calibrated prior to use. Table 2 summarizes the field parameters.

Samples for offsite laboratory analysis were collected directly into appropriate laboratory-prepared sample containers provided by Apex Laboratory, LLC of Tigard, Oregon. Samples were intended to be filtered in the field (i.e., by gravity draining the samples through a 0.45-micron filter); however, field filtering required as much as 90 minutes per sample and was an inconvenience to residents. After consultation with the laboratory, it was determined that laboratory filtration would be acceptable provided unpreserved samples containers were used.

Sample containers were labeled with the appropriate sample identification number, project number, time, and date. Sample containers were then placed in a cooler with ice for transportation to the laboratory for filtration and analysis. Samples were prepared for shipping in accordance with ASTM International (ASTM) D 4840 chain-of-custody protocols (ASTM, 1999).

The laboratory analyzed the drinking water samples using the following analytical methods in accordance with the QAP/OMP:

- Dissolved metals (arsenic, cadmium, calcium, copper, iron, lead, magnesium, and zinc) by U.S. Environmental Protection Agency (EPA) Method 6020
- Alkalinity by Standard Method (SM) 2320B
- Sulfate by EPA Method 300.0
- Hardness by EPA Method 6020
- TDS by SM 2540C
- TSS by SM 2540D

Table 2 summarizes the analytical results for the drinking water samples collected for the Fall 2012 Biannual Monitoring event. Calcium and magnesium are considered essential nutrients and as such were not included in the summary tables or data analysis. Table 2 also presents results from the previous drinking water sampling events for comparison. Appendix A provides the graphs containing concentration trends over time. Appendix B provides the complete laboratory analytical reports for the Fall 2012 Biannual Monitoring event. Appendix C includes field notes from Fall 2011 and Fall 2012 Biannual Monitoring activities.

2.2. SURFACE WATER SAMPLES

As specified in the QAP/OMP (URS, 2010a), sample locations were selected in Elliott Creek, Joe Creek, and an unnamed tributary to Joe Creek. Based on the criteria established in the QAP/OMP, surface water samples were collected from the following six locations (Figure 3):

- EC-04 (Elliott Creek) Approximately 1,000 feet downstream from the Elliott Creek bridge, where Elliott Creek is adjacent to Forest Service Road 1050. Elliott Creek is most safely accessed from the private road along the south side of Elliott Creek that intersects Forest Service Road 1060 at the south end of the bridge crossing Elliott Creek. There is a ramp down to the creek for an irrigation pump. GPS location: 42.000584, -123.133272.
- EC-06 (Elliott Creek) Approximately 70 feet upstream from the confluence with Joe Creek. GPS location: 41.998232, -123.127425.
- JC-01 (Joe Creek) Approximately 100 feet upstream from the Joe Creek bridge on Forest Service Road 1060. GPS location: 41.998048, -123.128053.
- JC-08 (Joe Creek) Approximately 200 feet downstream from the confluence of Sediment Basin 1A and Joe Creek. GPS location: 41.962802, -123.106136.
- JC-09 (Joe Creek) In the rip rap toe at the outlet of Sediment Basin 1A and the confluence of Joe Creek. GPS location: 41.962331, -123.105777.
- JC-10 (unnamed tributary to Joe Creek) Approximately 300 feet upstream of the mine site access road crossing Joe Creek where it intersects Forest Service Road 1060. GPS location: 41.961879, -123.103852.
- Each of these locations except JC-09 is marked in the field with paint on a nearby tree or rock surface, and with flagging and a metal ID tag fastened to a nearby tree.

In accordance with the QAP/OMP (URS, 2010a), each surface water sample was analyzed for alkalinity, sulfate, hardness, TDS, TSS, and dissolved metals. An MS/MSD sample (location JC-10) and a field duplicate sample (location JC-08) were collected for QC purposes in accordance with Section 5.0 of the QAP/OMP (URS, 2010a). Samples were obtained during the Fall 2012 Biannual Monitoring event from previously identified and marked locations. At each location, surface water field parameters (pH, temperature, and specific conductivity) were measured using an electronic water quality field meter.

During sample collection, field personnel stood out of the water or downstream of the location to be sampled to ensure that the sample reflected undisturbed creek conditions. Unfiltered samples were collected from the side of the creek channels in the flowing water column by submerging the sampling container into the creek and allowing it to fill with creek water. The samples were collected into appropriate laboratory-prepared sample containers. The sample containers were labeled with the appropriate sample identification number, project number, time, and date. Sample containers were then placed in a cooler with ice for transportation to the laboratory for filtering and analysis. Samples were prepared for shipping in accordance with ASTM D 4840 chain-of-custody protocols (ASTM, 1999).

The surface water samples were analyzed using the following analytical methods:

- Dissolved metals (arsenic, cadmium, calcium, copper, iron, lead, magnesium, and zinc) by EPA Method 6020
- Alkalinity by SM 2320B
- Sulfate by EPA Method 300.0
- Hardness by EPA Method 6020
- TDS by SM 2540C
- TSS by SM 2540D

Table 3 summarizes the analytical results for surface water samples collected for the Fall 2012 Biannual Monitoring event, and includes data from previous sampling events for comparison. Appendix A provides the graphs containing concentration trends over time. Appendix B provides the complete laboratory analytical reports for the Fall 2012 Biannual Monitoring event. Appendix C includes field notes from Fall 2011 and Fall 2012 Biannual Monitoring activities.

2.3. CREEK SEDIMENT SAMPLES

As specified in the QAP/OMP (URS, 2010a), creek sediment sample locations were selected to be the same locations as the surface water samples collected in Elliott Creek, Joe Creek, and an unnamed tributary to Joe Creek. Based on the criteria established in the QAP/OMP, creek sediment samples were collected from the following six locations (Figure 3):

- EC-04 (Elliott Creek)
- EC-06 (Elliott Creek)
- JC-01 (Joe Creek)
- JC-08 (Joe Creek)
- JC-09 (Joe Creek)
- JC-10 (unnamed tributary to Joe Creek)

In accordance with the QAP/OMP (URS, 2010a), each creek sediment sample was analyzed for metals (arsenic, cadmium, copper, iron, lead, and zinc), percent moisture, and grain size. An MS/MSD sample (location JC-01) and a field duplicate sample (location JC-09) were collected for QC purposes in accordance with Section 5.0 of the QAP/OMP (URS, 2010a). Representative MS/MSD and duplicate sediment samples were collected by alternating aliquots of sediment from each scoop or shovel into the primary and MS/MSD or field duplicate sample containers.

Discrete samples were collected from each location. Samples were collected from the top 6 inches of sediment in the creek from previously identified and marked locations using dedicated, clean, disposable plastic scoops. Each sample was placed into an appropriate, laboratory-prepared sample container. All sample containers were labeled with the appropriate sample identification number, project number, time, and date. Sample containers were then placed in a cooler with ice for transportation to the laboratory for analysis. Samples were prepared for shipping in accordance with ASTM D 4840 chain-of-custody protocols (ASTM, 1999).

The laboratory analyzed the creek sediment samples by the following analytical methods in accordance with the QAP/OMP:

- Metals (arsenic, cadmium, copper, iron, lead, and zinc) by EPA Method 6020
- Percent moisture by Apex SOP
- Particle size by ASTM D422

Table 4 summarizes the analytical results for metals for the creek sediment samples collected for the Fall 2012 Biannual Monitoring event, and includes data from previous sampling events for comparison. Appendix A provides the graphs containing concentration trends over time. Appendix B provides the complete laboratory analytical reports, particle size analysis, and percent moisture results data for the Fall 2012 Biannual Monitoring event. Appendix C includes field notes from Fall 2011 and Fall 2012 Biannual Monitoring activities.

2.4. FISH TISSUE SAMPLES

As specified in the QAP/OMP (URS, 2010a), fish tissue samples were selected to be collected in Elliott Creek and Joe Creek. Based on the criteria established in the QAP/OMP, fish tissue samples were collected from the following four locations (Figure 3):

- EC-01 (Elliott Creek)
- EC-04 (Elliott Creek)
- EC-06 (Elliott Creek)
- JC-01 (Joe Creek)

In accordance with the QAP/OMP (URS, 2010a), each fish tissue sample was analyzed for metals (arsenic, cadmium, copper, iron, lead, and zinc) and percent moisture. A field duplicate sample (location EC-04) was collected for QC purposes in accordance with Section 5.0 of the QAP/OMP (URS, 2010a).

A qualified field biologist collected all fish tissue samples and coordinated with the fisheries staff of the Rogue River-Siskiyou National Forest and the California Department of Fish and Game. Samples were

collected and stored in plastic bags and labeled with the appropriate sample identification number, project number, time, and date. The samples were stored in a cooler with ice and transported to EcoAnalysts, Inc., of Moscow, Idaho, for analysis. EcoAnalysts, Inc. subcontracted the work to TestAmerica, Inc. of Sacramento, California.

TestAmerica, Inc. analyzed the fish tissue samples by the following analytical methods in accordance with the QAP/OMP (URS, 2010a):

- Metals (arsenic, cadmium, copper, iron, lead, and zinc) by EPA Method 6020
- Percent moisture by Method D 2216-90

Table 5 summarizes the species, size, and approximate age of the fish captured during each sampling event. Table 6 summarizes the analytical results for fish tissue samples collected for the Fall 2012 Biannual Monitoring event, and includes data from previous sampling events for comparison. Appendix A provides the graphs containing concentration trends over time. Appendix B provides the complete laboratory analytical reports for the Fall 2012 Biannual Monitoring event. Appendix C includes field notes from Fall 2011 and Fall 2012 Biannual Monitoring activities.

2.5. AQUATIC MACROINVERTEBRATE SAMPLES

As specified in the QAP/OMP (URS, 2010a), aquatic macroinvertebrate samples were selected to be collected in Elliott Creek and Joe Creek. Based on the criteria established in the QAP/OMP, aquatic macroinvertebrate samples were collected from the following five locations (Figure 3):

- JC-01 (Joe Creek)
- JC-08 (Joe Creek)
- JC-10 (Joe Creek)
- EC-04 (Elliott Creek)
- EC-06 (Elliott Creek)

A trained field biologist collected the samples in accordance with EPA's "Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macro Invertebrates and Fish, Second Edition" (EPA, 1999). The purpose of the aquatic macroinvertebrate sampling is to determine specific composition and taxa richness, community structure (inter- and intra-sample comparison), and Benthic Index of Biotic Integrity, in accordance with the QAP/OMP (URS, 2010a).

The samples were collected and stored in sterile 1-liter laboratory-prepared Nalgene bottles provided by the laboratory (EcoAnalysts, Inc. of Moscow, Idaho) and labeled with the appropriate sample

identification number, project number, time, and date. The samples were preserved in 90 percent ethanol for transportation to the laboratory.

The laboratory analyzed the aquatic macroinvertebrate samples by the following test methods in accordance with the QAP/OMP (URS, 2010a):

- Species composition and taxa richness
- Community structure (inter- and intra-community comparison) Benthic Index of Biotic Integrity

Table 7 summarizes the results for the aquatic macroinvertebrate samples collected for the Fall 2012 Biannual Monitoring event, and includes data from previous sampling events for comparison. Appendix A provides the graphs containing concentration trends over time. Appendix B provides the complete laboratory analytical reports for the fall 2012 Biannual Monitoring event. Appendix C includes field notes from Fall 2011 and Fall 2012 Biannual Monitoring activities.

2.6. LEACHATE COLLECTION SUMP SAMPLES

Leachate samples were not collected during the Fall 2012 Biannual Monitoring event. Leachate samples were obtained from the leachate collection sump on September 12, 2011, May 2, 2012, and September 14, 2012 and profiled for Resource Conservation and Recovery Act (RCRA) metals and pH by Apex Laboratory, LLC. Approximately 500 gallons of leachate were disposed of as non-hazardous waste at the Waste Management Altamont facility located in Livermore, California on September 25, 2012. Table 8 summarizes the results from the leachate samples collected during previous sampling events. Waste disposal documentation can be found in Appendix D.

The Repository leachate collection sump will be monitored periodically to determine if disposal of leachate is necessary during upcoming maintenance activities. Samples will be collected as needed to profile the leachate for disposal.

2.7. TREATMENT BASINS SEDIMENT SAMPLES

Sediment samples were not collected during the Fall 2012 Biannual Monitoring event. Sediment samples obtained from the nine treatment basins were previously collected on May 2, 2012 as documented in the Spring 2012 Biannual Removal Action Monitoring Report prepared by ERRG and dated November 2012. Laboratory analytical results indicated RCRA metal concentrations and pH to be below the site cleanup goals except for one sample in Treatment Basin 3 where copper slightly exceeded the cleanup goal. Results from a split sample at that location were less than the copper cleanup goal. ERRG requested to leave the approximately 1 cubic yard of sediment on site due to the predominantly low concentrations. The Forest Service agreed to leave the sediment on site and bury it in a location away from potential water runoff. The sediment was removed from the nine treatment basins and buried on site during the August 2012 site maintenance activities as specified in the Operations and Maintenance Plan

(URS, 2010a) and approved by the USFS (ERRG, 2012a), and documented by the August 2012 Site Inspection Report (ERRG, 2012b). Analytical data for the sediment samples collected from the treatment basins is provided in Table 9. Treatment basins will be sampled again in the spring if removal of sediment is necessary during future maintenance activities.

Section 3. Results

This section summarizes the data collected during the Fall 2012 Biannual Monitoring event, as well as the comparison of data from previous sampling events. As part of the data evaluation, data were screened against values from the Final Site Inspection (SI) Report (URS, 2009) and the Engineering Evaluation/Cost Analysis (EE/CA) (URS, 2010b), consistent with the removal action objectives and in compliance with applicable or relevant and appropriate requirements presented in the EE/CA. The screening criteria are included in Tables 2 through 4 and 6 through 9 for comparison purposes.

3.1. DRINKING WATER

Drinking water samples were collected as part of ongoing post-removal action monitoring. ERRG collected biannual drinking water samples from drinking water sources of residents of Joe Bar, California. Appendix B contains the laboratory analytical reports for the Fall 2012 Biannual Monitoring event. Figure 3 shows the locations where the samples were collected and Table 2 provides the sample results.

Samples were analyzed in the field for pH, conductivity, dissolved oxygen (DO), and temperature. Field parameter results for the Fall 2012 Biannual Monitoring event are discussed below.

- Water temperature measurements ranged between 12.12 and 15.28 °C.
- Electrical conductivity measurements ranged between 0.164 and 0.289 milliSiemens per centimeter (mS/cm).
- DO concentrations ranged between 10.05 and 24.13 milligrams per liter (mg/L).
- pH measurements ranged between 7.50 and 8.02.
- Turbidity concentrations ranged from 1.2 to 1.8 nephelometric turbidity units.

Drinking water samples were analyzed for general chemistry parameters (total alkalinity, hardness, TDS, TSS, and sulfate). General chemistry results for the Fall 2012 Biannual Monitoring event are discussed below.

- Total alkalinity as calcium carbonate ($CaCO_3$) ranged from 157 mg/L to 254 mg/L.
- Hardness as $CaCO_3$ ranged from 210 mg/L to 275 mg/L.
- TDS ranged from 231 mg/L to 354 mg/L.
- TSS was not detected above the laboratory reporting limit of 5.0 mg/L.
- Sulfate concentrations ranged from 9.95 mg/L to 70.60 mg/L.

Samples were also analyzed for dissolved metals (arsenic, cadmium, calcium, copper, iron, lead, magnesium, and zinc). Drinking water results for the Fall 2012 Biannual Monitoring event were compared with the following human health screening criteria for metals:

- EPA maximum contaminant levels (MCLs)
- EPA regional screening levels (RSLs) for tap water

RSLs are tools for evaluating and cleaning up contaminated EPA Superfund Sites. These are risk-based concentrations used for initial screening level evaluations of environmental measurements to assist human health risk assessors. MCLs are the legal requirement for water companies to meet for serving water to the public. These are developed by analyzing both risk and what levels can be practically achieved. MCLs for arsenic are set considerably higher than RSLs due to the relatively high levels of arsenic common in water systems.

Dissolved metal results for the Fall 2012 Biannual Monitoring event are discussed below.

- Cadmium, copper, lead, and zinc concentrations in drinking water samples were less than the screening criteria.
- Arsenic results ranged from ND<0.50 micrograms per liter (µg/L) to 6.43 µg/L. The arsenic results were below the EPA drinking water MCL of 10 µg/L, in all samples collected. Arsenic exceeded the EPA RSL (0.045 µg/L) in samples from three locations (462, 541, and 12620 [drinking water]); however, the concentrations were below the MCL.
- Iron results ranged from 845 µg/L to 1,110 µg/L. All iron results exceeded both the EPA MCL (300 µg/L) and the California MCL (300 µg/L), but were below the EPA RSL for drinking water in all samples collected.

Table 2 summarizes the field parameter, general chemistry, and metals results for all sampling events from 2008 through 2012.

3.2. SURFACE WATER

ERRG collected surface water samples from Elliott Creek and Joe Creek during the Fall 2012 Biannual Monitoring event. Appendix B contains the laboratory analytical report for the Fall 2012 Biannual Monitoring event. Figure 3 shows the locations where these samples were collected and Table 3 summarizes the sample results.

Samples were analyzed in the field for pH, conductivity, and temperature. Field parameter results for the Fall 2012 Biannual Monitoring event are discussed below.

- pH measurements ranged between 7.76 and 8.63
- Electrical conductivity measurements ranged between 0.052 and 0.143 mS/cm
- Water temperature measurements ranged between 9.09 and 12.57°C

Surface water samples were analyzed for general chemistry parameters (total alkalinity, hardness, TDS, TSS, and sulfate). General chemistry results for the Fall 2012 Biannual Monitoring event are discussed below.

- Total alkalinity as $CaCO_3$ ranged from 28.4 mg/L to 67.8 mg/L
- Hardness as $CaCO_3$ ranged from 34.60 mg/L to 72.80 mg/L
- TDS ranged from 44 mg/L to 101 mg/L
- TSS concentrations ranged from ND<5.00 mg/L to 9.00 mg/L
- Sulfate concentrations ranged from 4.85 mg/L to 12.80 mg/L

Samples were also analyzed for dissolved metals (arsenic, cadmium, calcium, copper, iron, lead, magnesium, and zinc). Surface water results were compared with the following screening criteria for metals:

- Ecological
  - California Water Quality Standards (continuous concentration criteria [CCC])
  - EPA National Recommended Water Quality Criteria (NRWQC) (CCC)
- Human health
  - California Water Quality Standards (humans ingesting organisms only)
  - EPA NRWQC (protective of humans ingesting organisms only)

  * Note that no human health screening criteria have been established for cadmium, copper, iron, and lead.

The results for iron, lead, and zinc were less than the screening criteria. Dissolved metal results for the Fall 2012 Biannual Monitoring event are discussed below.

- Arsenic concentrations ranged from ND<0.500 µg/L to 0.656 µg/.L Arsenic concentations did not exceed the ecological screening criteria in any of the samples collected. It should also be noted that if any human's drinking water system source is directly from the stream, the MCL for arsenic is 10 µg/L.
- Cadmium concentrations ranged from ND<0.0400 µg/L to 0.344 µg/L, with two concentrations (0.344 µg/L and 0.233 µg/L) exceeding the ecological screening criteria (0.13 µg/L or 0.25 µg/L) in samples collected from JC-01 and JC-08, respectively.
- Copper concentrations ranged from ND<2.00 to 22.80 µg/L, with exceedances of the ecological screening criteria (9.00 µg/L) in samples collected from JC-01 and JC-08.

Table 3 summarizes the field parameter, general chemistry, and metals results for all sampling events.

3.3. CREEK SEDIMENT

ERRG collected creek sediment samples during the Fall 2012 Biannual Monitoring event. Samples were analyzed for arsenic, cadmium, copper, iron, lead, and zinc. Table 4 summarizes the results for the current and historical creek sediment sampling events.

The creek sediment results were compared with the ecological and human health screening criteria originally presented in Table 6 of the Final SI Report (URS, 2009). Metal results for the Fall 2012 Biannual Monitoring event are discussed below.

- Arsenic concentrations ranged from 1.12 milligrams per kilogram (mg/kg) to 37.2 mg/kg. Concentrations in samples from all five locations exceeded the human health screening criteria (1.5 mg/kg) and the concentration in samples from two locations exceeded both the human health and ecological (7 mg/kg) screening criteria.
- Cadmium concentrations ranged from ND<0.655 mg/kg to 6.61 mg/kg, with concentrations exceeding the ecological screening criteria (0.99 mg/kg) in samples collected from three locations at Joe Creek (JC-01, JC-08, and JC-09). Cadmium concentrations did not exceed screening criteria in samples collected from Elliott Creek. Cadmium was not reported at concentrations exceeding the human health screening criteria in any samples collected.
- Copper concentrations ranged from 38.5 mg/kg to 1,750 mg/kg, with concentrations exceeding the ecological screening criteria (42.9 mg/kg) in samples collected from Joe Creek (JC-01, JC-08, JC-09), with the exception of JC-10. Copper concentrations did not exceed ecological or human health screening criteria in sample EC-06 or EC-04 collected from Elliott Creek.
- Iron concentrations in sediment ranged from 10,300 mg/kg to 38,700 mg/kg; however, no ecological or human health screening criteria have been established for iron.
- Lead concentrations ranged from 1.90 mg/kg to 403 mg/kg. Only samples from two locations (JC-08 and JC-09) contained lead at a concentration that exceeded the ecological screening criteria (17 mg/kg). Only one sample collected from Joe Creek (JC-09) contained lead at a concentration that exceeded the human health screening criteria (400 mg/kg). Lead concentrations did not exceed ecological or human health screening criteria in samples collected from Elliott Creek.
- Zinc concentrations ranged from 29.3 mg/kg to 1,160 mg/kg, with concentrations exceeding the ecological screening criteria (121 mg/kg) in three samples (excluding duplicates) collected from Joe Creek (JC-01, JC-08, and JC-09). Zinc concentrations did not exceed the ecological screening criteria or human health screening criteria in any sample collected from Elliott Creek.

3.4. FISH TISSUE

ERRG contracted Environmental Technologies Group to collect fish tissue samples during the Fall 2012 Biannual Monitoring event. Samples were analyzed by TestAmerica, Inc. for arsenic, cadmium, copper, iron, lead, and zinc. Tables 5 and 6 summarize the results for the current and historical fish tissue sampling

events. Results of the November 2011 samples will be the baseline data set for comparison with fish tissue sample results collected during future post-removal action monitoring events.

The October 2012 fish tissue results were compared with the ecological and human health screening criteria originally presented in Table 6 of the Final SI Report (URS, 2009). All fish tissue samples were collected from Rainbow Trout (Oncorhynchus mykiss). Three samples (collected from EC-01, EC-04, and JC-01) exhibited cadmium concentrations exceeding ecological screening criteria of 0.15 mg/kg. Human health screening criteria for cadmium was not exceeded in any of the fish tissue samples collected.

Lead in fish tissue samples collected from EC-01 and EC-06 exceeded the ecological screening criteria of 0.12 mg/kg. The reporting limit for lead is slightly higher than the ecological screening criteria, thus it is unknown whether lead results exceed screening criteria in fish tissue samples collected from EC-01, EC-04, and JC-01. Human health screening criteria for lead was not exceeded in any of the fish tissue samples collected.

Arsenic results for the Fall 2012 Biannual Monitoring event were nondetect in all samples collected. Ecological screening criteria for arsenic was not exceeded in any of the fish tissue samples collected.

Screening criteria have not been established for copper, iron, or zinc. Copper results during the Fall 2012 Biannual Monitoring event ranged from 4.5 mg/kg to 12 mg/kg. Iron results ranged from 120 mg/kg to 3,100 mg/kg. Zinc results ranged from 94 mg/kg to 150 mg/kg.

3.5. AQUATIC MACROINVERTEBRATE

Aquatic macroinvertebrate samples were collected to evaluate the general health of the stream ecosystem by determining taxa richness, community structure, and Benthic Index of Biotic Integrity (B-IBI). Richness and diversity characteristics were measured and quantified, then evaluated by qualified technicians and summarized in a score, which is presented in Table 6. The range of B-IBI scores for samples collected from Joe and Elliott Creeks in 2012 is from 42.50 to 78.75 or from fair to good. The scores collected from JC-01 and EC-04 increased from fair to good from the previous samples collected in November 2011. The range of B-IBI scores for other sample locations remained the same as November 2011. Comparable data were presented in the Final SI Report (URS, 2009), which noted that macroinvertebrate populations in Elliott Creek may have been impacted by AMD and that populations in Joe Creek downstream of the site were “significantly degraded” because of AMD.

Section 4. Data Quality Analysis

Several QC samples, including three field duplicates (one each for drinking water, surface water, and creek sediment) were collected during the Fall 2012 Biannual Monitoring event. In addition, laboratory QA/QC was performed by the laboratory based on the QA/QC criteria established by the EPA (EPA, 2010). QC samples were not collected for waste characterization samples.

4.1. FIELD DUPLICATES

A field duplicate sample was collected at a minimum for 10 percent of the samples collected. Field duplicate analysis primarily measures consistency of field sampling procedures; however, the results are also affected by precision of the laboratory operations. Field duplicate results were compared with the results of the parent sample, and values of the relative percent difference (RPD) were calculated using the following formula:

$$RPD=(A-B)/((A+B)/2) \times 100$$

where:

A = parent sample concentration

B = duplicate sample concentration

RPD results are presented in Table 10. If an analyte was not detected above the laboratory control limit, half of the reporting limit was used for the RPD calculation.

The RPDs calculated for the duplicate pairs were all below established control limits (<40 percent) except for arsenic, lead, and zinc in duplicate pair BL-CS-JC09-101612 and BL-CS-JC09-101612 DUP. The RPD exceedances for these analytes can be attributed to the heterogeneous composition of soil and the data were deemed usable.

4.2. LABORATORY QUALITY ASSURANCE AND QUALITY CONTROL

Laboratory QA and QC procedures were carried out in accordance with EPA protocols, and the data were accepted based on the QA/QC criteria established by the EPA (EPA, 2010). Laboratory QA/QC included method blanks, storage blanks, laboratory duplicates, laboratory control samples (LCS), LCS duplicates (LCSD), and MS samples. Laboratory QA/QC analysis is summarized below for sediment, surface water, and drinking water samples.

There were no laboratory blank detections for creek sediment analysis. There were no laboratory blank detections for surface water, or drinking water analysis except for copper. Copper was detected in the preparation blank for dissolved metals by EPA Method 6020 between one half the reporting limit and the reporting limit. Results above the reporting limit have been flagged with "J+" indicating the result is an estimated quantity, but the result may be biased high.

MS samples were analyzed to evaluate matrix interferences in the associated sediment, surface water, and drinking water samples. Percent recoveries and/or RPD values for laboratory duplicates, LCS and MS samples were within method-specified control limits for surface water and drinking water analyses except for laboratory duplicate percent recovery for TSS. However, the associated blank spike percent recoveries were within method-specified control limits and the data are deemed usable.

Percent recoveries and/or RPD values for blank spikes, LCS/LCSD, and MS samples were within method-specified control limits for sediment analysis except for the laboratory duplicate RPDs for cadmium, lead, and zinc and the MS percent recoveries for copper, iron, lead, and zinc. However, the percent recoveries of the associated LCS was within laboratory control limits for all analytes, and the post-digestion spike performed for copper, iron, lead, and zinc were within laboratory control limits and data are deemed usable. Appendix B contains the laboratory analytical reports.

MS/MSD samples were collected at one location for each drinking water, surface water, and creek sediment. Because an Oregon-certified laboratory was used, MS/MSD samples were not analyzed; rather the laboratory only reported MS and LCS analyses, which is comparable to MSD. Refer to the evaluation in Section 4.2.

Section 5. Conclusions

This Fall 2012 Biannual Report evaluates the chemical concentrations reported in drinking water, surface water, and creek sediment during the period from the completion of the NTCRA to the Fall 2012 Biannual Monitoring event. For reference, historical chemical data are also presented in data Tables 2 through 4 and 6 through 9.

5.1. DRINKING WATER

Concentrations of metals detected in drinking water, except for arsenic and iron, were less than the screening criteria. Arsenic concentrations did not exceed the MCL of 10 µg/L in any of the drinking water samples collected. Concentrations of dissolved arsenic exceeding the RSLs were detected in drinking water samples. As stated in Section 3.1, MCLs are the legal limit for concentrations in drinking water for the public and are set higher than RSLs due to the relatively high levels of arsenic in water systems. These results are consistent with the elevated concentrations of dissolved arsenic detected in drinking water samples collected during the SI (URS, 2009) and previous biannual monitoring events. Arsenic present in drinking water samples cannot be directly attributed to contamination at the site and may be the result of naturally occurring arsenic because arsenic occurs naturally in California bedrock at concentrations ranging from 0.6 to 11 mg/kg (Bradford et. al, 1996). Background sampling upgradient of the site, in an area not affected by site contamination, would be necessary to determine whether elevated arsenic concentrations in drinking water samples is a direct result of site contamination.

A notable increase in iron concentrations was observed from June 2010 to November 2012 (Appendix A), with all results exceeding the MCLs (Table 2). Iron concentrations did not exceeded the RSL of 11,000 µg/L in any of the drinking water samples collected. Concentrations of iron collected during the fall of both 2011 and 2012 were similarly elevated as compared to the samples collected during spring of 2012. Because concentrations of other metals are relatively stable for both the spring and fall samples, the increased iron concentrations are not believed to be related to the mine activities. The variation in iron concentrations may be a result from local factors such as increased groundwater flow during spring, seasonally low groundwater elevations in the fall, or from decreased use of drinking water and irrigation wells in the fall resulting in an accumulation of iron in the well or plumbing. Iron concentrations will continue to be monitored and tracked, comparing the concentrations of iron to the seasons.

Concentrations of copper, cadmium, lead, and zinc indicate a stable trend over the monitoring period to date. ERRG will continue to monitor drinking water during QAP/OMP activities.

Appendix A provides the concentration trends for all metals over time. Data from future Biannual Monitoring events will be added to the concentration trends to allow a complete evaluation of metals concentrations during the QAP/OMP period.

5.2. SURFACE WATER

Joe Creek starts upstream from the mine and flows through the mine area before entering Elliott Creek several miles downstream. The Fall 2012 Biannual Monitoring surface water sample results showed the following:

- The samples collected from JC-01 and JC-08 were the only samples that contained copper exceeding the screening limit of the EPA NRWQC. Concentrations of copper in the sample collected from location JC-08 was detected only slightly above the screening limit.
- Zinc, iron, and lead concentrations remained below the screening limit of the California Water Quality Standards.
- Cadmium concentrations in surface water samples slightly exceeded the screening level of the California Water Quality Standards in three samples collected from locations JC-01, JC-08, and EC-04. Concentrations of cadmium in the remaining samples remained below the screening level of the California Water Quality Standards.
- Historically, elevated concentrations of arsenic were present in Elliott Creek. None of the samples contained arsenic concentrations exceeding the California Water Quality Standards or the EPA NRWQC, the ecological screening levels. Water samples collected from EC-04 and EC-06 contained arsenic concentrations exceeding the EPA NRWQC (protective of humans ingesting organisms), the human health screening level. If elevated concentrations of arsenic are detected in samples from Joe Creek, it could be an indication that the elevated concentrations are not a result of site contamination but reflect naturally occurring concentrations of arsenic.

Appendix A provides the concentration trends for metals over time. Results below the reporting limit are represented in Appendix A as half the reporting limit. Concentrations for arsenic, cadmium, copper, lead, and zinc are generally consistent and do not show a clear trend over the time period recorded. Data from future monitoring events will be added to the concentration trends to allow for a complete evaluation of metals concentrations during the QAP/OMP period.

5.3. CREEK SEDIMENT

Except for arsenic, metals concentrations in creek sediment are generally higher in Joe Creek than in Elliott Creek, particularly in samples downstream from the mine (JC-01, JC-08, and JC-09) (Table 4). This observation is consistent with historical data (e.g., URS, 2009) and is likely because Joe Creek flows through the historically excavated portions of the mine area before entering Elliott Creek several miles downstream. Arsenic is detected at similar concentrations in both creeks, which could be an indication

that these elevated concentrations are not soley the result of site contamination but reflect naturally occurring concentrations of arsenic.

Concentrations of metals in creek sediment samples were below the human health screening level in all samples collected with the exception of arsenic. Concentrations of arsenic were only slightly above the human health screening level with the exception of samples collected from JC-08 and JC-09. Samples collected from JC-08 and JC-09 were the only samples analyzed with concentrations of arsenic exceeding the ecological screening level. Arsenic concentrations in creek sediment samples collected from location JC-09 are similar to those concentrations detected in creek sediment collected in fall 2011. Concentrations of arsenic in creek sediment have increased at location JC-08 since fall 2011, and concentrations of arsenic in creek sediment at location JC-10 have decreased significantly. The contribution of sediments to Joe Creek from the former Waste Rock Piles is limited by the nine sediment collection and treatment basins except for periods of very high runoff such as major storm events and spring snowmelt. Therefore the variation in sample results may be the result of variations in the pre-existing sediment as it is naturally and continuously deposited and eroded at each sample location between the time of each sample event. Arsenic concentrations in creek sediment will continue to be monitored to determine if a trend develops.

Appendix A provides the concentration trends for metals over time. The data is generally stable and does not show a clear increasing or decreasing trend over the time period recorded. Concentrations of five metals analyzed are higher in the creek sediment sample collected at JC-09 since spring 2012. Conversely, concentrations of all five metals have either decreased or remained the same in the remaining sample locations since spring 2012. The only significant increases other than JC-09 were increases of arsenic and lead in creek sediment samples collected from JC-08. Further data are needed to compare concentrations during similar seasons in order to fully evaluate the significance of these changes in metal concentrations.

Analytical results for metals analyzed in creek sediment collected at JC-10 during fall 2011 remain an anomaly. No other sediment samples have ever had that high of concentrations of metals, meaning it is unlikely to be a result of a field mislabel from another location. Other sample results have been fairly consistent at each location. Metals concentrations collected from JC-10 in spring and fall of 2012 are fairly consistent with data collected in 2008. Another difference between the fall 2011 data and the spring 2011, spring 2012, and fall 2012 data for JC-10 is the greater percentage of fine grain sediment. The fall 2011 creek sediment sample collected at JC-10 contained 40 percent silt and 5 percent clay while spring 2011, spring 2012, and fall 2012 samples contained between 1 and 5 percent silt and 0 to 1 percent clay. As more data is collected, a trend over time will be more clear. Data from future monitoring events will be added to the concentration trend plots to further evaluate metals concentrations at the site.

5.4. FISH TISSUE

The November 2011 samples are the baseline data set for fish tissue samples collected during future post-removal action monitoring events. Concentrations of arsenic, cadmium, and lead are slightly above the screening levels and remain generally consistent with the pre-NTCRA data. No screening levels have been developed for copper, iron, and zinc. Copper concentrations in fish tissue samples have remained stable with the exception of samples collected from JC-01 which have increased. Iron concentrations in fish tissue have remained the same or decreased in all sample locations with the exception of EC-06, where concentrations have increased. Zinc concentrations in fish tissue samples collected from JC-01 have decreased while concentrations at other locations have increased. Increased concentrations of zinc, arsenic, and cadmium may be a result of the torrent sculpin (*Cottus rhotheus*) species sampled for the Fall 2012 Biannual Monitoring event as compared with rainbow trout (*Oncorhynchus mykiss*) sampled for the Fall 2011 Biannual Monitoring event. Torrent sculpin are generally not used for human consumption as compared with the rainbow trout and therefore would not normally be relevant screening criteria for human health.

5.5. AQUATIC MACROINVERTEBRATE

Results of aquatic macroinvertebrate samples collected from Joe and Elliott Creeks in 2012 show that creek ecology is fair to good. Comparable data collected in 2008 noted that macroinvertebrate populations in Joe Creek downstream of the site were “significantly degraded” due to AMD. The B-IBI increased (improved) in all samples collected with the exception of JC-08 where results remained similar to those of fall 2011. JC-08 is immediately downstream of the mine site and the B-IBI score is considered “fair”. Results of aquatic macroinvertebrate samples collected from JC-01 and EC-04 have increased from fair to good. The analytical results for aquatic macroinvertebrate samples collected from Joe Creek and Elliott Creek at this stage suggest that some improvement in surface water quality may be occurring. Samples will continue to be collected to evaluate whether this improvement in stream health continues over the monitoring period.

Section 6. References

ASTM International (ASTM), 1999. ASTM D 4840-99, "Standard Guide for Sample Chain-of-Custody Procedures." December 10.

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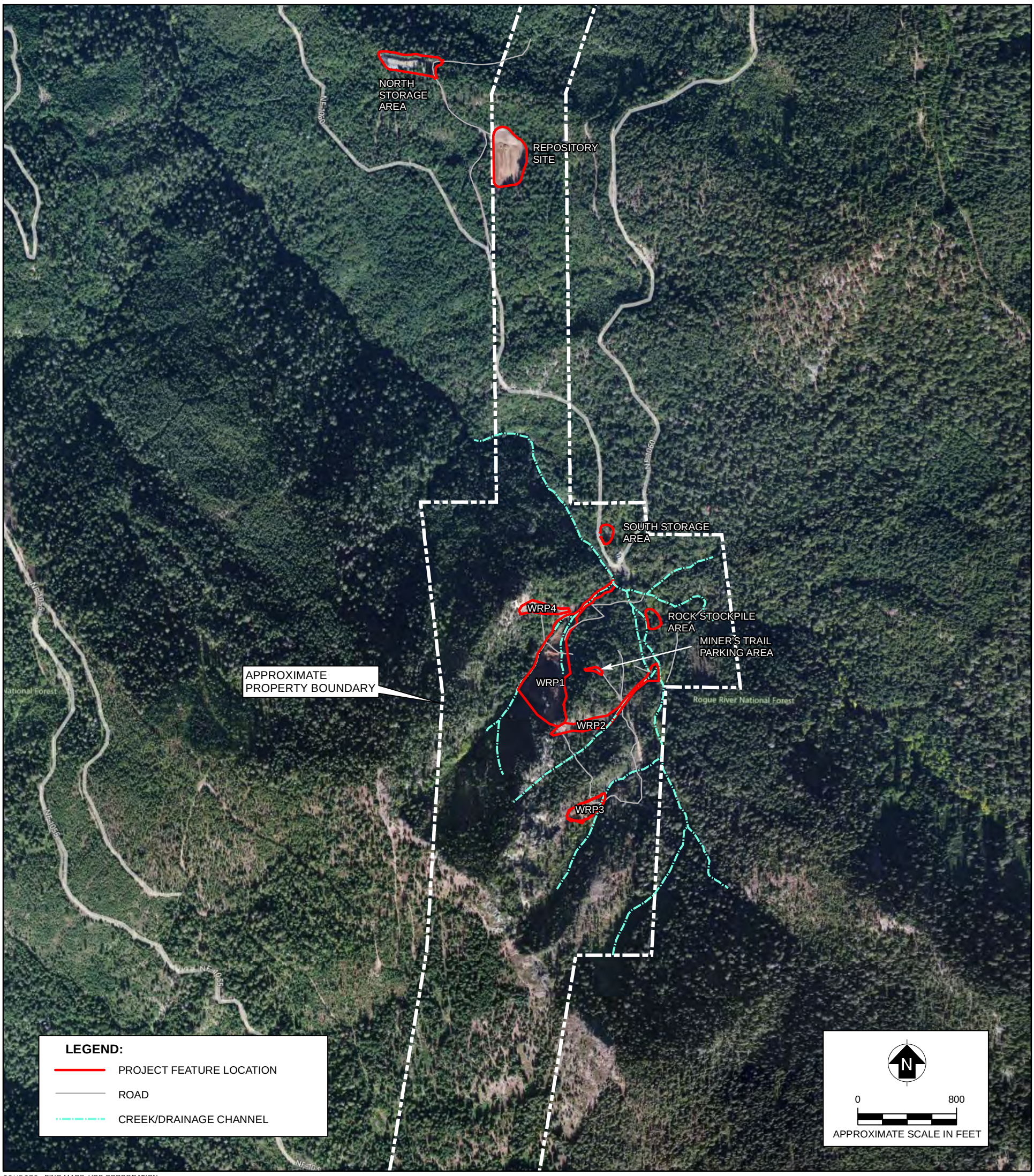
EPA, 2010. "USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review." OSWER 9240.1-51, EPA 540-R-10-011. January. Available Online at: <http://www.epa.gov/superfund/programs/clp/guidance.htm>.

Figures



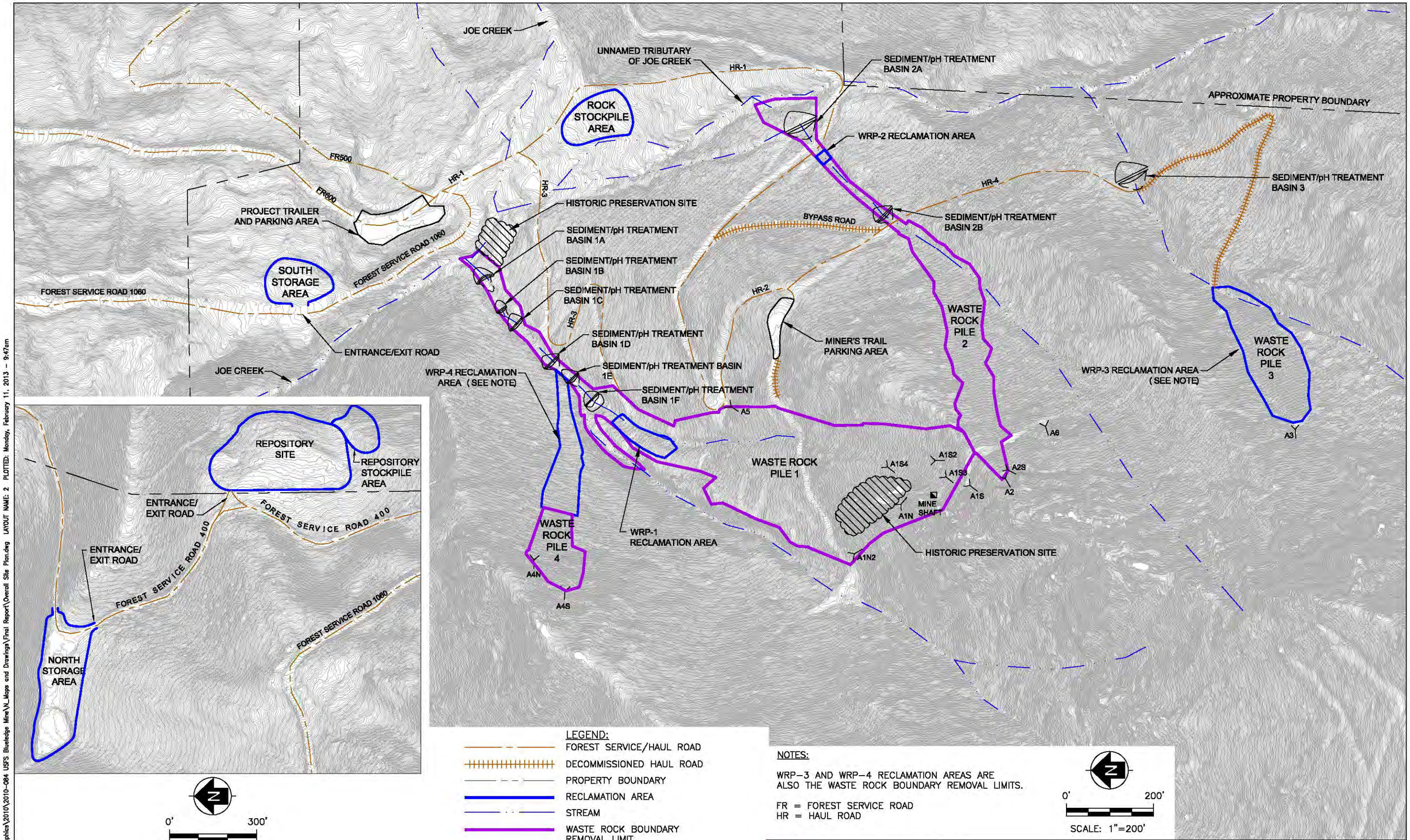
SOURCES: BING MAPS; URS CORPORATION

REGIONAL MAP

VICINITY MAP

ERRG Engineering/Remediation Resources Group, Inc. 616 First Ave., Suite 300 Seattle, Washington 98104 (206) 282-4749	CLIENT: USFS FOREST SERVICE	SITE LOCATION AND VICINITY MAP			
	LOCATION: BLUE LEDGE MINE SISKIYOU COUNTY, CALIFORNIA	DRAWN BY: JJC 6/14/2010	CHECKED BY: AMN 2/7/2013	PROJECT NO. 2010-084	FIG NO. 1

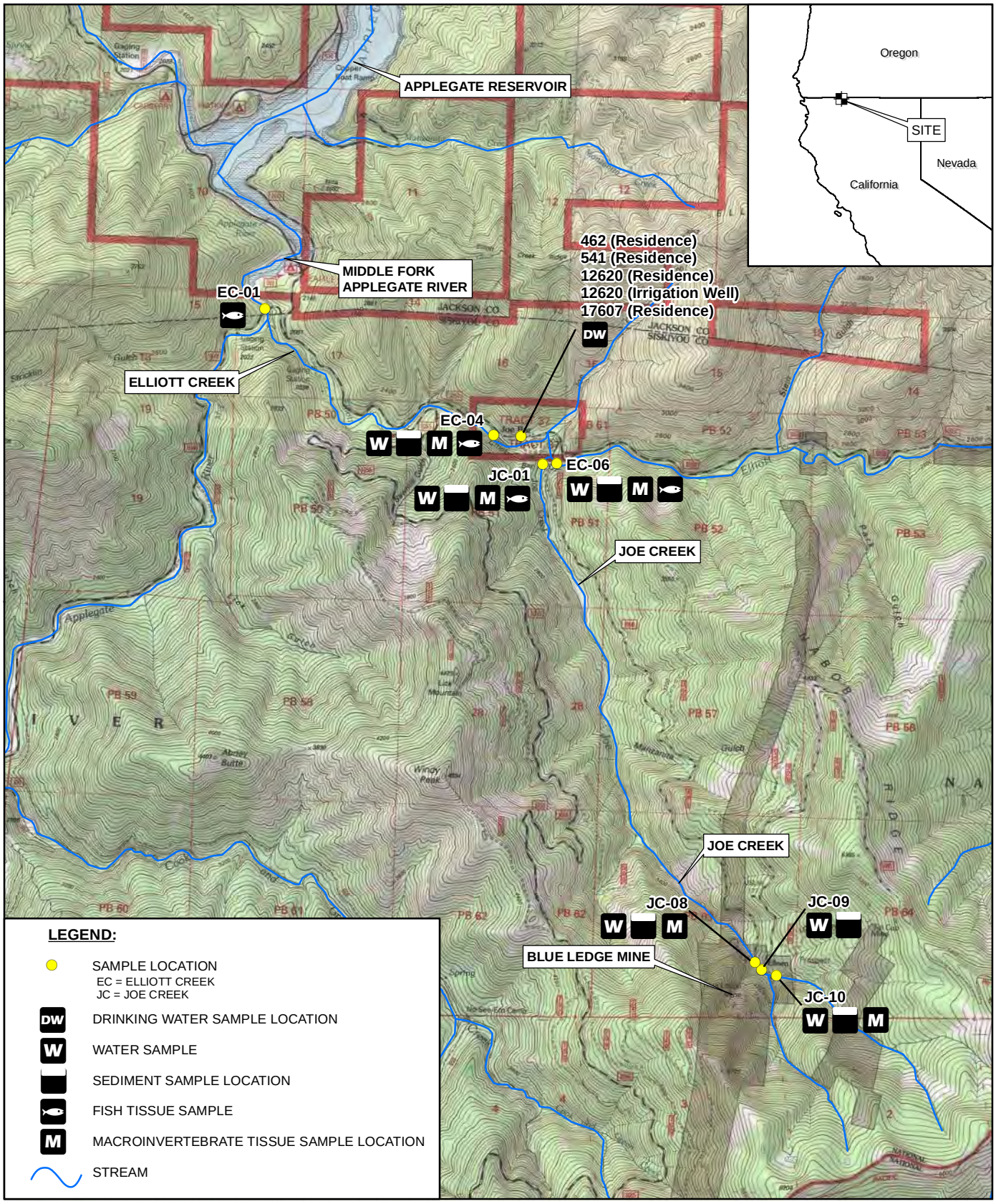
N:\Graphics\2010\2010-084 USFS Blueledge Mine\2011 GIS\Site Vicinity Map.mxd



SOURCE: URS BLUE LEDGE MINE REMOVAL ACTION, DRAWING NO. 101, SHEET 7 OF 60, CAD FILE NO. 101, DATED: 2/2010.

ERRG Engineering/Remediation Resources Group, Inc. 616 First Ave., Suite 300 Seattle, Washington 98104 (206) 282-4749	CLIENT: USFS FOREST SERVICE	OVERALL SITE PLAN			
	LOCATION: BLUE LEDGE MINE SISKIYOU COUNTY, CALIFORNIA	DRAWN BY: RDB 11/18/11	CHECKED BY: AMN 2/6/13	PROJECT NO. 2010-084	FIG NO. 2

FILE NAME: N:\Graphics\2010\2010-084 USFS Blueledge Mine\N_Maps and Drawings\Final Report\Overall Site Plan.dwg LAYOUT NAME: 2 PLOTTED: Monday, February 11, 2013 - 9:47am



SOURCE: "PROPOSED SAMPLING LOCATIONS", URS CORPORATION, 2010
DUTCH CREEK, CALIFORNIA USGS 7.5' TOPO QUAD, 1981
KANGAROO MOUNTAIN, CALIFORNIA USGS 7.5' TOPO QUAD, 1981
SQUAW LAKES, OREGON USGS 7.5' TPOP QUAD, 1983
CARBERRY CREEK, OREGON USGS 7.5' TOPO QUAD, 1983

0 3,660

SCALE: 1" = 3,600'

N

N:\Graphics\2010\2010-084 USFS Blueledge Mine\2011 GIS\Sampling_Locations.mxd

ERRG
Engineering/Remediation Resources Group, Inc.
616 First Ave., Suite 300
Seattle, Washington 98104
(206) 282-4749

CLIENT: USFS FOREST SERVICE	SAMPLING LOCATIONS			
LOCATION: BLUE LEDGE MINE SISKIYOU COUNTY, CALIFORNIA	DRAWN BY: JJC 1/17/2012	CHECKED BY: AMN 2/5/2013	PROJECT NO. 2010-084	FIG NO. 3

Tables

Table 1. Summary of Sampling Frequencies

Sample Matrix	Analyses	No. of Sample Locations	No. of Duplicates	No. of MS/MSD Samples
Biannual Samples (Spring and Fall)				
Drinking Water	Dissolved Metals	5	1	1
	Alkalinity			
	Hardness			
	Sulfate			
	Total Dissolved Solids			
	Total Suspended Solids			
Surface Water	Dissolved Metals	6	1	1
	Alkalinity			
	Hardness			
	Sulfate			
	Total Dissolved Solids			
	Total Suspended Solids			
Sediment (Creek)	Metals	6	1	1
	Particle Size			
	% moisture			
Annual Samples (Fall Only)				
Fish Tissue[1]	Metals	4	1	0
Aquatic Macroinvertebrate[1]	Species Composition and Taxa Richness	6	0	0
	Community Structure	6	0	0
	Benthic Index of Biotic Integrity	6	0	0

Notes:

All drinking water, surface water, creek sediment, and fish tissue samples will be analyzed for arsenic, cadmium, copper, iron, lead, and zinc.

1 = Macroinvertebrate and fish tissue sampling should only occur annually in the fall.

MS/MSD = Matrix spike/matrix spike duplicate

Table 2. Drinking Water Analytical Data

			Field Parameters					General Chemistry Parameters (mg/L)					Dissolved Metals					
Sample Location ID No.	Sample ID No.	Sample Date	Temperature (°C)	Conductivity (mS/cm)	Dissolved Oxygen (mg/L)	pH	Turbidity (NTU)	Total Alkalinity ($CaCO_3$)	Hardness ($CaCO_3$)	Total Dissolved Solids	Total Suspended Solids	Sulfate	Arsenic (µg/L)	Cadmium (µg/L)	Copper (µg/L)	Iron (µg/L)	Lead (µg/L)	Zinc (µg/L)
Ziem's Residence	WS-1	2008	NR	NR	NR	NR	NR	244	256	267.00	5 U	18.2	**6.24**	0.554	9.67	ND<20	2.82	540
Ruetiger's Residence	WS-2	2008	NR	NR	NR	NR	NR	258	271	276.00	5 U	21	**0.22 J**	0.019 J	1.16	ND< 4	0.09	7
Neilson's Residence	WS-3	2008	NR	NR	NR	NR	NR	160	246	324.00	5 U	77.4	**2.04**	0.062	4.00	ND<20	0.17	43
461 (Bob's Cabin)	BL-DW-461-063010	30-Jun-10	13.9	0.52	9.57	7.75	18.1	136.00	138.00	116.00	ND<5.00	8.23	*ND<0.50*	ND<0.02	1.00	ND<20.00	0.03	4.50
	BL-DW-461-063010DUP	30-Jun-10	--	--	--	--	--	134.00	139.00	161.00	ND<5.00	8.15	*ND<0.50*	ND<0.02	0.90	ND<20.0	0.02	4.30
	NS	21-Sep-10	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	NS	12-Jan-11	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	NS	13-Jul-11	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	NS	1-Nov-11	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	NS	2-May-12	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
462 (Bridgett)	BL-DW-462-063010	30-Jun-10	19.2	0.752	4.32	7.41	16	176.00	202.00	275.00	ND<5.00	35.50	**1.90**	0.05	4.60	ND<20.00	0.20	22.30
	BL-DW-462-092110	21-Sep-10	13.74	0.415	20.54	6.72	1.3	173.00	246.00	346.00	ND<5.00	58.90	*ND<2.00*	ND<1.00	6.77	NS	ND<1.00	21.90
	BL-DW-462-011211	12-Jan-11	NS	NS	NS	NS	NS	189.00	192.00	240.00	ND<5.00	22.20	*ND<2.00*	0.167	33.20	NS	ND<1.00	40.30
	BL-DW-462-071311	13-Jul-11	17.63	0.405	7.92	7.09	1.6	174.00	200.00	283.00	ND<5.00	42.60	*ND<2.00*	ND<0.100	18.90	NS	ND<1.00	26.30
	BL-DW-462-071311 DUP	13-Jul-11	--	--	--	--	--	180.00	200.00	286.00	ND<5.00	42.60	*ND<2.00*	ND<0.100	12.90	NS	ND<1.00	15.40
	BL-DW-462-110111	1-Nov-11	7.98	0.371	18.26	7.74	0.9	172.00	237.00	338.00	5.00	73.00	**1.79 J**	ND<0.2	11.90	**748.00**	ND<1.00	31.00
	BL-DW-462-050212	2-May-12	7.61	0.403	8.48	7.33	1.5	158.00	199.00	226.00	ND<5.00	30.30	**1.86 J**	0.0667	12.10	**457.00**	ND<1.00	31.30
	BL-DW-462-101612	16-Oct-12	14.61	0.289	11.58	7.63	1.2	157	223	348	ND<5.00	70.60	**4.38**	0.0667	29.1	**981**	ND<1.00	1,210
541 (Johan)	BL-DW-541-063010	30-Jun-10	15.6	0.9	4.3	7.19	18.7	230	247	302	ND<5.00	31.40	**7.00**	0.26	4.90	ND<20.00	1.09	194.00
	BL-DW-541-092110	21-Sep-10	13.14	0.388	17.89	7.07	6.0	242	265	302	ND<5.00	21.40	**5.10**	ND<1.00	4.77	NS	ND<1.00	228.00
	BL-DW-541-011211	12-Jan-11	NS	NS	NS	NS	NS	51	63	81	ND<5.00	4.81	*ND<2.00*	0.0667	ND<4.00	NS	ND<1.00	7.96
	BL-DW-541-011211 DUP	12-Jan-11	--	--	--	--	--	66	63	81	ND<5.00	4.84	*ND<2.00*	0.0667	ND<4.00	NS	ND<1.00	6.31
	BL-DW-541-011211 MSMSD	12-Jan-11	--	--	--	--	--	65	64	79	ND<5.00	4.87	*ND<2.00*	0.0778	ND<4.00	NS	ND<1.00	10.10
	BL-DW-541-071311	13-Jul-11	13.53	0.400	6.38	7.03	1.4	244	243	283	ND<5.00	22.60	**5.84**	ND<0.1	8.97	NS	ND<1.00	47.60
	BL-DW-541-110111	1-Nov-11	9.76	0.356	14.98	7.41	1.9	259	262	301	ND<5.00	17.40	**5.49**	ND<0.20	12.10	**766.00**	ND<1.00	50.40
	BL-DW-541-110111MSMSD	1-Nov-11	--	--	--	--	--	261	272	295	ND<5.00	17.40	**5.89**	ND<0.20	11.80	**759.00**	ND<1.00	39.20
	BL-DW-541-050212	2-May-12	7.92	0.415	7.62	7.39	1.5	226	284	277	ND<5.00	23.80	**6.33**	0.167	4.16	**558.00**	ND<1.00	201.00
	BL-DW-541-050212 MSMSD	2-May-12	--	--	--	--	--	236	261	263	ND<5.00	23.50	**6.50**	0.167	3.78	**569.00**	ND<1.00	196.00
	BL-DW-541-101612	16-Oct-12	13.46	0.277	23.9	7.72	1.8	234	252	272	ND<5.00	17.60	**6.43**	0.0556	9.70	**953**	ND<1.00	32.2
	BL-DW-541-101612 MSMSD	16-Oct-12	--	--	--	--	--	235	253	282	ND<5.00	17.60	**5.86**	ND<0.0400	8.44	**938**	ND<1.00	34.5
12620 (Ron James)	BL-DW-12620-063010	30-Jun-10	12.0	0.941	4.54	7.43	29.6	258	259	345	ND<5.00	21.50	**5.40**	0.04	1.00	103.00	0.12	24.80
	NS	21-Sep-10	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	NS	12-Jan-11	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	BL-DW-12620-071311	13-Jul-11	16.45	0.446	7.16	7.23	1.6	255	260	308	ND<5.00	24.90	**4.12**	ND<0.10	21.70	NS	1.46	109.00
	BL-DW-12620-071311MSMSD	13-Jul-11	--	--	--	--	--	256	258	311	ND<5.00	24.90	**4.37**	0.133	22.20	NS	1.13	191.00
	NS	1-Nov-11	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	NS	2-May-12	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	BL-DW-12620-101612	16-Oct-12	12.12	0.202	12.19	7.50	1.8	244	269	300	ND<5.00	21.90	**3.84**	0.0667	4.83	**1,110**	ND<1.00	30.7
12620 (Irrigation Well)	BL-DW-12620irrig-101612	16-Oct-12	12.12	0.202	24.13	7.77	1.8	197	210	231	ND<5.00	9.95	*ND<0.50*[a]	0.0667	ND<2.00	**845**	ND<1.00	19.5
17607 (Luke)	BL-DW-17607-063010	30-Jun-10	17.4	0.782	9.35	7.73	11.8	230.00	135	283.00	ND<5.00	19.70	*ND<0.50*	0.03	1.70	**ND<20.00**	0.11	8.60
	BL-DW-17607-092110	21-Sep-10	13.57	0.414	16.46	7.75	2.4	274.00	295	345.00	ND<5.00	20.90	*ND<2.00*	ND<1.00	ND<4.00	**NS**	ND<1.00	24.90
	BL-DW-17607-092110DUP	21-Sep-10	--	--	--	--	--	271.00	297	336.00	ND<5.00	20.90	*ND<2.00*	ND<1.00	ND<4.00	**NS**	ND<1.00	10.50
	BL-DW-17607-011211	12-Jan-11	NS	NS	NS	NS	NS	220.00	232	266.00	ND<5.00	31.00	**3.00**	0.50	6.84	**NS**	2.02	1,730.00
	BL-DW-17607-071311	13-Jul-11	15.95	0.405	8.62	7.53	1.2	243.00	238	268.00	ND<5.00	17.90	*ND<2.00*	ND<0.1	ND<4.00	**NS**	ND<1.00	7.54
	BL-DW-17607-110111	1-Nov-11	11.32	0.388	16.51	7.97	1.9	268.00	284	293.00	ND<5.00	21.30	**0.522 J**	ND<0.200	ND<4.00	**728.00**	ND<1.00	8.96
	BL-DW-17607-110111DUP	1-Nov-11	--	--	--	--	--	272.00	278	304.00	ND<5.00	21.20	*ND<0.50*[a]	ND<0.200	16.3	**704.00**	1.22	14.20
	BL-DW-17607-050212	2-May-12	8.2	0.398	8.41	7.63	1.7	180.00	217	221.00	ND<5.00	17.10	*ND<0.50*[a]	*ND<0.0400*[a]	ND<0.200	**399.00**	ND<1.00	11.00
	BL-DW-17607-050212DUP	2-May-12	--	--	--	--	--	191.00	216	219.00	ND<5.00	17.10	*ND<0.50*[a]	*ND<0.0400*[a]	2.78	**391.00**	ND<1.00	12.20
	BL-DW-17607-101612	16-Oct-12	15.28	0.164	10.05	8.02	1.7	254	275	354	ND<5.00	22.6	*ND<0.50*[a]	*ND<0.0400*[a]	4.50	**890**	ND<1.00	8.72
	BL-DW-17607-101612DUP	16-Oct-12	--	--	--	--	--	251	271	306	ND<5.00	22.7	*ND<0.50*[a]	*ND<0.0400*[a]	5.89	**909**	ND<1.00	12.8
Human Health Screening Criteria[1]																		
		EPA MCLs	--	--	--	--	--	--	--	--	--	--	10	5	1,300	300	15	--
		EPA RSLs for Tap Water	--	--	--	--	--	--	--	--	--	--	0.045	6.9	620	11,000	--	4,700
		California MCLs	--	--	--	--	--	--	--	--	--	--	10	5	1,000[b]	300	15	5,000[b]
		North Coast Basin Plan	--	--	--	--	--	--	--	--	--	--	50	10	--	--	50	--

Table 2. Drinking Water Quality Data *(continued)*

Notes:

* Arsenic analyzed by ICPMS fall 2012 only

1 = Human health screening criteria are from Table 3-1a in the Engineering Evaluation and Cost Analysis for Blue Ledge Mine (URS Corporation, 2010b).

a= Method Detection Limit (MDL), rather than reporting limit (RL)

b = Secondary Maximum Contaminant Level (California Department of Public Health)

Bold = result exceeds screening criteria

Italic = RL or MDL is above selected screening criteria

EPA = U.S. Environmental Protection Agency

J = estimated value

MCL = maximum contaminant levels

mg $CaCO_3$/L = milligrams of calcium carbonate per liter

ND < = not detetected at concentrations greater than the reporting limit

ND < 0.50 = Non detected above the laboratory method reporting limit

NR = not reported

NS = not sampled

RSLs = regional screening levels

µg/L = micrograms per liter

Table 3. Surface (Creek) Water Analytical Data

			Field Parameters			General Chemistry Parameters (mg/L)					Dissolved Metals (µg/L)						
Sample Location ID No.	Sample ID No.	Sample Date	pH (SU)	Conductivity (µS/cm)	Temperature (ºC)	Total Alkalinity ($CaCO_3$)	Hardness ($CaCO_3$)	TDS	TSS	Sulfate	Arsenic	* Dissolved Arsenic by ICPMS with Hydride Preparation	Cadmium	Copper	Iron	Lead	Zinc
EC-04	EC-04-SW-080625-URS	25-Jun-08	7.51	101	13.5	42.00	44.00	64.00	ND<5.00	3.00	**0.37 B**	--	0.04	3.22	ND<4.0	0.012 B	3.82
	EC-04-SW-DUP-080625-URS	25-Jun-08	NA	NA	NA	44.00	43.10	82.00	ND<5.00	2.90	**0.4 B**	--	0.049	3.25	ND<4.0	0.013 B	4.73
	BL-SW-EC04-110111	1-Nov-11	8.03	178	6.5	71.20	68.70	103.00	ND<5.00	6.43	*ND<0.50* [a]	--	*ND<0.200*	ND<4.00	199.00	*ND<1.00*	5.80
	BL-SW-EC04-050212	2-May-12	7.66	88	5.28	32.70	36.70	29.00	15.00	2.67	**0.567 J**	--	*ND<0.0400* [a]	2.17	ND<100	*ND<1.00*	ND<4.00
	BL-SW-EC04-101612	16-Oct-12	8.34	128	11.86	66.2	72.80	101	ND<5.00	6.75	**0.556**	0.399	*ND<0.0400* [a]	5.87	257	*ND<1.00*	ND<4.00
EC-06	EC-06-SW-080625-URS	25-Jun-08	6.92	82	10.9	38.0	40.40	73.0	ND<5.00	3.10	**0.22 B**	--	**0.18**	**13.9**	ND<4.0	0.016 B	22.30
	BL-SW-EC06-110111	1-Nov-11	7.99	180	7.26	61.0	70.80	88.0	ND<5.00	5.88	***0.589 J***	--	*ND<0.200*	ND<4.00	176	*ND<1.00*	ND<4.00
	BL-SW-EC06-050212	2-May-12	7.58	92	5.46	32.4	37.00	21.0	11.00	2.48	**0.664 J**	--	*ND<0.0400* [a]	*ND<2.00*	ND<100	*ND<1.00*	ND<4.00
	BL-SW-EC06-101612	16-Oct-12	7.89	143	11.76	67.8	72.80	98.0	ND<5.00	6.15	**0.656**	0.450	*ND<0.0400* [a]	*ND<2.00*	250	*ND<1.00*	ND<4.00
JC-01	JC-01-SW-080625-URS	25-Jun-08	7.4	75	10.5	35.0	37.00	48.0	ND<5.00	5.1	**ND<0.07**	--	**0.564**	**31.3**	ND<4.0	0.014 B	**79.40**
	BL-SW-JC01-110111	1-Nov-11	7.67	161	7.88	66.0	72.40	102.0	ND<5.00	12.6	*ND<0.50* [a]	--	**0.589**	**15.20**	218	*ND<1.00*	**79.10**
	BL-SW-JC01-050212	2-May-12	8.01	89	6.13	31.8	36.20	52.0	ND<5.00	4.42	*ND<0.50* [a]	--	**1.48**	**16.30**	ND<100	*ND<1.00*	36.10
	BL-SW-JC01-101612	16-Oct-12	7.87	122	12.57	55.2	68.50	91.0	ND<5.00	12.80	*ND<0.50* [a]	0.0689	**0.344**	**22.8**	263	*ND<1.00*	30.3
JC-08	JC-08-SW-080626-URS	26-Jun-08	6.94	47	10.5	21.0	20.60	21.0	ND<5.00	2.80	ND<0.07	--	**0.228**	**29.00**	ND<4.0	0.043	42.90
	BL-SW-JC08-110111	1-Nov-11	7.5	78	4.59	32.4	35.80	35.0	ND<5.00	4.64	*ND<0.50* [a]	--	*ND<0.200*	ND<4.00	93	*ND<1.00*	ND<4.00
	BL-SW-JC08-110111DUP	1-Nov-11	--	--	--	45.4	35.50	35.0	ND<5.00	4.63	*ND<0.50* [a]	--	*ND<0.200*	ND<4.00	93	*ND<1.00*	ND<4.00
	BL-SW-JC08-050212	2-May-12	7.91	40	2.91	ND<20.00	19.60	16.0	ND<5.00	3.19	*ND<0.50* [a]	--	***0.189***	**18.0**	ND<100	*ND<1.00*	31.9
	BL-SW-JC08-050212DUP	2-May-12	--	--	--	ND<20.00	19.70	21.0	15.00	3.20	*ND<0.50* [a]	--	***0.200***	**17.4**	ND<100	*ND<1.00*	31.3
	BL-SW-JC08-101612	16-Oct-12	7.99	52	9.34	28.4	34.60	50.0	6.00	6.01	*ND<0.50* [a]	0.0521	***0.211***	**10.6**	129	*ND<1.00*	34.8
	BL-SW-JC08-101612DUP	16-Oct-12	--	--	--	28.6	34.70	46.0	9.00	6.00	*ND<0.50* [a]	0.0475	***0.233***	**10.2**	118	*ND<1.00*	33.8
JC-09	JC-09-SW-080627-URS	27-Jun-08	7.29	48	9.1	22.0	21.30	15.0	ND<5.00	2.30	ND<0.07	--	0.031	3.45	ND<4.0	0.014 B	6.01
	BL-SW-JC09-110111	1-Nov-11	7.53	81	5.72	31.0	33.20	41.0	ND<5.00	5.97	*ND<0.50* [a]	--	**0.300**	**9.57**	82	*ND<1.00*	**66.40**
	BL-SW-JC09-050212	2-May-12	7.73	38	2.69	ND<20.00	18.40	16.0	ND<5.00	2.66	*ND<0.50* [a]	--	0.0556	3.66	ND<100	*ND<1.00*	8.87
	BL-SW-JC09-101612	16-Oct-12	7.76	53	9.23	28.8	35.10	44.0	ND<5.00	5.26	*ND<0.50* [a]	0.0484	0.122	6.61	128	*ND<1.00*	25.50
JC-10	JC-10-SW-080627-URS	27-Jun-08	8.13	55	9.7	25.0	24.50	26.0	ND<5.00	2.5	ND<0.07	--	ND<0.008	0.77	ND<4.0	0.007 B	0.65
	BL-SW-JC10-110111	1-Nov-11	7.36	83	4.47	32.0	33.10	51.0	ND<5.00	4.73	*ND<0.50* [a]	--	*ND<0.200*	ND<4.00	87.50	*ND<1.00*	16.50
	BL-SW-JC10-110111MSMSD	1-Nov-11	--	--	--	31.8	33.00	48.0	ND<5.00	4.72	*ND<0.50* [a]	--	*ND<0.200*	ND<4.00	85.60	*ND<1.00*	16.80
	BL-SW-JC10-050212	2-May-12	7.85	43	2.57	21.5	21.80	ND<10.00	ND<5.00	2.13	*ND<0.50* [a]	--	*ND<0.0400* [a]	ND<2.00	ND<100	*ND<1.00*	ND<4.00
	BL-SW-JC10-050212MSMSD	2-May-12	--	--	--	ND<20.00	21.60	37.0	ND<5.00	2.14	*ND<0.50* [a]	--	*ND<0.0400* [a]	ND<2.00	ND<100	*ND<1.00*	ND<4.00
	BL-SW-JC10-101612	16-Oct-12	8.63	57	9.09	33.6	38.50	50.0	ND<5.00	4.85	*ND<0.50* [a]	0.0538	*ND<0.0400* [a]	ND<2.00	138	*ND<1.00*	ND<4.00
	BL-SW-JC10-101612MSMSD	16-Oct-12	--	--	--	33.2	38.60	51.0	ND<5.00	4.89	*ND<0.50* [a]	0.0488	*ND<0.0400* [a]	ND<2.00	139	*ND<1.00*	ND<4.00
Ecological Screening Criteria[1]																	
	California Water Quality Standards (CCC)		--	--	--	--	--	--	--	--	150	150	0.13	--	1,000	0.92	54
	EPA NRWQC (CCC)		--	--	--	--	--	--	--	--	150	150	0.25	9	1,000	2.5	120
Human Health Screening Criteria[1]																	
	California Water Quality Standards (humans ingesting organisms only)		--	--	--	--	--	250.00	--	250.00	--		--	--	--	--	--
	EPA NRWQC (protective of humans ingesting organisms only)		--	--	--	--	--	--	--	--	0.14		--	--	--	--	26,000

Notes:
* Arsenic analyzed by ICPMS fall 2012 only
1 = Ecological and human health screening criteria are from Table 3-1a in the Engineering Evaluation and Cost Analysis for Blue Ledge Mine (URS Corporation, 2010b).
a= Method Detection Limit (MDL), rather than reporting limit (RL)
B = Flagged by the laboratory stating "compound was found in the blank and sample".
Bold = concentration exceeds the screening criteria
Italic = Reporting limit is greater than one or more of the selected screening criteria
$CaCO_3$ = calcium carbonate
DEQ = Oregon Department of Environmental Quality
EPA = U.S. Environmental Protection Agency
J = the result is an estimated quantity; the associated numeric value is the approximate concentration of the analyte in the sample
ND< = nondetected above the laboratory method reporting limit
NRWQC = national recommended water quality criteria
U = the analyte was analyzed for but was not detected above the reported sample method detection limit
SU = standard unit
TDS = total dissolved solid
-- = not applicable
µg/L = micrograms per liter
µS/cm = microSiemens per centimeter

Table 4. Creek Sediment Analytical Data

Sample Location ID No.	Sample ID No.	Sample Date	Arsenic (mg/kg)	Cadmium (mg/kg)	Copper (mg/kg)	Iron (mg/kg)	Lead (mg/kg)	Zinc (mg/kg)
EC-04	EC-04-SD-080625-URS	25-Jun-08	**6.20**	0.211	39.90	27,700	5.52	77.10
	EC-04-SD-DUP-080625-URS	25-Jun-08	**5.20**	0.270	**51.30**	32,200	4.72	75.10
	BL-CS-EC04-110111	1-Nov-11	**1.82 J**	0.339	33.30	9,420	3.40	57.10
	BL-CS-EC04-050212	2-May-12	**5.97**	0.335	**73.70**	23,200	5.80	72.50
	BL-CS-EC04-101612	16-Oct-12	**3.53**	ND<0.669	39.2	15,500	5.03	47.0
EC-06	EC-06-SD-080625-URS	25-Jun-08	**4.92**	0.581	**119**	33,200	10.4	**114**
	BL-CS-EC06-110111	1-Nov-11	**6.11**	0.236	37.2	21,500	5.6	53.3
	BL-CS-EC06-05022012	2-May-12	**4.02**	0.174	30.9	15,900	3.58	39.1
	BL-CS-EC06-101612	16-Oct-12	**5.41**	ND<0.753	38.5	18,900	7.58	42.2
JC-01	JC-01-SD-080626-URS	26-Jun-08	**3.01**	**2.14**	**430**	26,200	5.85	**440**
	BL-CS-JC01-110111	1-Nov-11	**5.91**	**4.44**	**975**	25,000	12.5	**1010**
	BL-CS-JC01-110111-MSMSD	1-Nov-11	**6.34**	**3.29**	**903**	19,300	**35.3**	**870**
	BL-CS-JC01-05022012	2-May-12	***2.48***	**1.46**	**423**	13,500	6.97	**375**
	BL-CS-JC01-050212-MSMSD	2-May-12	**5.93**	**4.17**	**518**	16,300	10.6	**797**
	BL-CS-JC01-101612	16-Oct-12	1.12	**1.6**	**271**	10,300	2.57	**314**
	BL-CS-JC01-101612-MSMSD	16-Oct-12	**4.13**	**2.02**	**377**	14,900	6.01	**460**
JC-08	JC-08-SD-080627	27-Jun-08	**2.54**	0.941	**978**	24700	13.8	**208**
	BL-CS-JC08-110111	1-Nov-11	1.07 J	0.178	**62.2**	13400	1.33	25.3
	BL-CS-JC08-050212	2-May-12	**17.6**	**7.95**	**2250**	30900	**45.9**	**1210**
	BL-CS-JC08-101612	16-Oct-12	**37.2**	**6.61**	**1,750**	38,100	**84.4**	**1,160**
JC-09	Not sampled in 2008							
	BL-CS-JC09-110111	1-Nov-11	**30.00**	**1.79**	**736.00**	41,100	**147**	**403**
	BL-CS-JC09-110111 DUP	1-Nov-11	**25.80**	**4.16**	**1,010**	31,300	**90.60**	**688**
	BL-CS-JC09-050212	2-May-12	**5.32**	0.496	**154**	16,000	9.64	84.50
	BL-CS-JC09-050212DUP	2-May-12	**5.07**	0.668	**174**	15,200	12.60	96.20
	BL-CS-JC09-101612	16-Oct-12	**22.7**	**4.14**	**1,480**	38,700	**403**	**707**
	BL-CS-JC09-101612DUP	16-Oct-12	**14.4**	**2.77**	**1,170**	29,200	**43.4**	**463**
JC-10	JC-10-SD-080627-URS	27-Jun-08	**2.68**	0.214	**51.70**	24,000	2.67	55.60
	BL-CS-JC10-110111	1-Nov-11	**85.10**	**19.80**	**5,030**	76,500	**797.00**	**2,900**
	BL-CS-JC10-050212	2-May-12	**2.00**	0.258	36.7	12,500	1.84	27.4
	BL-CS-JC10-101612	16-Oct-12	**2.23**	ND<0.655	**45.1**	14,500	1.9	29.3
		Ecological Screening Criteria[1]	7	0.99	42.9	--	17	121
		Human Health Screening Criteria[1]	1.5	39	2,900	--	400	23,000

Notes:

Bold = Value is equal to or greater than the screening criteria

1 = Ecological and human health screening criteria are from Table 5 in the Final Site Inspection Report for Blue Ledge Mine (URS Corporation, 2009).

J = estimated value

mg/kg = micrograms per kilogram

ND< = nondetect at concentration greater than the laboratory method reporting limit

-- = not applicable

Table 5. Fish Species Sample Data

Sampling Location ID No.	Species	Quantity Collected	Age	Length (inches)	Sample Date
EC-01	Rainbow Trout	1	not reported	7.5	10-Nov-11
	Torrent Sculpin	2	not reported	3.25, 3.75	
	Pacific Giant Salamander	2	1	4.25, 5	16-Oct-12
	Torrent Sculpin	8	1+	2.75, 1.75, 1.75, 2.25, 2, 1.5, 1.25, 1.5	
EC-04	Rainbow Trout	4	unreported, juvinile, juvinile, adult	8.5, 5.5, 3, unreported	10-Nov-11
	Torrent Sculpin	14	not reported	3.5, 3, 3.25, 3, 2.75, 3.5, 3, 3, 2.75, 3, 3.5, 2.25, 3.5, 3.25	
	Rainbow Trout	4	1+, 2+	4.25, 5, 2.75, 2.5	16-Oct-12
	Torrent Sulpin	3	1+	2.75, 2.5, 2.5	
EC-06	Rainbow Trout	5	1 adult, 4 juviniles	9.25, 3.25, 3.5, 3.5, 3.25	10-Nov-11
	Rainbow Trout	1	2+	9.5	16-Oct-12
	Torrent Sculpin	1	1	3.25	
JC-01	Rainbow Trout	1	not reported	6.75	10-Nov-11
	Rainbow Trout	1	2+	6	16-Oct-12

Notes:

rainbow trout = Oncorhynchus mykiss

torrent sculpin = Cottus rhotheus

Pacific Giant Salamander = Dicamptodontidae

Table 6. Fish Tissue Analytical Data

Sampling Location ID No.	Sample ID No.	Sample Date	Arsenic (mg/kg)	Cadmium (mg/kg)	Copper (mg/kg)	Iron (mg/kg)	Lead (mg/kg)	Zinc (mg/kg)	Percent Moisture
EC-01	EC-01-TS-111011	10-Nov-11	*ND<0.51*	*ND<0.17*	6 J	269 J	*ND<0.21*	57.1	70.8
	EC-01-TS-101612	16-Oct-12	*ND<0.89*	***0.32 J***	5.1	190	**0.32 J**	100 B	77 H
EC-04	EC-04-FT-080626-URS	26-Jun-08	**0.15**	0.134	4.79	1,140	**0.194**	29.2	--
	EC-04-TS-111011	10-Nov-11	*ND<0.58*	*ND<0.19*	4.4 J	75.4 J	*ND<0.23*	113	74.1
Duplicate	EC-04-TSD-111011	10-Nov-11	*ND<0.69*	**0.17 B**	7.3 J	95.6 J	*ND<0.35*	61.7	71.0
	EC-04-TS-101612	16-Oct-12	*ND<0.69*	**0.19 J**	4.5	120	*ND<0.34*	150 B	72 H
Duplicate	EC-04-TSD-101612	16-Oct-12	*ND<0.85*	**0.21 J**	8.6	190	*ND<0.42*	100 B	75 H
EC-06	Not sampled in 2008								
	EC-06-TS-111011	10-Nov-11	*ND<0.55*	*ND<0.18*	6.7 J	1940 J	**0.26**	76.3	72.9
	EC-06-TS-101612	16-Oct-12	*ND<0.79*	*ND<0.39*	8.2	3,100	**0.33 J**	140 B	76 H
JC-01	Not sampled in 2008								
	JC-01-TS-111011	10-Nov-11	*ND<0.48*	*ND<0.16*	5.5 J	97.1 J	*ND<0.19*	124	68.8
	JC-01-TS-101612	16-Oct-12	*ND<0.74*	**0.39**	12	120	*ND<0.37*	94 B	74 H
Ecological Screening Criteria[1]			6.60	0.15	--	--	0.12	--	NA
Human Health Screening Criteria[1]			0.0062	0.49	--	--	0.50	--	NA

Notes:
1 = Ecological and human health screening criteria are from Table 6 in the Final Site Inspection Report for Blue Ledge Mine (URS Corporation, 2009).

Bold = result excceds screening criteria

Italic = reporting limit is greater than screening criterion

B = Flagged by the laboratory stating "compound was found in the blank and sample".

H = Flagged by the laboratory stating "sample was prepped or analyzed beyond the specified holding time".

J = Flagged by the laboratory stating "result is less than the reporting limit but greater than or equal to the method detection limit and the concentration is an approximate value".
mg/kg = milligrams per kilogram

ND< = nondetect at concentration greater than the laboratory reporting limit

NR = not reported
-- = not applicable

Table 7. Aquatic Macroinvertebrate Analytical Data

Sample Date	Sample Location	EPT Richness		Coleoptera Richness		Diptera Richness		% Intolerant Individuals		% Non-Gastropoda Scraper Individuals		% Predator Individuals		% Shredder Taxa		% Non-Insect Taxa		NorCal B-IBI	Condition Category
		Value	**Score**	**Value**	**Score**	**Value**	**Score**	**Value**	**Score**	**Value**	**Score**	**Value**	**Score**	**Value**	**Score**	**Value**	**Score**		
9-Nov-11	JC01	3	1	0	0	3	3	29.03	7	0.00	0	32.26	10	16.67	10	0.00	10	51.25	Fair
16-Oct-12		13	5	2	3	4	4	32.89	8	5.26	3	13.16	6	17.39	10	7.89	10	61.25	Good
9-Nov-11	JC08	5	1	1	1	2	2	76.47	10	5.88	3	52.94	10	25.00	10	0.00	10	58.75	Fair
16-Oct-12		10	3	0	0	1	1	61.70	10	0.00	0	25.53	10	16.67	10	2.13	10	55.00	Fair
9-Nov-11	JC10	11	4	0	0	1	1	61.90	10	19.05	10	14.29	6	21.43	10	14.29	8	61.25	Good
16-Oct-12		25	10	0	0	6	6	74.31	10	24.11	10	15.18	7	21.21	10	3.57	10	78.75	Good
9-Nov-11	EC04	12	4	0	0	3	3	39.18	9	18.56	10	16.49	7	0.00	0	0.00	10	53.75	Fair
16-Oct-12		20	7	2	3	5	5	49.59	10	19.01	10	33.06	10	6.25	4	7.44	10	73.75	Good
9-Nov-11	EC06	14	5	1	1	4	4	22.34	6	9.04	5	7.45	3	0.00	0	6.91	10	42.50	Fair
16-Oct-12		19	7	2	3	6	6	27.32	7	16.62	8	10.42	5	6.67	4	23.38	7	58.75	Fair

Notes:

B - IBI = Benthic Index of Biotoc Integrity

B-IBI Key	
Score	Rating
0 - 19	Very Poor
20 - 39	Poor
40 - 59	Fair
60 - 79	Good
80 - 100	Very Good

Table 8. Leachate Analytical Data

Sample ID No.	Sample Date	Arsenic (µg/L)	Barium (µg/L)	Cadmium (µg/L)	Chromium (µg/L)	Copper (µg/L)	Iron (µg/L)	Lead (µg/L)	Mercury (µg/L)	Selenium (µg/L)	Silver (µg/L)	Zinc (µg/L)	Quantity Disposed (gallons)[1]
BL-RS-091211	12-Sep-11	ND<2.00	--	127	--	17.0	534,000	ND<1.00	--	--	--	64,700	500
BL-RS-050212	2-May-12	ND<2.00	27.6	42.8	ND<2.00	--	--	ND<1.00	0.123	ND<4.00	ND<1.00	--	
BL-RS-091412[2]	14-Sep-12	ND<10.0	23.7	35.0	ND<10.0	64.6	2,060,000	ND<5.00	ND<0.400	ND<10.0	ND<5.00	148,000	

Notes:

Analyzed by US Environmental Protection Agengy method 6020 for dissolved metals.

1=Leachate was disposed on September 25, 2012

2=Analyzed by EPA Method 6020 for total metals

ND< = nondetect at concentration greater than the laboratory method reporting limit

µg/L = micrograms per liter

-- = not reported

Table 9. Sediment Basin Analytical Data

Sample ID No.	Sample Date	Arsenic (mg/kg)	Barium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Iron (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)	Zinc (mg/kg)
BL-TB-1A-050212	5/2/2012	41.1	271	1.77	16.2	803	51,100	142	0.921	ND<3.00	5.04	366
BL-TB-1B-050212	5/2/2012	45.3	265	3.04	16.7	**1,170**	58,800	149	1.03	ND<3.34	5.93	543
BL-TB-1C-050212	5/2/2012	39.3	251	1.54	15.4	880	49,900	126	0.845	ND<3.30	4.38	320
BL-TB-1D-050212	5/2/2012	61.9	329	1.02	18.1	704	58,800	98.2	0.485	2.8	2.94	242
BL-TB-1E-050212	5/2/2012	31.0	96.6	1.44	13.7	521	39,400	57.7	0.275	ND<2.34	1.65	279
BL-TB-1F-050212	5/2/2012	50.0	84.2	0.467	28.8	413	61,000	104	0.290	ND<2.17	2.63	172
BL-TB-1FL-050212	5/2/2012	17.4	137	0.582	35.7	247	38,300	55.6	0.347	ND<2.48	1.57	164
BL-TB-2A-050212	5/2/2012	15.5	183	0.849	14.5	512	29,700	76.9	0.420	ND<2.78	2.17	302
BL-TB-2B-050212	5/2/2012	11.1	99.1	0.667	16.9	379	29,800	38.1	0.192	ND<2.43	ND<1.21	429
BL-TB-3-050212	5/2/2012	11.4	108	2.35	5.81	**2,450**	26,800	52.6	0.414	ND<2.67	1.53	365
BL-TB-3S-050212	5/2/2012	11.5	129	1.08	15.2	486	26,600	30.8	0.339	ND<2.15	1.80	264
Soil Removal Goals[1]		**87.00**	NA	**23.00**	NA	**1,041.00**	NA	**179.00**	NA	NA	NA	**660.00**
Tolerance Limit (Soil Removal Goals +15%[1])		100.05	NA	26.45	NA	1,197.15	NA	205.85	NA	NA	NA	759.00

Notes:

Removal Goal Concentration and Tolerance: Metals concentrations are to be no more than 15 percent above the numeric standards, and no more than 15 percent of the sample results will be allowed to have concentrations above the 15 percent tolerance.

Analyzed by US Environmental Protection Agengy method 6020 for metals.

Bold = Value is equal to or greater than the removal goal

Shade samples exceed the tolerance limit (removal goal plus 15 percent).

[1] = Soil Removal Goals as presented in Removal Action Completion Report prepared by Engineering/Remediation Resources Group (ERRG), February 2012.

mg/kg = milligrams per kilogram

NA = Not Applicable

ND< = nondetect at concentration greater than the laboratory method reporting limit

-- = not reported

Table 10. Relative Percent Difference Results

Sample ID No.	Matrix	Total Solids	Date	Alkalinity	Hardness	TDS	TSS	Sulfate	Arsenic	Cadmium	Copper	Iron	Lead	Zinc	Arsenic with Hydride Prep[1]
BL-DW-17607-101612	Drinking Water	NA	16-Oct-12	254	275	354	ND<5.00	22.60	ND<2.00	ND<0.200	4.50	890	ND<1.00	8.72	0.188
BL-DW-17607-101612DUP	Drinking Water	NA	16-Oct-12	251	271	306	ND<5.00	22.70	ND<2.00	ND<0.200	5.89	909	ND<1.00	12.20	0.188
			RPD (%)	1.19	1.47	14.55	0	0.44	0	0	26.76	2.11	0	33.27	0
BL-SW-JC08-101612	Surface Water	NA	16-Oct-12	28.4	34.6	50.0	6.00	6.01	ND<2.00	0.211	10.6	129	ND<1.00	34.8	0.0521
BL-SW-JC08-101612DUP	Surface Water	NA	16-Oct-12	28.6	34.7	46.0	9.00	6.00	ND<2.00	0.233	10.20	118	ND<1.00	33.8	0.0475
			RPD (%)	0.70	0.29	8.33	40.00	0.17	0	9.91	3.85	8.91	0	2.92	9.24
BL-CS-JC09-101612	Sediment	74.6	16-Oct-12	NA	NA	NA	NA	NA	22.70	4.14	1480.00	38,700	403.0	707	NA
BL-CS-JC09-101612DUP	Sediment	71.8	16-Oct-12	NA	NA	NA	NA	NA	14.40	2.77	1,170	29,200	43.4	463	NA
			RPD (%)	NA	NA	NA	NA	NA	**44.74**	39.65	23.40	27.98	**161.11**	**41.71**	**NA**

Notes:

1 Dissolved arsenic by ICP-MS with hydride preparation

If analyte is not detected above the reporting limit, half the reporting limit is used to calculate the RPD

Bold = RPD exceeds target range (<40%)
NA = not analyzed
NC = not calculated
ND< = not detected at concentrations greater than the reporting limit
RPD = relative percent difference
TDS = total dissolved solids

TSS = total suspended solids