Longfellow Mill Site
Tuolumne County, California
Removal Site Evaluation Report
Final

Forest Service Regional Environmental Response Action Contract # AG91S8C090037
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LIST OF ACRONYMS

ACRONYMS AND ABBREVIATIONS

%	percent
ARAR	Applicable or Relevant and Appropriate Requirement
AWQC	Ambient Water Quality Criteria
bgs	below ground surface
BLM	Bureau of Land Management
BMI	benthic macroinvertebrates
CDP	census designated place
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
EE/CA	Engineering Evaluation/Cost Analysis
EPA	United States Environmental Protection Agency
EPT	Ephemeroptera (mayfly), Plecoptera (stonefly), and Trichopera (caddisfly)
µg/kg	microgram per kilogram
µg/L	microgram per liter
mg/kg	milligram per kilogram
NOAA	National Oceanic and Atmospheric Administration
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
PA	Preliminary Assessment
RMC	Risk Management Criteria
RSE	Removal Site Evaluation
RSL	Regional Screening Level
SQuiRTs	Screening Quick Reference Tables
USGS	U.S. Geological Survey
WESTON	Weston Solutions, Inc.
XRF	x-ray fluorescence

1.0 INTRODUCTION

The United States Bureau of Land Management (BLM) tasked Weston Solutions, Inc. (WESTON®) to conduct a Removal Site Evaluation (RSE) following a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Non-Time Critical Removal Process for the Longfellow Mill site (Site), under contract AG91S8C090037. The site is located in the Big Oak Flat Mining District of Tuolumne County, California.

The remainder of this report consists of Section 2.0 Site Description, Section 3.0 Environmental Release Assessment, Section 4.0 Streamlined Risk Assessment, Section 5.0 Basis for Removal Action, Section 6.0 Preliminary Removal Action Objectives and Goals, and Section 7.0 Data Gaps and Areas of Additional Investigation. Section 8.0 provides references used in the preparation of the RSE report.

This RSE report summarizes sample data collected by the WESTON. The purpose of this RSE is to assess the potential threat to human health and the environment, and to determine if there is a need for further action. The objectives of this investigation are as follows:

- Identify and characterize sources of contamination at the Site,
- To determine whether or not sources of contamination at the site pose a viable threat to human health or the environment,
- To identify the presence of potential migration pathways of contamination at the Site, and
- Recommend further actions if needed.

2.0 SITE DESCRIPTION

2.1 Location and Topography

The Site is in Big Oak Flat, Tuolumne County, California and is approximately 90 miles south-southeast of Folsom, California or about 40 miles east of Modesto, California. The Site occupies approximately 14 acres. The Site is at 2,895 feet and the topography is relatively steep and forested. It is located at longitude 120 15’ 48.15”W by latitude 37 49’ 31.45”N, UTM 11N, NAD83, units in meters 212767.53mW x 4191440.96mN, or Mt Diablo Base Meridian, T 1 S, R 16 E, Section 30. Tuolumne County. The Site location is shown in Figure 2-1 (BLM, 2007).

The Site is accessed from the town of Big Oak Flat a few hundred feet off the state highway, CA-120. CA-120 runs through town and provides access to Yosemite National Park. The Site is also accessible from Vassar Road (unpaved off of CA-120) and from an undeveloped access road, which is a short walk from the Big Oak Flat Little League field parking lot. This current undeveloped access road runs through private property before reaching the BLM Site. The Site is bordered by residences to the north, east, and south.

2.2 Climate

The climate in the area of the Site is characterized by cold, wet winters and very warm, mostly dry summers. Average annual precipitation is 38.7 inches and occurs mainly from October to May each year. The average total snowfall for the year is 31.9 inches. Average maximum and minimum daily temperatures in Groveland are 68 degrees Fahrenheit and 42 degrees Fahrenheit, respectively (Western Regional Climate Center, 2010).

2.3 Geology and Soils

The Site is located in the Western Metamorphic Belt of the Sierra Nevada geomorphic province. This belt of metasedimentary and metavolcanic rocks of the Paleozoic and Mesozoic age lies between the granitic Sierra Nevada batholiths to the east and overlapping sediment of the Great Valley province of central California to the west. The Site is located within the central terrain of the western Sierra Nevada metamorphic belt, and located about a half-mile south of the Sonora Fault, and two miles northeast of the Melones Fault Zone. The site is in a metasedimentary phyllite belt where the country rock consists mainly of phyllite and stretched conglomerate derived from argillaceous and coarser-grained sediments (Higgins, 1997).

Within the Sierra Nevada metamorphic belt, gold-bearing quartz veins were introduced along faults and shear zones during the Late Jurassic Period. The Site is within the East Belt where small but rich gold-bearing quartz-vein systems occur. A considerable number of north, northwest and west-trending quartz veins occur in phyllite and granodiorite. Ore shoots contained free gold and often abundant sulfides, especially galena. The Big Oak Flat mining district, which the Site resides in, produced over 1.2 million ounces of gold between 1850 to the 1930s (BLM, 2007).

The general soil component and surface texture is Rock Outcrop and unweathered bedrock and has a Class D (very slow infiltration rate) designation. The soils are clayey, have a high water table, or are shallow to an impervious layer. According to the Soil Vegetation Map of the Sonora Quadrangle, southwest quarter, the parent material for soils in the vicinity of the Site is metasedimentary rock, schist. The soil type is a blend of gravelly sandy loam over gravelly loam subsoil, and light clay loam over gravelly clay loam subsoil. The pH is slightly to moderately acid over moderately to strongly acid subsoil (Appendix C; Higgins, 1997).

2.4 Hydrology and Hydrogeology

The site is north and upgradient, but immediately adjacent to the perennial stream, Rattlesnake Creek. The Rattlesnake Creek drainage flows south through the west end of Big Oak Flat community and eventually flows approximately 3.6 miles southwest into the Don Pedro Reservoir. The Don Pedro Reservoir and the Site are located in the Tuolumne River watershed. The Tuolumne River flows nearly 150 miles from the central Sierra Nevada into the San Joaquin River in the Central Valley. Beginning at almost 13,000 feet in elevation in Yosemite National Park, the Tuolumne River flows west through deep canyons before entering into the foothills and being impounded in Don Pedro Reservoir. The Don Pedro Dam and reservoirs are popular recreational areas and provide electricity and divert water drinking water and irrigation water to serve farms in the Modesto Irrigation District, the Turlock Irrigation District and cities in the San Francisco Bay Area (BLM, 2007).

2.5 Vegetation and Wildlife

The major vegetation types of the Site are Foothill Woodland and Mixed Conifer. Foothill Woodland consist primarily of grey pine (*Pinus sabiniana*) and blue oak (*Q. douglasii*), but also includes valley oak (*Q.lobata*). Chapparal also mixes freely. Mixed Conifer is comprised of conifers and some hardwoods; including ponderosa pine (*P. ponderosa*), sugar pine (*P.lambertiana*), incense cedar (*Libocedrus decurrens*), Douglas fir (*Pseudostuga menziesii*), black oak (*Q.kelloggii*), madrone (*Arbutus menziesii*), canyon live oak (*Q. chrysolepsis*), and giant sequoia (*Sequoiadendron giganteum*).

The habitat associated with Lower elevations of the Tuolumne River ecosystem offers a diverse array of mammals, birds, amphibians, reptiles, fish and invertebrates take advantage of the ample supply of food, water and shelter along the Lower River. In the lower-montane zone, due to relatively mild winters, lower-elevation climate wildlife species typically found in these habitats include black bear, bobcat, mountain beaver, gray fox, mountain kingsnake, Gilbert's skink, white-headed woodpecker, brown creeper, great gray owl, spotted owl, willow flycatcher, Yosemite toad and a wide variety of bat species. In addition to the more abundant wildlife, several sensitive, rare and endangered species depend on conditions provided by the Tuolumne's riparian complex as well. These include the fall-run Chinook salmon (species of concern), steelhead trout (threatened), Riparian Brush Rabbit (endangered), Riparian Wood Rat (endangered), Valley Elderberry Longhorn Beetle (threatened), Least Bell's Vireo (threatened), and Swainson's Hawk (species of concern). Despite major declines in the last two decades, the river continues to host the largest naturally reproducing population of Chinook salmon in the San Joaquin Valley (Tuolumne River Trust, 2010).

2.6 Cultural Resources

A cultural resources survey has not been conducted by the BLM at the Site. In May 2009, at the request of the BLM, Thomas Fischer prepared a "Longfellow Mill Site Documentation and Evaluation Report" of the Site and found the mill structure and remaining machinery somewhat intact, though in a state of advanced decay, collapse, erosion, years of neglect and vandalism (BLM, 2009).

The following is an excerpt borrowed from Oakland Museum of California; "Gold Districts of California" (BLM, 2007).

Considered the most productive mine in Southern Tuolumne County, the Longfellow Stamp Mill is now the only mill left in Big Oak Flat, California. Although it is severely decayed, it is still considered a historical landmark in Tuolumne County. The mine has a long history, operation from the early days of the California Gold Rush to the middle of the 20th Century.

Early photos of Longfellow Mill show the original wooden structure and "Bull Wheel" (main wooden drive pulley) inside. The mill was laid out on a number of terraces or steps descending an elevation difference of around 50 -60 feet, which allowed gravity feed of ore from the upper level to descend through various processes to the lower levels. The purpose of a stamp mill was to reduce the size of ore to be more efficiently processed to extract the valuable, gold content. Almost all stamp mill operations used the "wet milling" process in which water is introduced into the stamp mortars. Water supply used for the "wet milling" at Longfellow Mine was obtained from the adit of the mine, which is about 100 yards east of the mill on an upper terrace. About halfway between the mill and adit were large wooden tanks which served as a means of settling and storing process water (Appendix C; BLM, 2009).

At the time of the RSE sampling event conducted on May 13, 2010 and May 14, 2010, the former mill area was fenced and locked in order to prevent access. The Site Layout is shown in Figure 2-2. Pictures showing current Site conditions are contained in Appendix A. Burned debris of the former mill area are located within the fenced perimeter and include the former mill and cyanide tanks. Metal sheet debris is located within the fenced perimeter and directly outside of it. Another debris pile is located just southeast of the adit, which consists of metal sheets and wood. A large tailings pile consisting of three adjacent piles is located to the east of the former mill area. The large tailings pile is outside of the fenced perimeter. The large tailings pile is up to 30 feet high in places and occupies approximately less than one half acre. Additionally, what appear to be approximately five small tailings piles consisting of large broken quartz rocks mixed with shale are located to the southeast of the former mill area. The small tailings piles were sparsely covered with chaparral. WESTON also discussed tailings piles that are located outside the Site boundary to the southwest with the BLM on March 13, 2010. Two tailings piles were located in the area, shown on Figure 2-2. The tailings piles were mostly crushed quartz pieces. Large broken rocks up from 12 to 24 inches in length were located at the bottom of one of the tailings piles.

2.7 Land Use and Population

Groveland-Big Oak Flat is a census designated place (CDP) in Tuolumne County with a population of 3,388 at the 2000 census. The CDP includes the communities of Groveland, Big Oak Flat, and Pine Mountain Lake. Groveland is the location of the Groveland Ranger District office of the Stanislaus National Forest. The primary land use is recreation and tourism, due to Groveland-Big Oak Flat being an important stop on the highway to Yosemite. The town hosts an annual 49er Festival every September.

2.8 Mine History and Description

Big Oak Flat mining district was founded by James D. Savage who began mining the area around 1851. In the 1860s, Mr. Dearborn Longfellow acquired the Butler Mine and by 1899, the Longfellow Stamp mill had produced 24,200 ounces of gold. In the mines early days digging was relatively near the surface, but from 1895 until about 1914, hard rock mining was dominant.

The shaft at Longfellow Mine was about 450 feet deep. Tax records show that by 1909 the Longfellow Consolidated Mining Company had charge of a stationary boiler and hoist, compressor and receiver, mining cars and blacksmith tools, four concentrators, miscellaneous buildings, and a 20-stamp mill. During World War I, the hard rock mining declined and the Longfellow Stamp Mill did not return into full operation until 1936. By 1970 the mill and mine were no longer operational and abandoned (GYGM, 2010).

2.9 Sources

Major potential sources of contamination at the Site the former mill area, and a large tailings pile to the east of the former mill area. Additionally, two large tailings piles to the southwest of the Site boundary were documented during RSE sampling activities. Photographs in Appendix A document site conditions during the May 2010 site investigation by WESTON. As discussed in Section 3.0, soil is present at the Site is a source of elevated concentrations of metals.

3.0 ENVIRONMENTAL RELEASE ASSESSMENT

3.1 Previous Environmental Investigations

A Draft Preliminary Assessment (PA) was prepared for the Site on March 12, 2007 by the BLM National Science & Technology Center located in Denver, Colorado. The PA summarized sample results for 16 x-ray fluorescence (XRF) samples were collected at the Site on February 20, 2004. The specific sample locations are not available. The following metals were detected at maximum concentrations: arsenic at 706 milligrams per kilogram (mg/kg), cobalt at 1,440 mg/kg, copper at 12,669 mg/kg, iron at 158,925 mg/kg, lead at 5,210 mg/kg, manganese at 12,397 mg/kg, mercury at 2,469 at mg/kg, nickel at 4,579 mg/kg, nickel at 4,579 mg/kg, selenium at 77 mg/kg, and zinc at 6,147 mg/kg. Confirmation samples were not submitted for laboratory analysis (BLM, 2007).

On November 16, 2005 BLM employee David Lawler submitted four solid samples collected at the Site. The specific sample locations at the Site are not recorded. Eighty-five percent of the samples were pulverized to less than 72 micrometers. The following metals were detected at maximum concentrations: silver at 15.55 mg/kg, aluminum at 3.02 mg/kg, arsenic at 11.6 mg/kg, barium at 380 mg/kg, beryllium at 0.58 mg/kg, cadmium at 0.23 mg/kg, cerium at 23.7 mg/kg, cobalt at 6.1 mg/kg, chromium at 160 mg/kg, cesium at 0.83 mg/kg, copper at 42.3 mg/kg, gallium at 10.6 mg/kg, germanium at 0.06 mg/kg, hafnium at 0.6 mg/kg, mercury at 3.18 mg/kg, indium at 0.036 mg/kg, lanthanum at 12.3 mg/kg, lithium at 6.3 mg/kg, manganese at 321 mg/kg, molybdenum at 49.7 mg/kg, niobium at 3.6 mg/kg, nickel at 23.7 mg/kg, phosphorus at 220 mg/kg, lead at 56.9 mg/kg, rubidium at 38.0 mg/kg, tin at 48.3 mg/kg, selenium at 2 mg/kg, strontium at 40.2 mg/kg, tantalum at 0.30 mg/kg, tellurium at 1.01 mg/kg, thorium at 3.8 mg/kg, uranium at 1.2 mg/kg, vanadium at 78 mg/kg, yttrium at 6.6 mg/kg, zinc at 54 mg/kg, and zirconium at 21.7 mg/kg. The following metals were detected at maximum total percentage of sample: calcium at 0.29 percent (%), iron at 2.38 %, potassium at 1.1 %, magnesium at 0.24 %, sodium at 0.89 %, sulfur at 0.19 %, and titanium at 0.187 %.

Five additional samples were submitted for laboratory analysis by the BLM on May 21, 2007. The following metals were detected at maximum concentrations: gold at 67.7 mg/kg, silver at 267 mg/kg, arsenic at 165 mg/kg, barium at 790 mg/kg, beryllium at 2.59 mg/kg, bismuth at 8.07 mg/kg, cadmium at 10.05 mg/kg, cerium at 114 mg/kg, cobalt at 90.2 mg/kg, chromium at 72 mg/kg, cesium at 1.93 mg/kg, gallium at 20.4 mg/kg, germanium at 0.41mg/kg, hafnium at 2.4 mg/kg, mercury at 35.6 mg/kg, indium at 0.439 mg/kg, lanthanum at 55.8 mg/kg, lithium at 13.4 mg/kg, manganese at 670 mg/kg, molybdenum at 696 mg/kg, niobium at 5.6 mg/kg, nickel at 217 mg/kg, phosphorus at 1,020 mg/kg, lead at 1,450 mg/kg, rubidium at 41.4 mg/kg, rhenium at 0.069 mg/kg, antimony at 1,695 mg/kg, scandium at 12.3 mg/kg, selenium at 33 mg/kg, tin at 28.5 mg/kg, strontium at 99.1 mg/kg, tantalum at 0.32 mg/kg, tellurium 21.1 mg/kg, thorium at 10.7 mg/kg, thallium at 0.79 mg/kg, uranium at 2.9 mg/kg, vanadium at 88 mg/kg, tungsten at 5 mg/kg, yttrium at 32.7 mg/kg, zinc at 2,170 mg/kg, and zirconium at 63.9 mg/kg. The following metals were detected at maximum total percentage of sample: aluminum at 7.02 %, calcium at 0.4 %, iron at 12.2 %, potassium at 0.98 %, magnesium at 0.38 %, sodium at 1.47 %, sulfur at greater than 10 %, and titanium at 0.218 %.

3.2 Removal Site Evaluation

Weston conducted a RSE sampling event at the Site on May 13, 2010 and May 14, 2010. A total of 13 soil samples were collected including two background samples and one duplicate. Soil samples were collected at locations that were deemed by WESTON most likely to contain metals at concentrations significantly above background as well as locations that required characterization. “Significantly above background” is defined as three times the background concentration for all media. If the background concentration is below the analytical quantitation limit, then the default background level is the background sample quantitation limit; “significantly above background” for this scenario is defined as a detect in the media where the analyte was not detected in the background media. All sample locations are shown in Figure 3-1. A total of four surface water and sediment samples were collected at the Site including one duplicate. A background surface water and sediment sample was not collected. After discussion with BLM personnel on-site, it was decided that a background sample would not be collected and surface water and sediment samples would be for characterization only based upon lack of surface water upstream. Two soil samples were collected in addition to what was planned in the field sampling plan. One field blank sample was collected. Three water biota samples were collected including one water biota sample collected at the surface water/sediment background location.

Soil samples collected from the site were submitted for CAM 17 metals analysis via United States Environmental Protection Agency (EPA) Method 6010B/7470A. Sediment and surface water samples were submitted to a laboratory for analysis of CAM 17 metals by EPA Method 6010B/7470A series and for methyl mercury via EPA method 1630. Water biota samples were collected at all three of the surface water/sediment sample locations. Additionally, the water quality parameters temperature, pH, conductivity, turbidity, and dissolved oxygen were measured on-site for each surface water sample collected.

Soil Sample Results:

Soil sample results are shown in Table 3-1. Mercury was detected in four samples at concentrations significantly above background at a maximum concentration of 6.6 mg/kg. Antimony was detected in five samples at concentrations significantly above background at a maximum concentration of 156 mg/kg. Arsenic was detected at in four samples concentrations significantly above background at a maximum concentration of 94.6 mg/kg. Cadmium was detected in three samples at concentrations significantly above background at a maximum concentration of 1.2 mg/kg. Copper was detected in one sample at a concentration significantly above background at a maximum concentration of 811 mg/kg. Lead was detected in three samples at concentrations significantly above background at maximum concentration of 525 mg/kg. Molybdenum was detected in seven samples at concentrations above background at a maximum concentration of 125 mg/kg. Selenium was detected in four samples at concentrations significantly above background at a maximum concentration of 7.4 mg/kg. Silver was detected in six samples at concentrations significantly above background at a maximum concentration of 55.3 mg/kg. Zinc was detected in one sample at a concentration significantly above background at a maximum concentration of 734 mg/kg.

Mercury was detected in soil samples collected from two tailings piles near the former Longfellow Mill and soil collected from the former Longfellow Mill area. Metals were detected at concentrations significantly above background in two of the three tailings piles located near the former Longfellow Mill as well as within the former Longfellow Mill area. A tailings pile to the west of the boundary of the Site was sampled at BLM request on May 13, 2010. The soil sample collected at the western tailings pile also contained metals at concentrations significantly above background. Metal concentrations were highest for all metals detected in a soil sample collected below the former cyanide tanks, sample LM-SS-7.

Surface Water Sample Results:

Surface Water Sample Results are shown in Table 3-2. As discussed above, a surface water background sample was not collected. Mercury was not detected in any surface water samples collected at the Site. Methyl mercury was detected in three samples at a maximum concentration of 0.29 nanograms per liter. Barium was detected in four samples at a maximum concentration of 38 micrograms per liter (µg/L). Copper was detected in four samples at estimated concentrations ranging from 2.5 µg/L to 5.7 µg/L. Molybdenum was detected in four samples at estimated concentrations ranging from 7 µg/L to 14 µg/L. Nickel was detected in four samples at a maximum concentration of 24 µg/L. Selenium was detected in one sample at an estimated concentration of 14 µg/L. Zinc was detected in four samples at a maximum concentration of 39 µg/L.

Sediment Sample Results:

Sediment Sample Results are shown in Table 3-3. As discussed above, a sediment background sample was not collected. Methyl mercury was detected in three samples at a maximum concentration of 1.9 micrograms per kilogram. Mercury was detected in four samples at a maximum concentration of 1.6 mg/kg. Antimony was detected in two samples at estimated concentrations ranging from 3.2 mg/kg to 3.8 mg/kg. Arsenic was detected in four samples at a maximum concentration of 18.3 mg/kg. Barium was detected in four samples at a maximum concentration of 144 mg/kg. Beryllium was detected in four samples at a maximum concentration of 2.4 mg/kg. Cadmium wad detected in four samples at a maximum concentration of 5.4 mg/kg. Chromium was detected in four samples at a maximum concentration of 11.5 mg/kg. Cobalt was detected in four samples at a maximum concentration of 269 mg/kg. Copper was detected in four samples at a maximum concentration of 354 mg/kg. Lead was detected in four samples at a maximum concentration of 23.2 mg/kg. Molybdenum was detected in four samples at a maximum concentration of 57.1 mg/kg. Selenium was detected in one sample at an estimated concentration of 3.9 mg/kg. Silver was detected in four samples at a maximum concentration of 0.4 mg/kg. Thallium was detected in one sample at a concentration of 5.1 mg/kg. Vanadium was detected in four samples at a maximum concentration of 21.8 mg/kg. Zinc was detected in four samples at a maximum concentration of 439 mg/kg.

Metal concentrations were the highest in the sample collected the furthest downstream in Rattlesnake Creek, sample LM-SD-3, shown in Figure 3-1.

Water Biota Sample Results:

Water Biota sample results are shown in Table 3-4. Water biota samples were colocated with surface water and sediment samples.

A taxonomic listing of the benthic macroinvertebrates (BMI) collected at the Longfellow Mill survey sites is presented in Table 3-4. Each site had relatively unique BMI assemblages. The LM-WB-1 sample location was dominated by Ostracods (seed shrimp), the clam *Pisidium*, and Oligochaetes (earthworms). Two dipteran (true flies) taxa were also common, including midges (Chironomidae) and the biting midge Bezzia/Palpomyia. The abundant taxa at the LM-WB-1 sample location were in the collector feeding guilds, which typically proliferate at sites with high amounts fine particulate substrate. The LM-WB-2 sample location had fewer taxa than the LM-WB-1 sample location, but the overall assemblage may have indicated somewhat better ecological conditions with two Coleoptera (beetle) taxa and one sensitive Ephemeroptera taxon. At the LM-WB-3 sample location only midges of the family Chironomidae were collected.

Five biological metrics, shown in Table 3-5, were selected to provide a basis for comparing the biotic integrity of the sample locations. Each of these metrics increase with increasing biotic integrity. Taxa richness of the three sites ranged from one unique taxon at the LM-WB-3 sample location to seven at the LM-WB-1 sample location. Intolerant (sensitive) taxa (tolerance value of 0, 1, or 2) were not collected at any of the sites. One type of the Ephemeroptera (mayfly), Plecoptera (stonefly), and Trichopera (caddisfly) (EPT) taxa was collected at the LM-WB-2 sample location where the minnow mayfly *Centroptilum/Procloeon* was noted to be abundant. Coleoptera taxa were limited to the LM-WB-2 sample location, including the predaceous diving beetle *Agabus* and the water scavenger beetle *Laccobius*. Predator taxa were most diverse at the LM-WB-1 sample location with three different taxa.

Based on the biological metrics of the BMI communities, the LM-WB-2 sample location had the highest biotic integrity, followed by the LM-WB-1 sample location. The LM-WB-3 sample location was of substantially lower biotic integrity with a single taxon represented by midges of the family Chrionomidae.

Water Quality parameters are shown in Table 3-6. Values for pH ranged from 6.41 to 7.88. Dissolved oxygen ranged from 7.27 milligrams per liter to 11.29 milligrams per liter. Temperature ranged from 12.88 degrees Celsius to 15.58 degrees Celsius. Conductivity ranged from 641 microSiemens per second to 917 microSiemens per second. Oxidation Reduction Potential ranged from 124.5 millivolts to 155.2 millivolts. Turbidity ranged from 1.6 Nephelometric Turbidity Units to 2.8 Nephelometric Turbidity Units.

4.0 STREAMLINED RISK ASSESSMENT

According to Section 300.410 (b) of the National Contingency Plan (NCP), a removal site evaluation includes evaluation by agencies of the threat to public health, and evaluation of the magnitude of risk. WESTON has conducted streamlined surface water and soil pathway risk assessments in accordance with EPA's guidance for conducting non-time critical removal actions (EPA, 1993).

The primary objective of this section is to perform a streamlined risk assessment for the site and to establish the potential risk to human health and wildlife. In order to evaluate the potential threat to human health and the environment, soil, surface water, and sediment sample results have been compared against applicable Risk Management Criteria (RMC) for Metals at BLM Mining Sites, EPA Regional Screening Levels (RSLs) for industrial soil, National Oceanic and Atmospheric Administration (NOAA) Screening Quick Reference Tables (SQuiRTs) Threshold Effect Levels, and EPA Ambient Water Quality Criteria (AWQC). Based upon the proximity of residences and the Little League field to the Site, the BLM Residential RMC is referenced for soil samples.

4.1 Risk Assessment Results

Soil:

Soil samples results are shown in Table 3-1. A total of 13 surface soil samples were collected at the Site. Mercury was detected in 10 of 13 soil samples at concentrations ranging from 0.067 mg/kg to 6.6 mg/kg. One soil sample contained mercury at concentrations above the BLM Residential RMC of 2 mg/kg at a concentration of 6.6 mg/kg. Antimony was detected in three samples at concentrations above the BLM Residential RMC of 3 mg/kg. Arsenic was detected in nine samples above the BLM Residential RMC of 1 mg/kg at a maximum concentration of 94.6 mg/kg. Copper was detected in one sample at a concentration above the BLM Residential RMC of 250 mg/kg at a concentration of 811 mg/kg. Lead was detected in one sample above the BLM Median Wildlife RMC of 125 mg/kg at a concentration of 525 mg/kg. Lead was detected in the same sample at a concentration above the BLM Residential RMC of 400 mg/kg. Silver was detected in one sample above the BLM Residential RMC of 35 mg/kg at a concentration of 55.3

mg/kg. Zinc was detected in one sample at a concentration above the BLM Median Wildlife RMC of 307 mg/kg at a concentration of 734 mg/kg (BLM, 2004).

Surface Water:

Surface Water sample results are shown in Table 3-2. Five surface water samples were collected at the Site. Methyl mercury was not detected above the EPA AWQC Chronic value of 0.0028 μg/L in sample collected at the Site. Mercury was not detected in samples above EPA AWQC Chronic value of 0.77 μg/L or the BLM Recreational Camper RMC value of 93 μg/L. Selenium was detected in one sample above the EPA AWQC Chronic value of 5 μg/L at an estimated concentration of 14 μg/L (BLM 2004, NOAA 2008).

Sediment:

Sediment sample results are shown in Table 3-3. Mercury was detected above the NOAA SQuiRTs Threshold Effects Level of 0.174 mg/kg in three of the four sediment samples collected at the Site at a maximum concentration of 1.6 mg/kg. In addition, cadmium, copper, nickel, and zinc were detected at respective concentrations above the NOAA SQuiRTs Threshold Effects Levels in these three samples. Cadmium was detected in three samples at concentrations ranging above the Threshold Effects Level of 0.596 mg/kg at a maximum concentration of 5.4 mg/kg. Copper was detected in three samples above the NOAA SQuiRTs Threshold Effects Level of 35.7 mg/kg at a maximum concentration of 354 mg/kg. Nickel was detected in four samples above the NOAA SQuiRTs Threshold Effects Level of 18 mg/kg at a maximum concentration of 218 mg/kg. Zinc was detected in two samples above the NOAA SQuiRTs Threshold Effects Level of 123 mg/kg at a maximum concentration of 439 mg/kg (BLM 2004, NOAA 2008).

Mercury and all other metals were not detected above respective BLM Recreational Camper RMC values. Criteria are included in Tables 3-1, 3-2, and 3-3 for reference when applicable (BLM 2004, NOAA 2008).

The streamlined risk screening indicates that several State and Federal criteria/goals established for metals in soil, surface water, and sediment samples collected at the Site were exceeded. Tailings piles as well as soil located at the former mill area are sources for elevated metals in soil at the Site. Recreational and ecological receptors are subject to potential exposure via ingestion and/or dermal contact as well as potential residents in the vicinity of the Site. As discussed above, the Site lies in a residential area. Soils at the Site contain mercury, antimony, arsenic, copper, lead, and silver at concentrations above the BLM Residential RMC. Metals were detected at the highest concentrations within the former mill area.

4.2 Regulatory Framework Conclusions

According to Section 300.410 (b) of the National Contingency Plan (NCP), a removal site evaluation includes evaluation by agencies of factors necessary to determine whether a removal action is necessary. In addition, a determination must be made as to whether a non-federal party is responsible for undertaking or assisting with a cleanup.

The project was developed by the BLM using its delegated authority under CERCLA to assess impacts to human health and the environment posed by the former mill structure and tailings as well as to determine whether a removal action is warranted. BLM has elected to use its CERCLA authority for the Site to determine if a release of hazardous substances has occurred or if potential exists for a release or threat of a release of CERCLA hazardous substances. In accordance with Section 300.415(b)(2)(i-viii) of the NCP, a removal action is selected when one of the following criteria is satisfied:

• Actual or potential exposure to nearby populations, animals or the food chain from hazardous substances, pollutants or contaminants:

There is a viable potential for exposure to metals by human (recreational and residential) and aquatic receptors. Soils at the Site contain mercury, antimony, arsenic, cadmium, copper, lead, molybdenum, selenium, silver, and zinc at concentrations significantly above background. Metal concentrations in surface water and sediment samples exceed criteria for ecological and recreational receptors.

• Actual or potential contamination of drinking water supplies or sensitive ecosystems:

Rattlesnake Creek is a tributary to the Don Pedro Reservoir . The Don Pedro Reservoir provides drinking water to the City of Modesto as well as the City of La Grange. The City of Modesto has a population of approximately 210,000. The City of La Grange has a population of approximately 70.

• Hazardous substances in drums, barrels, tanks or other bulk containers that may pose a threat of release:

There is no evidence of containers at the Site.

• High levels of hazardous substances, pollutants, or contaminants in soils largely at or near the surface that may migrate:

All soil samples collected at the Site were collected at ground surface. Soils are able to migrate from the former mill area as well as from tailings piles. Rattlesnake Creek begins at the bottom of the tailings piles located within the vicinity of the former mill area and it is possible that soils may migrate via the surface water pathway.

• Weather conditions that may promote migration of hazardous substances:

Surface water flow is likely to increase during high precipitation events. Tailings piles are located at the headwaters of Rattlesnake Creek.

• Threat of fire or explosion:

There is no known threat of fire or explosion.

• Availability of other appropriate Federal or State response mechanisms to respond to the release:

At the time of this RSE report, the BLM assumes the primary responsibility of responding to the release.

• Other situations or factors that may pose threats to public health, welfare or the environment:

In order to prevent ongoing releases of metals, measures should be taken to prevent further contamination migration off of the Site. In addition, metals in soils located at the former mill area and mine tailings at the Site poses a threat to wildlife as well as humans at nearby residences and during recreational use. Mine tailings with soils containing metals at concentrations significantly above background that are located to the east of the former mill area and are estimated at a volume of 6,700 cubic yards. Recreational use may occur at the Site. Several empty bottles were found on the Site during RSE sampling activities that occurred on May 1, 2010 and May 14, 2010. Potential remediation activities to reduce metal contamination in Rattlesnake Creek include surface water controls, waste consolidation and containment, and sediment excavation. This may include localized retention of sediment that has previously discharged from the Site and is now in the creeks. It is recommended that a non-time critical action be taken for the Site and that an Engineering Evaluation/Cost Analysis (EE/CA) be prepared to fully develop remedial action objectives, alternatives, and feasibility.

5.0 BASIS FOR REMOVAL ACTION

Metals in soils at the Site poses a threat to human health and ecological receptors. Ingestion of mercury-impacted fauna also poses a threat to human health and other ecological receptors. Sediment and soil at the Site contain mercury above soil screening concentrations for protection of potential ecological receptors. Potential impacts to human and ecological receptors due to exposure to mercury are described below, followed by a summary of removal action criteria from the NCP that are met at the Site.

5.1 Potential Human Impacts of Mercury Exposure

Exposure to high levels of metallic, inorganic, or organic mercury can permanently damage the brain, kidneys, and developing fetus. Mercury's harmful effects that may be passed from the mother to the fetus include brain damage, mental retardation, uncoordination, blindness, seizures, and inability to speak. Children poisoned by mercury may develop problems of their nervous and digestive systems, and kidney damage. Effects of exposure to mercury on brain functioning may result in irritability, shyness, tremors, changes in vision or hearing, and memory problems. Methyl mercury and metallic mercury vapors are more harmful than other forms, because mercury in these forms more readily reaches the brain. Short-term exposure to high levels of metallic mercury vapors may cause effects including lung damage, nausea, vomiting, diarrhea, increases in blood pressure or heart rate, skin rashes, and eye irritation (ATSDR 1999).

5.2 Potential Ecological Impacts of Mercury Exposure

In the environment, inorganic mercury can be methylated by microorganisms to produce methyl mercury. Methyl mercury will accumulate in the tissues of organisms. The animals at the top of the food chain tend to accumulate the most methyl mercury in their bodies. Any source of mercury release to the environment may, therefore, lead to increased levels of methyl mercury in tissues of large fish, reptiles, birds, and mammals. Mercury affects the reproduction and foraging ability of fish and is also neurotoxic to fish. Exposure to mercury can impair reproduction of birds, cause mortality of bird eggs, and is related to the impaired feeding ability of birds. Exposure effects of mammals to mercury are similar to effects in humans and include lethargy, tremors, convulsions, and mortality (ASTDR 1999).

5.3 NCP Removal Action Criteria

The potential risks to humans and ecological receptors described above document attainment of the following NCP removal action factors found at 40 Code of Federal Regulations (CFR) Section 300.415(b)(2):

- Actual or potential exposure to nearby human populations, animals, or the food chain from hazardous substances or pollutants or contaminants.
- Actual or potential contamination of drinking water supplies or sensitive ecosystems.
- High levels of hazardous substances or pollutants or contaminants in soils largely at or near the surface that may migrate.
- Weather conditions that may cause hazardous substances or pollutants to migrate or be released.

Based upon these four NCP factors, a removal action is necessary at the Site to prevent human and ecological exposure to high levels of metals, to prevent the continued migration of metals from the Site into Rattlesnake Creek, and to prevent accumulation of mercury in the food chain.

6.0 PRELIMINARY REMOVAL ACTION OBJECTIVES AND GOALS

This section of the RSE report identifies removal action objectives and associated clean up levels, statutory limits on removal, the removal action scope, and a preliminary removal action schedule. These objectives and goals will be finalized after the evaluation of applicable or relevant and appropriate requirements (ARAR) completed as part of the EE/CA.

Removal Action Objective: Removal action objectives are intended to remove the site conditions that create the NCP factors for a removal action. These factors are:

1) Actual or potential exposure to nearby human populations, animals, or the food chain from hazardous substances or pollutants or contaminants. Humans are exposed to high levels of metals when they disturb site soils or sediment in Rattlesnake Creek. Residences border the northern, eastern, and southern boundaries of the Site.

2) Actual or potential contamination of drinking water supplies or sensitive ecosystems. Sediment containing mercury is located at the Site. Rattlesnake Creek runs from the Site to the Don Pedro Reservoir, which provides drinking water to approximately 210,070 people, irrigation water, and serves as recreational fishing habitat. Surface water at the Site contains methyl-mercury. Sediment at the Site contains mercury at concentrations above the NOAA SQuiRTs Threshold Effects Level.

Based on these NCP removal action factors the following removal action objectives are identified for the Site:

1) Minimize the hazards associated with soils containing elevated concentrations of metals.

2) Prevent the release of metals from tailings and the former mill area to Rattlesnake Creek.

Attaining these objectives is expected to result in mitigation of NCP removal action factors, protection of human and ecological receptors, and protection of water quality at the Site. There are no known specific cleanup levels applicable to the Site. Therefore, the removal action will reduce the amount of metals including mercury and methyl mercury in soils and sediment available for transport, dissolution, volatilization, methylation, and bioaccumulation.

Statutory Limits on Removal Action. Statutory limitations on response are found at Section 104 of the CERCLA. Limitations at CERCLA Section 104(a)(3) prevent removal actions in response to a release or threat of release:

(A) Of naturally occurring substances in their unaltered form (or that have been altered solely through natural processes);

(B) From products which are part of the structure of and result in exposure within, residential buildings or business or community structures;

(C) Into public or private drinking water supplies due to deterioration of the system through ordinary use.

None of the preceding statutory limitations apply to the Site. Limitations at CERCLA Section 104(c)(1) prohibit expenditure of more than $2,000,000.00 or a removal duration of more than 12 months for Time Critical actions funded out of the Superfund account. This limit on funds and duration does not apply to removal actions at the Site because this action is not financed by the Superfund account. However, time limits are generally used to help determine Time Critical Removal Actions.

The NCP at Section 300.410(b)(3) provides for the completion of an EE/CA whenever a planning period of at least 6 months exists before on-site activities must be initiated. BLM intends to complete an EE/CA for removal actions at Site.

The NCP at Section 300.410(f) specifies that if the removal action does not fully address threats posed by the release, an orderly transition from removal to remedial response activities will be provided. BLM will provide for an orderly transition to remedial response if removal actions do not fully address threats posed by the release.

The NCP at Section 300.410(i) requires that Fund financed removal actions attain ARARs to the extent practicable and considering the exigencies of the situation. While this is not a Superfund financed action, this requirement is normally adhered to for removal actions completed under the NCP.

The NCP at Section 300.410(k) encourages provision for post-removal site controls for Superfund financed removal actions. The purpose of post-removal site controls includes actions necessary to ensure the effectiveness and integrity of the Time Critical removal action after completion, or after the $2,000,000 and 12 month limits are reached. While this is not a Superfund financed action, post removal site controls are normally applied after removal actions completed under the NCP

Removal Action Scope. The removal action is intended to address to remove threats to ecological receptors and humans from the mine tailings located at the Site. To effectively address mercury in sediment, the sources of mercury need to be removed or release mechanisms interrupted. The actual methods used to attain removal action objectives will be identified in an EE/CA.

Removal Action Schedule. A removal action schedule will be available pending the completion of an EE/CA, which is scheduled to be completed in 2012.

7.0 DATA GAPS AND AREAS OF ADDITIONAL INVESTIGATION

For the purpose of the Longfellow Mill RSE a data gap is information needed to assess whether a release to the environment has occurred at the Site as well as information required to delineate the source area. In addition, data that is required to quantify the volume of the source is discussed below.

Appropriate data was collected per EPA CERCLA requirements to document a release to soil. As discussed in Section 3.0, background samples were not collected for surface water and sediment samples. Based on soil sampling results, a source is present on-site. Metals were detected in the former mill area and several tailings piles at concentrations significantly above background. The tailings piles located in the vicinity of the former mill area are estimated at a volume of 6,700 cubic yards. This estimate is based upon global positioning system coordinates and is likely conservative as WESTON assumed that the tailings fully extend from the top to the bottom of the tailings piles. However, the tailings are located on a slope and in order to fully estimate the tailings piles, borings should be collected from the tailings piles that correctly distinguish tailings from native soil. A tailings pile to the west of the Site was found to have metal concentrations significantly above background. The tailings pile sampled to the west of the Site boundary that contains elevated metal concentrations is estimated at 1,100 cubic yard and is also located on a slope. The tailings piles to the west will also require borings to obtain a precise volume in the case that the BLM decides the tailings pile falls within the scope of a removal at the Site. Metals were detected at the highest concentrations in soils that lie at the burnt down mill area and below the former cyanide tanks. WESTON has not estimated the volume of soil at the former mill area. Soil samples collected were level with the ground or served as a foundation for the former mill. The removal of soils form the former mill area would require demolishing part or all of the former mill structures, which may have cultural value as discussed in Section 2.6.

Analytical results show mercury exceeds ecological risk criteria in sediment on-site. Further sampling is required to quantify sediment contamination at the Site and potentially downstream of the Site.

8.0 REFERENCES

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Appendix A

Site Photographs

Photo 1: Adit located at the Longfellow Mill site (Site). Sample location LM-SW/SD-1.

Photo 2: Sample Location LM-WB-1.

Photo 3: Sample location LM-SS-1. Disturbed area near adit with small broken quartz rock near sediment.

Photo 4: Sample location LM-SS-2.

Photo 5: View of former mill area from the large tailings pile to the east.

Photo 6: Sample location LM-SS-4.

Photo 7: One of the tailings pile to the west of Site boundary.

Photo 8: Former mill area.

Photo 9: Former mill area.

Photo 10: Soil at former mill area.

Photo 11: Rock wall and debris at former mill area.

Photo 12: Former cyanide tanks. Metal debris is located outside of the fenced former mill area.

Photo 13: Sample location LM-SS-7 at cyanide tank area.

Photo 14: Cyanide tank area.

Photo 15: Big Oak Flat Little League field.

Photo 16: Sample location LM-SS-8.

Photo 17: View of Site from Big Oak Flat Little League field (southeast corner of Site).

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Photo 18: Sample location LM-SS-10.

Photo 19: Sample location LM-SS-BG1.

Photo 20: Sample location LM-SS-11. Small tailings piles area.