PRELIMINARY ASSESSMENT REPORT
York & Rannells Mine Site
Malheur National Forest, Grant County, Oregon

March 2001

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Site Location:
York & Rannells Mine
FS Road 667
Malheur National Forest
Grant County, Oregon

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EXECUTIVE SUMMARY

Cascade Earth Sciences was retained by the USDA, Forest Service, Malheur National Forest (MNF) to perform a Preliminary Assessment (PA) with limited sampling at the York & Rannells Mine (the Site). The Site is a historic mercury mining site in Grant County, Oregon (NE¼, SW¼ Section 7 of Township 16 south, Range 29 east, 44°11'49" latitude and 119°17'14" longitude). The PA included limited sampling and analysis of several soil, and waste samples from the Site and vicinity.

The objective of the PA at the York & Rannells Mine was to collect sufficient information about the Site, and historical operations associated with the Site, for use by the Oregon Department of Environmental Quality (ODEQ) in completing a hazard ranking of the Site. The information was collected in general accordance with U.S. Environmental Protection Agency *Comprehensive Environmental Response, Compensation, and Liability Act*[1] protocols and documentation requirements for preliminary site assessments involving hazardous substances.

Mercury was mined as cinnabar, a mercury sulfide (HgS) mineral. The ore was processed using a retort, which was constructed in the mid to late 1960s. The retort process involved crushing, heating, and vaporizing the ore and collecting the mercury from a condensation tray. According to records, total production was 21 pounds of mercury[2]. In the 1950s ore from this mine was processed at the Roba Westfall Mine located approximately 2 miles to the north.

Several soil and waste samples were collected from the Site and analyzed for metals. Mercury and arsenic are the only metals in these samples that clearly exceed the relevant regulatory levels. The concentration of mercury in soil ranges from 1 to 5,500 mg/kg. Arsenic ranges from 3.1 to 94.5 mg/kg.

A Potential Hazardous Waste Site Preliminary Assessment Form for the York & Rannells Mine is attached (Appendix A) and the information pertinent to the form is summarized in Section 9.0 of this report.

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[1]*Comprehensive Environmental Response, Compensation and Liability Act*, as amended.
[2]Brooks, H.C., 1963. Quicksilver in Oregon. Bulletin 55. Oregon Dept. of Geology and Mineral Industries.

1.0 INTRODUCTION

Cascade Earth Sciences (CES), was retained by the U.S. Forest Service (USFS), Malheur National Forest (MNF) on September 6, 2000 to perform a Preliminary Assessment (PA) with limited sampling of the York & Rannells Mine (the Site or the Mine) in Grant County, Oregon. The Mine is a historic mercury mining site. Charlie Kurtz, P.E., of the Ochoco National Forest is coordinating the PA project. The investigation followed the U.S. Environmental Protection Agency (EPA) publication, *Guidance for Performing Preliminary Assessments Under CERCLA* (EPA, 1991). The PA included limited sampling and analysis of several soil and waste samples from the Site and vicinity.

This investigation was performed under USFS Contract Number 53-04HI-5-7740 and following the Work Plan developed by CES and approved by the USFS on October 13, 2000 (CES, 2000). The Work Plan was developed based on a preliminary site reconnaissance conducted by USFS personnel on August 5, 1996 and CES personnel on June 28, 2000.

2.0 OBJECTIVE AND SCOPE

The objective of the PA at the York & Rannells Mine was to collect sufficient information to determine the "presence or absence" of human health and/or environmental hazards at the Site and to determine whether further environmental actions at the Site are warranted. This information, including historical operations associated with the Site, will be used by the Oregon Department of Environmental Quality (ODEQ) in completing a hazard ranking evaluation of the Site. The information was collected in general accordance with *Comprehensive Environmental Response Compensation and Liability Act* (CERCLA) protocols and documentation requirements for preliminary site assessments involving hazardous substances. This PA is not designed to determine the lateral and vertical extent or all locations and types of environmental hazards at the Site.

The scope of work for the project was based on the information requirements of the PA and the Work Plan (CES, 2000). Project activities were divided into a series of tasks associated with the PA and included the following:

- Preliminary Assessment:
  - Conduct a historical site review to determine past site activities and processes that are potential sources of contamination
  - Review currently available regulatory agency records relating to the property and vicinity to identify documented releases of chemicals and determine past operating practices in handling hazardous substances and wastes related to site operations
- Site Reconnaissance and Sampling:
  - Conduct a reconnaissance of the Site to identify potential areas of concern related to past practices or current conditions

- Collect preliminary samples from areas identified as potential areas of concern, and analyze samples for potential contaminants of concern

- Reporting:
  - Prepare a descriptive report of the findings of the preliminary assessment, reconnaissance and sampling activities

  - Complete a Potential Hazardous Waste Site Preliminary Assessment Form (Appendix A).

3.0 SITE DESCRIPTION

This section gives a specific description of the Site as well as a general description of the region; including location, climate, geology, and hydrogeology. Photographs of the Site are included in Appendix B and are referenced throughout the text.

3.1 Site Location and Description

The York & Rannells Mine is located at the end of Forest Service Road 667 in the northeast ¼ of the southwest ¼ of Section 7, Township 16 south, Range 29 east of the Willamette Meridian (Figure 1). The Site is in Grant County approximately 23 miles southwest of John Day, Oregon. To reach the Site, travel 17 miles south from John Day on U.S. Highway 395 to the intersection with Forest Service Road 63 (FS 63). Turn right onto FS 63 and head west approximately 10 miles to the intersection with FS 24. Turn right onto a gravel road and head north approximately 6 miles (at 3 miles the road turns to the west) to the intersection of FS 24 and FS 667. Turn left onto FS 667 and drive south approximately 2 miles. The Mine is at the end of FS 667.

The Site encompasses an area of approximately 5.5 acres on National Forest System Land (NFSL) within the Malheur National Forest on the Bear Valley Ranger District. The Site is located at an approximate elevation of 5,640 feet above mean sea level. The site is moderately vegetated with large pines, brushes, and grasses. Several structures are present at the Site.

Beginning at the top of the Site, a collapsed and bulldozed vertical mineshaft (Photograph 1) is present with a loading dock nearby (Photographs 2 and 3). Two bench access roads (Photograph 4), referenced herein as the upper and lower roads, are located below the mineshaft to the south. A coarse ore bin (Photograph 5) is present on the lower bench road and a fine ore bin (Photograph 6) is present below the road. Immediately below the crushed ore hopper is the exhaust hood, rotary furnace, and firing hood (Photograph 7). Immediately to the west of the fine ore bin is the dust collector (Photograph 6) and condenser tubes and tray (Photograph 7). At the end of the rotary furnace is the burnt ore bin, calcine soaking pit, and calcine scrapper (Photograph 8). An ore pile is located between the upper and lower bench roads (Photograph 9). Some small waste piles with vegetative cover are located west of the rotary furnace (Photograph 4). Wooden stairs are present leading from the crushed ore hopper to the lower bench road (Photographs 4 and 6). A wooden cabin is located approximately 100 yards to the east (Photograph 10).

The Site is situated above and between a few unnamed tributaries of the North Fork Deer Creek. According to the USGS topographic map, Flagtail Mountain (USGS, 1990), springs and groundwater seeps appear to be the primary source for the surface water drainage features in the area. The nearest body of water to the Site on the USGS map is an unnamed tributary located ¼ mile north and downslope from the Site. During a visit by CES in June 2000, another unnamed creek, $^{1}/_{8}$-mile south and downslope of the Site, was observed to be flowing at approximately 1 to 2 ft^3/s. No other surface water drainage or water storage features were observed at the Site.

3.2 Public Use of Site and Vicinity

Public use of the Site and vicinity is most likely minimal, although public access roads are maintained near the Site. Access is currently not restricted by either fencing or posted notifications. Public access is generally limited to recreational activities such as hunting, rock collecting or firewood cutting. Timber harvesting is not extensive in the immediate area though extensive roads provide access to the area.

3.3 Climate

No climatic data is available for the immediate Site, but the town nearest to the Site, Seneca, Oregon, receives approximately 13.2 inches of precipitation and 57.8 inches of snowfall annually, with approximately 70% of precipitation occurring between November and May (WRCC, 2000). Precipitation at the Site, which is located in the forested mountain terrain and at a higher elevation, is probably somewhat higher than for Seneca. The climate is characterized by cold winters with heavy snows, and hot dry summers. Deep snowpack accumulates in the winter. The average annual air temperature in Seneca is 40°F with daily temperatures averaging 57°F for the summer months and 32°F for the winter months (WRCC, 2000).

3.4 Geology

The Site is situated within the Blue Mountain physiographic providence in northeast Oregon. The providence is typified by mountains, ice-sculpted mountain peaks, deep canyons, and broad valleys to the east and wide uplifted plateaus to the west. The providence is a cluster of smaller ranges of various origins and relief (Orr, et al., 1992). The site is near the continental suture with accreted clusters of land masses of Permian, Triassic, and Jurassic age rocks along the late Mesozoic shoreline, which once laid across eastern Washington and Idaho. Metamorphism, volcanic activity, and intrusions joined these exotic terranes to the North American continent. The geologic block terrane, which encompasses the Site, is known as the Izee Terrane, an assemblage of Upper Triassic age layered rocks from an ancient basin between an oceanic subduction trench and volcanic islands. Rocks grouped in this terrane are limestone, mudstone, silt, and sandstone deposited in distinct shallow marine environments. In many places the rocks occur as islands surrounded by Tertiary lavas and pyroclastics (Brooks, 1963). The pre-Tertiary and Tertiary rocks are warped by large broad folds and major faults are common. Intense folding and thrust events along with intrusions of Cretaceous granitic rocks resulting in metamorphism of marine sediments, greenstones, and basic intrusives has greatly complicated the geologic interpretation of the area (Brooks, 1963).

The mercury deposit at this site occurs in the pre-Tertiary graywackes and shales mapped as Upper Triassic age (Brooks, 1963). Bedding planes of the formations strike a few degrees east of north and dip 45^o to 65^o east. Rocks in this vicinity are cut by small faults and shear zones of diverse trend, although most lie along the bedding plane (Brooks, 1963). Cinnabar occurs as disseminations in narrow gouge-filled fractures and as thin films along fractures and bedding planes. The deposit in the area is aligned in a north-south direction for approximately 1,000 feet.

The mineshaft at the York & Rannells Mine was sunk on one of the better showings and the majority of ore extracted was from above the 25-foot level. Below the 25-foot level the intensity of fracturing, oxidation, and cinnabar mineralization decreased (Brooks, 1963). A shaft at the 60-foot level was also worked, but was reported as almost barren of cinnabar.

3.5 Surface Hydrology and Water Quality

An assessment of the nearby bodies of water located immediately downslope from the Site was investigated. During the site visit in the fall 2000, no surface water was present. Approximately 100 feet to the south was a small unnamed/unmapped 2-foot-wide and 6-inch-deep dry channel, which appeared to transmit water during wetter times of the year. The ground in the area was soggy, indicating that the soil was saturated and may have contained groundwater. No other surface water or springs were noted near the Site.

The unnamed intermittent creek to the north was also dry during the site visit. This creek is farther from the Site (at least ¼ mile downslope) and it is assumed that it could only be impacted by activities from the mineshaft and ore loading. A National Wetland Inventory prepared by the United State Fish and Wildlife Service (USF&WS) identified the creek as palustrine (or marsh), scrub-shrub, and seasonally flooded (USF&WS, 1995). The two springs located near the head of the creek are classified as palustrine, scrub-shrub, and saturated.

Deer Creek, located approximately 1 to 2 miles north and down slope from the Site, is a perennial surface water body with many adjoining wetland features with respective wetland classifications.

Locations of the unnamed/unmapped intermittent creek downslope from the mill portion of the Site, the unnamed intermittent creek to the north of the Mine, and Deer Creek are shown on Figures 1 and 2.

3.6 Hydrogeology

Little is known about the hydrogeology of the area. Based on observations, it appears that a thin veneer of soil is present over the bedrock of the area. Soil probably thickens in the draws and bases of the canyons. Based on the soggy ground downslope from the former mill, it is likely that groundwater may be present in the colluvial sediment over the bedrock during wetter months of the year. The relationship of intermittent groundwater with deeper aquifers in the bedrock below, if any, can not be determined. It is expected that the numerous fractures and faults in the area are likely to be water bearing.

3.7 Local Water Use

Based on records with the Oregon Water Resources Department, no registered water wells are located within 1 mile of the Site. Furthermore, no permanent residences are located within 4 miles of the Site (USFS, 2001). Beneficial water use of the area is likely to be solely to provide seasonal flow to Deer Creek and recharge to the regional aquifer.

3.8 Endangered and Threatened Species

The Oregon Department of Fish & Wildlife (ODF&W) was contacted and they indicated that while there are Preble's shrew and goshawks in the vicinity, they are not of concern for the Site (ODF&W, 2001). The shrew was recently delisted and the nearest documented goshawk nest is a mile away. Mid-Columbia steelhead, which is a threatened species, do run up North Fork Deer Creek, which is located 1.2 miles from the Site. They do not run up the unnamed/unmapped intermittent creek between North Fork Deer Creek and the Site (ODF&W, 2001). Due to the absence of steelhead in the unnamed/unmapped intermittent creek and the distance from the Site, impacts to this threatened species are unlikely. No other endangered or threatened species are known to exist at the Mine.

A biological evaluation conducted by the USFS for a timber sale in the Deer Creek Watershed, which includes the vicinity of the Site, identified seven endangered and threatened species (USFS, 1999). The listed endangered species is the American Peregrine Falcon. Species considered threatened are the Northern Bald Eagle, Summer Run Steelhead, Fall Chinook Salmon, and Columbia River Basin Bull Trout. Sensitive species are the California Wolverine, Preble's Shrew, Townsend's Big-eared Bat, Spring Chinook Salmon, and Interior Redband Trout, Westslope Cutthroat Trout, Blue Mountain Caddisfly, Sierra Onion, Washington Monkey Flower, and Least Phacelia. Although there are a number of threatened and endangered species in the watershed, the ODF&W wildlife biologist stated that none exist at the Site (ODF&W, 2001).

3.9 Sensitive Environments

The biological evaluation conducted for the Deer Creek Watershed indicated the Mid-Columbia River and Snake River as Essentially Significant Units (USFS, 1999). An Evolutionary Significant Unit (ESU) listing means the total geographic area in which the fish are listed. Surface water flow originating from the Site could reach a tributary of the Columbia River, but not tributaries of the Snake River. Because the Site is at distance from the nearest tributary to the Columbia River, impact to this sensitive environment is unlikely.

The ODF&W indicated that Deer Creek is designated a critical habitat by the National Marine Fisheries Service, due to the threatened mid-Columbia steelhead. Any in-stream work on Deer Creek or potential impacts to water quality of this creek would need to be addressed with the ODF&W. No other sensitive environments are known to exist near the Site.

4.0 MERCURY IN THE ENVIRONMENT

The following information is summarized from Steinnes (1990) unless specifically noted.

Mercury is among the most toxic elements to man and many higher animals, and all chemical compounds of mercury are toxic to humans. Depending on the geochemical conditions, mercury may occur in three different valency states (Hg^0, Hg_2^{2+}, and Hg^{2+}). Mercury salts show a high acute toxicity with a variety of symptoms and damages. Some organomercurials, particularly alkyl mercury compounds, are considered even more hazardous to humans because of their high chronic toxicity with respect to various, largely irreversible, defects of the nervous system.

Chloride concentration, sulfide concentration and pH are key parameters in determining the speciation found in soils. In addition to chemical reactions, transformation into methyl mercury may be mediated by microbial activity. Methyl mercury is the dominant toxic mercury species in the environment. Under naturally occurring conditions of pH and temperature in an aqueous environment, mercury in any form (organic or inorganic) has been shown to be readily converted into methyl mercury through a combination of microbially catalyzed and chemical equilibrium systems (EPA, 1976).

The primary fate of elemental mercury in the environment is thought to be adsorption onto the surfaces of particulate phases, followed by a settling into bed sediment. To a lesser degree, dissolved mercury is ingested by aquatic biota and transported by water movement. Hg^0 is also volatile, and high concentrations of Hg^0 are frequently observed in the air in the vicinity of mercury-bearing ores. Mercury is not generally available for plant uptake but will tend to accumulate in the roots.

Cinnabar is relatively resistant to the normal processes of oxidation and weathering and is extremely insoluble in water. Therefore, mercury enters the geochemical cycle from cinnabar mainly in the form of mechanically degraded particulate material. The release of mercury gas is a more important source of mercury in the geochemical cycle. Mercury is strongly fixed (adsorbed) in soils and its removal by leaching is not significant in most cases when the soil pH is greater than 4. The background concentration of mercury in surface soils in the western United States ranges from 0.01 to 4.6 mg/kg.

5.0 SITE HISTORY

5.1 Mercury Mining in Oregon

The following background information is summarized from Brooks (1963) unless specifically noted. This information is provided to help the reader understand typical mercury mining practices in the region.

5.1.1 Ore Distribution

Mercury ore (quicksilver) deposits are widely distributed in Oregon, but areas of high productivity are found in the southwest, southeast and north-central portions of the state. Cinnabar, the red mercuric sulfide (HgS), is the only mercury-bearing mineral of commercial significance in Oregon, though several other mercury-bearing minerals have been recognized in Oregon. Pure cinnabar contains 86 percent mercury and 14 percent sulfur. It can be identified by its vermilion red color, hardness (2.5), and high specific gravity (8.10). It crystallizes in hexagonal crystals; however,
well-formed crystals of appreciable size are rare.

Mercury deposits are associated with ascending hydrothermal solutions related to subsurface magma bodies. The deposition of cinnabar is thought to take place in alkaline environments, such as Tertiary and Quaternary age volcanic rocks. Mercury-bearing minerals form near the surface, and most of the world's mercury has come from depths of less than 1,000 feet. Oregon's deposits conform to this. Some ore bodies have yielded little or no ore from depths greater than 100 feet. Mercury deposits are formed at lower temperatures and pressures than the majority of most other metals formed from residual magmatic solutions. This accounts for the small amount of metallic minerals other than cinnabar in mercury deposits.

Mercury is a silver-white, mobile, highly conductive, liquid metal at room temperature, solidifying to a malleable solid at -38.8°C, beginning to vaporize at 356.7°C, and boiling at 580°C. It has a specific gravity of 13.6 at 0°C and is slightly volatile at ordinary temperatures. Its solubility in water at 25°C is 0.28 µmole/liter. Mercury forms alloys (amalgams) with most metals except iron.

5.1.2 Mercury Production

Mercury production is measured by the number of flasks produced; each flask contains 76 pounds of mercury. Most of the mercury that enters the market is about 99.9 percent pure. The production of mercury from Oregon mines through 1970 was approximately 108,000 flasks (Brooks, 1971). Five mines in Douglas, Lane, Jefferson, and Malheur counties produced approximately 103,500 flasks. The five mines are the only mines within the state that produced more than 1,000 flasks. More than 60 other mines in the state have produced between 1 and 1,000 flasks.

Mercury was first discovered in Oregon about 1852 in Jackson County, but the first record of production was 50 flasks in 1882 from the mines in Douglas County. Mercury production in Oregon reached its peak during the early 1940's. This peak and other smaller peaks that followed were all triggered by the demand for strategic metals during periods of war and conflict (Brooks, 1963). From 1936 through 1944, Oregon ranked second only to California in annual production. As of 1963, the reserves minable under the economic conditions have been virtually exhausted; however, should the economic climate become favorable, Oregon could produce substantial amounts of mercury.

5.1.3 Ore Extraction and Processing

Mines may be either open pit or subsurface mines. The relatively shallow nature of most cinnabar deposits lends itself to open pit mining.

The production of metallic mercury, the end product of cinnabar mining operations, is a relatively straight-forward process that involves a series of steps beginning with the removal of ore from the mine and ending with the condensation of mercury vapors (Figure 3). The initial steps in ore processing include crushing and screening to optimize the size of the material and to increase recovery of mercury during furnacing. Mercury ore was roasted at temperatures above the boiling point of mercury (580°C) in a rotary kiln furnace to transform the mercury into a vapor. The furnaces were generally fired with fuel oil. During furnacing, other gases and dust accompanied mercury vapors emitted from the ore. Dust was removed by a collector system prior to condensation of the vapors. The general steps involved with condensing included drawing the gases through a cyclone dust collector, then through a series of vertical condenser pipes or chambers, joined alternately at the top and bottom with U-shaped connections. The lower U connections had openings from which mercury, along with some dust and soot (commonly called mud), was collected in water filled pans. The mud was then mixed with lime, which caused the mercury particles to coalesce. The liquid mercury was then collected, filtered, and placed into flasks.

Other gases were scrubbed using water and discharged into the atmosphere. One byproduct of this process was sulfuric acid. The amount of acid generated varied with the sulfur content of the ore. Calcines (burnt ore) were discharged from the bottom of the furnaces into calcined ore bins. Furnace dumps (or burnt ore piles) would have been associated with each mill location. Figure 3 illustrates the general layout of a rotary furnace.

5.2 Mining at the York & Rannells Mine

The information presented in this section is summarized from Brooks (1963) unless specifically noted. The initial mercury claim at this Site was discovered in the 1940s by Cecil Rannells and Homer York, and is also known as the Broadway Prospects. Brooks' reference lists 2,000 pounds of ore produced from Broadway Prospect, all sent to the Roba Westfall Mine (approximately 2 miles to the north) to generate 21 pounds of mercury in the late 1950s. In the 1960s, the claim was leased to Reeves and Farrin of Prineville, Oregon. Reeves and Farrin set up the retort, of which some of the portions remain today. The method of metal extraction employed at the Site was a retort process, which consists of crushing and vaporizing the ore and collecting the mercury from a condensation tray (refer to Section 5.1.3). Construction on the retort was in progress in 1965 and was finished by 1968 although there are no references that address production from the York facility. The retort was then moved onto the Site from an inactive mine in the Prineville area. Photograph 11, taken in the early 1970's, shows the mill layout before if fell into disrepair and was stripped by vandals (USFS, 2001).

6.0 ENVIRONMENTAL AGENCY RECORDS REVIEW

Recent EPA and ODEQ environmental lists were reviewed to help identify recognized environmental conditions in connection with the Site. For this review, primary records were obtained from Environmental Data Resources (EDR, 2000). The approximate minimum required search distance (MSD) for the Site vicinity is noted under each database listed below with target property (TP) representing the Site itself. The list date for each record is behind the name in parentheses. The EDR report and supporting documentation is included in Appendix C. A summary of the database information and regulatory records review is included in the following sections.

6.1.1 Federal Database Information

NPL (current as of 6/13/00) (MSD=1.0 mile)

The National Priorities List (NPL) is the EPA's database of uncontrolled or abandoned hazardous waste sites identified for priority remedial action under the Superfund Program (CERCLA – *Comprehensive Environmental Response, Compensation, and Liability Act*). To be included on the NPL, a site must either meet or surpass a predetermined Hazard Ranking System score, be chosen as a state's top-priority site, or meet all three of the following criteria: (1) the U.S. Department of Health and Human Services issues a health advisory recommending that people be removed from the site to avoid exposure; (2) the EPA determines that the site represents a significant threat; and (3) the EPA determines that remedial action is more cost-effective than removal action. Review of the NPL database did not reveal any hazardous waste sites within a 1.0-mile radius of the Site.

Delisted NPL (current as of 6/13/00) (MSD=1.0 mile)

The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) establishes the criteria that the EPA uses to delete sites from the NPL. In accordance with 40 CFR 300.425(e), sites may be deleted from the NPL where no further response is appropriate. Review of the Delisted NPL List did not identify any facilities within a 1.0-mile radius of the Site.

CERCLIS List (current as of 4/16/00) (MSD=0.5 mile)

The Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) list is a compilation by the EPA of sites that the EPA has investigated or is currently investigating for a release or threatened release of hazardous substances pursuant to the 1980 Superfund Act. The CERCLIS database did not list any release sites within a 0.5-mile radius of the Site.

CERC-NFRAP (current as of 4/16/00) (MSD=0.25 mile)

The Comprehensive Environmental Response, Compensation, and Liability Information System – No Further Remedial Action Planned (CERC-NFRAP) list is a compilation by the EPA of sites where no contamination was found, was removed quickly or was not serious enough to require Superfund Action or NPL consideration. Review of the database did not identify any facilities within a 0.25-mile radius of the Site.

CORRACTS Report (current as of 4/20/00) (MSD=1.0 mile)

The EPA's Corrective Action Report (CORRACTS) identifies hazardous waste handlers with RCRA corrective action activities. Review of the database did not reveal any CORRACTS facilities within a 1.0-mile radius of the Site.

RCRIS - TSD Facilities (current as of 6/21/00) (MSD=0.5 mile)

The EPA's Resource Conservation and Recovery Information System (RCRIS) provides selective information on sites that generate, transport, store, or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act of 1976 (RCRA). The TSD Facilities database is a compilation by EPA of reporting facilities that treat, store, or dispose of hazardous waste. Review of the database did not reveal any TSD facilities within a 0.5-mile radius of the Site.

ERNS Database (current as of 8/8/00) (MSD=TP)

The Emergency Response Notification System (ERNS) database contains more than 25,000-spill records and stores information on reported releases of oil and hazardous substances. The database is compiled from reports made to federal authorities, including the EPA, the U.S. Coast Guard, the National Response Center, and the Department of Transportation. A search of the database did not reveal any reported releases at the Site.

CONSENT (date of version not available) (MSD=1 mile)

The EPA's Superfund (CERCLA) Consent Decrees lists major legal settlements that establish responsibility and standards for cleanup at NPL sites. A search of the CONSENT database (no date listed) did not reveal any records within 1.0-mile of the Site.

ROD (current as of 1/31/99) (MSD=1.0 mile)

The Record of Decision (ROD) documents mandates a permanent remedy at an NPL site containing technical and health information to aid in the cleanup. A search of the ROD database did not reveal any record for facilities within 1.0-mile of the Site.

FINDS (current as of 10/13/99) (MSD=TP)

The Facility Index System (FINDS) is a cross-reference compilation of properties and facilities that the EPA has investigated, reviewed, or been made aware of in connection with its various regulatory programs. FINDS provides cursory facility information and references other sources/databases that contain more detailed information for that listing. A search of the FINDS database did not reveal any records for the Site.

HMIRS (current as of 6/30/99) (MSD=TP)

The Hazardous Materials Information Reporting System (HMIRS) contains hazardous material spill incidents reported to the Department of Transportation. A search of the HMIRS database did not reveal any records for the Site.

MLTS (current as of 4/23/00) (MSD=TP)

The Material Licensing Tracking System (MLTS) is maintained by the Nuclear Regulatory Commission (NRC) and contains a list of approximately 8,100 sites that posses or use radioactive materials that are subject to NRC licensing requirements. A search of the MLTS database did not reveal any records for the Site.

MINES (current as of 8/1/98) (MSD=1.0 mile)

The Mines Master Index File (MINES) identifies mines that were listed as active or open since 1971. Review of the MINES database did not identify any facilities within a 1.0-mile radius of the Site.

NPL Liens Database (current as of 10/15/91) (MSD=TP)

The National Priorities List (NPL) Liens database is a compilation of liens filed by the EPA against real property in order to recover remedial action expenditures or when the property owner receives notification of potential liability. A search of the NPL Liens database did not reveal any records for the Site.

PADS (current as of 1/1/00) (MSD=TP)

The PCB Activity Database System (PADS) identifies generators, transporters, commercial storers and/or brokers and disposers of polychlorinated biphenyl’s (PCB's) who are required to notify the EPA of such activities. A search of the PADS database did not reveal any records for the Site.

RAATS (current as of 4/17/95) (MSD=TP)

The RCRA Administrative Actions Tracking System (RAATS) tracks and records RCRA Section 3008 Compliance Orders and Orders on Consent for the Office of Waste Programs Enforcement (EPA). A search of the RAATS database did not reveal any records for the Site.

TRIS (current as of 12/31/97) (MSD=TP)

The Toxic Chemical Release Inventory System (TRIS) identifies facilities that release toxic chemicals to the air, water and land in reportable quantities under the Superfund Amendment and Reauthorization Act, Title III Section 313. A search of the TRIS database did not reveal any records for the Site.

TSCA List (current as of 12/31/98) (MSD=TP)

The Toxic Substance Control Act (TSCA) list identifies manufacturers and importers of chemical substances included on the TSCA Chemical Substance Inventory. It includes data on production volume of these substances by plant site. A search of the TSCA database did not reveal any records for the Site.

6.1.2 State Database Information

<u>ECSI System (current as of 8/16/00)</u> (MSD=1.0 mile)

The Environmental Cleanup Site Information System (ECSI) records information about sites in Oregon that may be of environmental interest. The database is maintained by the DEQ and contains sites considered to be actually or potentially contaminated and presenting a possible threat to human health and the environment. These sites are generally listed by the state to warn the public or as a part of an investigation and cleanup program managed by the state. The ECSI list did not identify any facilities within a 1.0-mile radius of the Site.

<u>Solid Waste Facilities List (current as of 7/1/00)</u> (MSD=0.5 mile)

The Solid Waste Facilities List typically contains an inventory of solid waste disposal facilities or landfills in a particular state. Depending on the state, these may be active or inactive facilities or open dumps that failed to meet RCRA subtitle D Section 4004 criteria for solid waste landfills or disposal sites. Review of the solid waste facility database did not identify any facilities within a 0.5-mile radius of the Site.

<u>LUST List (current as of 3/20/00)</u> (MSD=0.5 mile)

The Leaking Underground Storage Tank (LUST) list is a collection of known or suspected releases of petroleum products from underground storage tanks. The LUST database did not identify any facilities within a 0.5-mile radius of the Site.

<u>Registered Underground Storage Tank List (current as of 6/1/00)</u> (MSD=0.25 mile)

The Registered Underground Storage Tank (UST) list is a compilation of underground storage tanks registered with the DEQ. The UST database did not identify any facilities within a 0.25-mile radius of the Site.

<u>Spills (current as of 5/31/00)</u> (MSD=TP)

The DEQ maintains a database of reported spill sites that includes facilities with a confirmed release that the DEQ has determined to require further investigation, removal, remedial action, or related long-term environmental or institutional controls. Again, the spill database provides detailed release characteristics and is organized based on the cleanup status. Review of the spill database did not identify any facilities in the vicinity of the Site.

<u>CRL (current as of 6/21/00)</u> (MSD=1.0 mile)

The Confirmed Release List (CRL) is a compilation maintained by the DEQ of ECSI facilities with confirmed releases. The CRL provides detailed information of confirmed release characteristics and is organized based on the status of the cleanup. Review of the CRL database did not identify any facilities located within a 1.0-mile radius of the Site.

VCS Program (current as of 8/2/00) (MSD=0.5 mile)

The DEQ maintains a database of facilities that have entered into the state sponsored voluntary cleanup program (VCS) for the remediation of confirmed spill sites. A review of the VCS database did not identify any facilities within 0.5-mile of the Site.

Hazmat Incident Listing (current as of 3/27/00) (MSD=TP)

The Hazmat Incident Listing is a comprehensive inventory of all hazmat responses reported to the Oregon Office of State Fire Marshal. The listing did not identify any entries within the vicinity of the Site.

HSIS (current as of 3/27/00) (MSD=TP)

The State Fire Marshal's Office list of companies in Oregon submitting the Hazardous Substance Information Survey (HSIS) and either reporting or not reporting hazardous substances. A review of the HSIS database did not reveal any facility names in the vicinity of the Site.

6.1.3 Unmappable Facilities

Unmappable facilities are facilities that present some level of environmental risk that cannot be geocoded but can be located by zip code or city name. The EDR report identified the following seven unmappable facilities for the area:

Orphan Site	Location
Dry Creek Oil Spill	10S/33E/S24
Anderson's Chevron Diesel Spill	Hwy 26 Milepost 182.5
Crane Prairie Work Center	Crane Prairie – Malheur National Forest
Valley Sanitation	Section 20 Township 13S Range 31E
Retherford's	Section 21 Township 13S Range 31E
Canyon City	Section 36 Township 13S Range 31E
Seneca Landfill	P.O. Box 208 97873

Based on a cursory review of County maps and discussions with the USFS, none of the facilities were in the vicinity of the Site.

6.1.4 Additional Regulatory Inquiries

Former Manufactured Gas (Coal Gas) Sites (date of version not available) (MSD=1.0 mile)

EDR maintains a proprietary database for coal gas sites. Review of the database did not identify any facilities within 1.0-mile radius of the Site.

7.0 SITE RECONNAISSANCE

The purpose of the site reconnaissance was threefold. First, it was conducted to determine whether or not a release of a hazardous substance(s) to the environment is occurring or has occurred at the Site. Second, it was to make a preliminary determination whether or not the Site poses an imminent or substantial threat to human health and the environment. Third, the site reconnaissance was performed to provide sufficient information so that the ODEQ can perform a preliminary scoring of the Site using the hazard ranking system (HRS) criteria.

The reconnaissance included a complete walkover of the mine and processing facility at the York & Rannells Mine. It also included a limited amount of sampling at several areas of potential concern. The sampling was not intended to characterize both the vertical and horizontal extent of contamination at the Site.

7.1 Mine Site Reconnaissance

On October 24 and 25, 2000, CES performed a reconnaissance of the Mine, including the mine shaft area and the ore processing area (Figure 2). CES also walked through the forest surrounding the mine site for evidence of waste disposal or other mining activities. The following observations were recorded during that visit.

The area of the former mineshaft is located at the top of the high point in the area. The crest of the hill is sparsely forested with numerous bedrock outcroppings. According to USFS information, the mineshaft was bulldozed in a number of years ago. Soil and rocks from around the former mine shaft were used to fill in the opening. Mounds of overburden rock and ore piles surround the area. Older workings are covered with vegetation. To the northeast of the former mine shaft, a wooden loading dock and road leading to the mill area still exist.

To the southwest of the mineshaft and downslope, bedrock outcrops in numerous places. The slope is moderately forested with sparse undergrowth. Large depressions, overgrown by small pines and shrubs, are present. Presumably these are test holes dug with a bulldozer in search of other cinnabar ore deposits.

The mill area still contains a number of pieces of equipment used to process the ore, although vandals have removed many of the smaller parts from the Site. The remaining equipment, most of which has rusted and fallen over, includes a coarse ore hopper, fine ore bin, exhaust hood assembly, rotary furnace, firing hood assembly, burnt ore bin, dust collector and fan, and some condenser tubes and collection tray (Photographs 5 to 8). Because the equipment is large, much of it remains in approximately the same position as when in operation (Figure 2). Some stairs made from railroad ties remain in the ground along where the ore delivery system and crushing system was set on the hillside (Photograph 7). An ore pile was observed on the upper bench road (Photograph 9, Figure 2). The actual point of crushing could not be determined based on the remains, although it is presumed to be in the vicinity of the lower bench road (Photograph 4). The mill processing equipment is set on level ground at the base of the hillside. Near the end of the calcine (burnt ore) soaking pit (Photograph 8), the flat land extends approximately 50 feet and then drops sharply onto a small meadow (Photograph 4). Vegetation was not growing on the face of the small escarpment and it appeared that the flat land extending out from the end of the calcine-soaking pit is comprised of burnt ore waste tailings (Photograph 4).

A small wooden cabin is located approximately ¼ mile to the east (Photograph 10). It did not appear that any ore or processing type activity occurred in this area. There was no evidence of a water supply well at the cabin. Except for the meadow, the area surrounding the former mill and cabin is moderately forested with pines and sparse undergrowth.

No surface water was observed within ¼ mile of the Site. A small dry channel was evident south and downslope of the mill area. It is possible that at wetter times of the year it may transmit water.

8.0 SAMPLE COLLECTION AND ANALYSIS

As part of the PA, a total of 13 soil and waste samples were collected an analyzed to further evaluate the potential for impact to the Site. The samples collected for this project were grab samples from several potential areas of concern. The samples were collected and analyzed according to the protocols established in the Work Plan prepared by CES and submitted to the USFS on October 13, 2000.

8.1 Methods and Protocols

8.1.1 Sample Collection

Initially, sampling activities began with a reconnaissance to verify that planned sample locations were appropriate and accessible. Based on the reconnaissance, the following modifications were made to the sampling locations:

- Sample YR-WS1, which was to be collected near the mineshaft, was actually collected from near the top of the loading dock (Photograph 2). This modification was made because the mineshaft was bulldozed in with native soil and rock adjacent to the shaft. It was determined that this material may not be representative of the ore removed from the mineshaft. The ground immediately adjacent to the loading dock did not look disturbed and would probably offer the most representative sample of the ore, which was likely spilled to some degree at this location.

- Sample YR-WS2, which was to be collected from the ore stockpile between the upper and lower bench roads, was actually collected from an ore stockpile on the upper road (Photograph 9). The ground between the upper and lower bench roads was determined to be a mix of native soil and rock from the hillside.

- Sample YR-S1, which was to be collected from the native soil below the dust collector and condenser tray area, was actually collected from the soil below the condenser tray only. Based on the layout of the mill, it appeared more likely that significant spillage would be associated with the condenser tray, which had a shallow rimmed tray and liquid extraction portal.

- Sample YR-S8 was an additional sample collected from the area below the loading dock (Photograph 3). This sample was collected because it represented another area in which significant spillage may have occurred while loading ore onto trucks.

- Sample YR-S9 was an additional sample collected from the base of a dry channel downslope and southeast of the mill. This sample was collected because it was assumed that the channel did transmit water during wetter times of the year and that contaminants in runoff from the mill may have been transported by surface water down this channel.

All sampling equipment, including trowels, augers, and buckets, was washed between samples with fresh water, laboratory grade soap, a dilute nitric acid rinse, and a final rinse with distilled water. Samples were placed in laboratory cleaned glass jars, properly labeled and placed in a cooler chilled to 4°C, custody sealed, and shipped overnight under chain-of-custody to ACZ Laboratories, Inc. in Steamboat Springs, Colorado.

Field notes are included in Appendix D and photographs in Appendix B. Sample locations are shown on Figure 2.

8.1.2 Sample Analysis

All of the samples were shipped on October 26, 2000 to ACZ Laboratories, Inc. for analysis according to Tier II analysis and reporting protocols. The samples were received at the laboratory on October 27, 2000. The complete analytical report, including the QA/QC results, is included in Appendix E.

All of the samples were analyzed for 13 metals on the EPA Priority Pollutant List by EPA method 6000/7000 series. This method gives the total concentration of each metal in the sample. In addition, each of the samples was analyzed for saturated paste pH and percent solids.

8.2 Results and Discussion

The following sections discuss relevant regulatory goals and results from the limited sampling conducted at the Site. Discussion of results includes those samples collected by the USFS in August 1996 (USFS, 1996) for greater understanding of the extent and degree of contaminant impacts known at the Site.

The relevant regulatory criteria discussed in the following section is for soil and waste material. Waste material is defined as tailings, crushed rock, mill equipment, and timber used for the mill structures. The term “waste” is not a label for hazardous waste. A discussion of whether the soil or waste material is considered hazardous waste is included in Section 8.2.1.

8.2.1 Relevant Regulatory Criteria

Applicable or Relevant and Appropriate Requirements (ARARS) have not been established for the Site and were beyond the scope of this project. However, the EPA preliminary remediation

goals can serve as a guide for evaluating the analytical results of the samples collected from the Site.
Risk-based standards set by EPA Region 9 are referred to as the Preliminary Remediation Goals (PRGs). These are risk-based concentrations for the Superfund/RCRA programs, derived from standardized equations combining exposure information assumptions with EPA toxicity data. They are considered by the EPA to be protective for humans (including sensitive groups), over a lifetime. However, PRGs are not always applicable to a particular site and do not address non-human endpoints such as ecological impacts. PRGs are commonly used for site screening and as initial cleanup goals or as tools for identifying initial cleanup goals at a site and are calculated levels based on residential and industrial scenarios. Industrial PRG standards are shown in Table 1.

To apply the industrial standards, a site must meet the following three criteria:

1. The site is planned and zoned for industrial use;

2. Uses of the property and uses of properties within 100 meters of the contaminated area are industrial uses or are other uses where the Department concurs that the exposure is limited and thus does not warrant application of the residential standard; and

3. Appropriate institutional controls (e.g. deed restrictions, restrictive covenants, environmental hazard notices, etc.) will be in force.

An industrial standard for the York & Rannells Mine is appropriate until a more site-specific risk assessment is performed. The Site could be occupied under the Mining Law given proper USFS approval (36 CFR 228, Subpart A). However, residential occupation is considered unlikely. The industrial soil cleanup levels are based on a daily exposure of 8 hours per day, 5 days per week. This Site is not currently occupied on a regular basis and may not be occupied for extensive periods. Therefore, the risk of long-term exposure to contaminants at the Site is low.

Another set of standards that could apply to any waste generated at the Site is the Hazardous Waste Rules. Waste material on the Site, such as the burnt ore, could be a hazardous waste as defined under the *Resource Conservation and Recovery Act of 1976* (RCRA). Soil excavated from the Site may also be considered a hazardous waste if it exceeds the RCRA standards. However, the waste was generated pre-RCRA (1976) and is not subject to RCRA and its exemptions. During a cleanup, the soil is not a hazardous waste until such time that it is relocated or otherwise reclassified as a hazardous waste. As it currently exists on the Site, it is not defined as a waste.

8.2.1.1 Total Metals

Results of samples collected from the Site indicated that most of the 13 priority pollutant metals analyzed were present at the Site in concentrations indicative of native soils or at elevated concentrations typical of a mine site. Lead and silver were almost absent in concentrations above the laboratory method detection limit. As would be expected for a mercury mine and mill, mercury was present in all of the samples collected and indicated the widest range of concentrations from

0.11 to 7,300 mg/kg (Table 1). All other metals fell within a fairly limited range and were generally near the range for the corresponding metal analyzed in the background samples.

8.2.1.2 Arsenic

Arsenic was detected in all of the samples collected from the Site. Concentrations ranged from 2.8 to 11.1 mg/kg, with background soil samples between a range of 2.0 to 5.9 mg/kg.

The source for the arsenic in the area can not be determined, although it is likely a weathering component of the local geology of the area. The most common of the arsenic minerals is arsenopyrite (FeAsS), which is found associated with many types of mineral deposits, especially those including sulfide mineralization (Alloway, 1990). Background levels in soils reported in the engineering evaluation of the Mother Lode Mine site had values as high as 10.7, 12.5, 16.9 and 29.2 mg/kg, with a geometric mean of 4.44 mg/kg for 16 values (CES, 1997). Arsenic concentrations in soil across the state of Oregon can vary from 1.1 to 12 mg/kg, and average 5.1 mg/kg (DEQ, 1996). Within the United States, arsenic can range from 1 to 40 mg./kg with most being in the lower half of this range (Alloway, 1990). Mean values for finer grained argillaceous and metamorphic argillaceous rocks, which are the dominant rocks of the area, average 10 to 15 mg/kg (Alloway, 1990).

8.2.1.3 Mercury

Mercury was detected in all the samples collected from the Site with concentrations ranging from 0.11 to 7,300 mg/kg. The highest concentrations were found in the area of the fan housing (7,300 mg/kg), condenser tray (1,020 mg/kg), and soil below the condenser tray (950 mg/kg). All of these areas exceeded the PRG industrial standard of 610 mg/kg. Other areas with elevated concentrations include the ore below the crushing area (480 mg/kg), soil below the loading dock (246 mg/kg), residue in the exhaust hood clean-out (153 mg/kg), the ore near the mine shaft (95 mg/kg), and the soil between the upper and lower bench roads (51 mg/kg). Low concentrations of mercury were indicated in the soil below the crushing area (3.44 mg/kg) and the waste ore tailings in the burnt ore bin (1.73 mg/kg). The concentration of mercury in the channel of the dry creek was near site background levels of 0.11 to 0.36 mg/kg at 0.69 mg/kg.

Although a TCLP analysis test was not conducted on these samples, total constituent analysis can be used to determine whether a material may be considered hazardous (EPA, 2001). Given that the material is 100% solid, the total result can simply be divided by 20 to convert the total results into the maximum leachable concentration. Using this calculation, maximum leachable mercury concentrations for samples collected from the Site range from 0.006 to 365 mg/l. The TCLP standard for mercury is 0.2 mg/l, or, any total concentration that exceeds 4 mg/kg could qualify the material as a characteristic hazardous waste if removed from the Site as a remediation waste subject to RCRA cleanup rules.

Based on the soil sampling and Site reconnaissance, the surface area of soil exceeding the PRG industrial level of 610 mg/kg is estimated at 12,500 ft^2. The estimated surface area is based on the limited sampling conducted, knowledge of the operation and layout of the mill, and judgement about how metal-impacted soil may have been spread across the area.

The concentrations of the total metals in all the samples along with the applicable regulatory standards are summarized in Table 1.

8.2.2 Saturated Paste pH

A saturated paste pH analysis measures the pH of the soil water or leachate extract from a soil sample. Saturated paste pH is used to determine the acidity/alkalinity state of the soil. If the soil becomes too acidic, below approximately pH 6.0, metals that are in the soil may become soluble and leach into the groundwater.

Saturated paste pH ranged from 5.9 to 7.7 standard units (std unts). The samples collected from the soil were slightly acidic (6.7 std unts) on average compared to the samples collected from the waste (7.0 std unts). The two most acidic samples were from the background locations (YR-S5 and YR-S6). The most basic sample was collected from the soil between the upper and lower bench roads (YR-S3). Saturated paste pH values for collected samples are summarized in Table 1.

Because mercury-laden soil and waste material are not highly acidic, the potential for leaching metals to groundwater is low.

8.2.3 Percent Solids

The percent solid analysis indicated that solids accounted for the majority of the weight of the sample ranging from 78.0 to 90.5%. On average, those samples collected from the soil contained slightly more water by weight than the samples collected from the waste rock areas. Percent solid values for collected samples are summarized in Table 1.

9.0 PRELIMINARY ASSESSMENT

A Potential Hazardous Waste Site Preliminary Assessment Form for the York & Rannells Mine is included in Appendix A. The information pertinent to the PA form is summarized in this section.

9.1 General Information

The site is known as the York & Rannells Mine site. In the past it has been called the Broadway Prospects. It is located in the Malheur National Forest in Grant County Oregon near the junction of Forest Service roads FS443 and FS434. The site coordinates are 44^{o}11'49" latitude and 119^{o}17'14" longitude. The approximate size of the Site is 5.5 acres or 240,000 square feet.

9.2 Site and Waste Characteristics

The predominant land uses of the area are forests, fields and mining. The area is rural and the distance to the nearest dwelling is approximately 4 miles. Mercury was mined and processed at the Site between the 1940s and late 1960s. The owners of the operation are no longer present and the Site has been inactive since mining ceased.

Mine waste and mine-contaminated media are present at the Site and accessible to the general public. Tailing piles (ore and waste) and contaminated soil and equipment appear to be the sources of contamination at the Site. Metal contamination, particularly mercury is the concern for this Site. Determination of the full nature and extent of contaminants present at the Site is beyond the scope of a Preliminary Assessment.

9.3 Groundwater Pathway

According to water well record database maintained by the Oregon Water Resources Department, no water wells exist within 4 miles of the Site. Also, as noted in Section 9.2, no dwellings are located closer than 4 miles to the Site. Therefore the possibility of non-registered water wells located near the Site is very low. Based on this information, groundwater is not used for drinking within 4 miles of the Site. For these same reasons, it is assumed that a designated wellhead program area is not located within 4 miles of the Site.

Based on observations, it is possible that groundwater may exist in the colluvial material above the bedrock, which thickens in the draws and bases of the canyons. This is evidenced by the saturated ground on the meadow and near the channel downgradient to the Site. However, given that the Site is near a ridge top and can be quite dry during the long, warmer summer and early fall months, shallow groundwater is not likely to be present year-round. It is likely that groundwater, if present, is likely to be greater than 10 feet below ground surface. Given the highly insoluble nature of mercury, soil pHs primarily above 6.0, and intermittent groundwater, transport by groundwater for all practical purposes is unlikely and considered an incomplete pathway.

9.4 Surface Water Pathway

Perennial surface water does not occur near the Site. The nearest perennial surface water body, North Fork Deer Creek, is approximately 1.2 miles downslope to the northwest. North Fork Deer Creek eventually drains to the south where it joins Deer Creek, which flows another approximately 15 miles to the west where it joins the South Fork John Day River. Based on the presence of a dry channel located downslope and near the mill area, it is possible that surface runoff may transport contaminants into surface water. However, if metals are being transported via this pathway, elevated metal concentrations should be evident in the base of the channel. Since the levels of mercury are near the levels indicated in background samples, surface water is presumed not to be a complete pathway.

9.5 Soil Exposure Pathways

Soil and waste material containing concentrations of mercury and arsenic above the listed PRGs levels have been identified on the Site. However, there are currently no residents or workers on the Site.

The York & Rannells Mine would qualify for the industrial standards if appropriate institutional controls were in force. The industrial soil cleanup levels are based on a daily exposure of 8 hours per day, 5 days per week. This Site is not currently occupied on a regular basis and may never be occupied for extensive periods. Therefore, the risk of long-term exposure to contaminants at the Site is low. However, because mercury impacted soil and waste is at the surface where humans and ecological receptors could be exposed, the soil exposure pathway is complete. Given the location and use of the Site, further assessment into site-specific levels is recommended.

9.6 Air Exposure Pathways

Mercury was likely released to the air during processing as vapors and as dust and particulate matter. Currently, the most likely air pathway is due to inhalation of particulate matter. As with soil exposure, this pathway is complete because mercury impacted soil and waste material is at the surface where humans and ecological receptors could be exposed through particulate matter. Given the location and use of the Site, further assessment into site-specific levels is recommended.

10.0 QUALITY ASSURANCE AND QUALITY CONTROL

Standards were maintained during sampling and analysis to ensure that data generated for the assessment meet data quality objectives outlined in *Data Quality Objectives for Remedial Response Activities, Development Process* (EPA, 1987). All laboratory and field data met EPA Level II Quality Assurance/Quality Control (QA/QC) standards. The following sections detail QA/QC.

10.1 Field QA/QC

10.1.1 Accuracy

Accuracy is a measure of the closeness of the measured value to the "true value." It is a function of techniques and procedures that minimize sampling and analytical error. The accuracy in the field was maintained by field personnel by following the sampling procedures outlined in the Work Plan. Duplicate samples were collected as required as outlined in the work plan.

Many of the metals analyzed in the original and duplicate samples indicated values that were more than 10% apart (Table 2). Large variation in concentrations within soil samples is expected due to the nature of the ore body and how the material has been mixed and spreading mining operations. The metal indicating the largest difference was mercury, which also proved to be quite variable across the Site (Table 1). Arsenic and nickel also indicated a large percent difference, which can be variable across mine sites. The accuracy of values for metals not normally associated with the ore body, such as beryllium, zinc, copper and chromium, were as expected. Most of the other differences exceeding 10% were due to the range of small values just over the method reporting limit. A summary of QA/QC is shown in Table 2.

Given the results and the variability inherent in mines and ore deposits, the accuracy appears normal. No concerns with the accuracy of the sampling and analytical procedures were identified; therefore, no corrective actions were deemed necessary.

10.1.2 Precision

Precision measures the reproducibility of measurements under a given set of conditions. Specifically, it is a quantitative measure of the variability of a group of measurements compared to their average values.

A field duplicate sample was collected for each medium sampled (waste material and soil). The sample was split from another predetermined sample as indicated in the Work Plan (CES, 2000). This split sample was submitted as a blind split sample using a false sample number. The true identity of the blind split sample was recorded on field note sheets.

Each sample was labeled using an indelible marker with the following information:

- Project Number
- Unique Sample Identification
- Sample Location
- Sample Depth (if applicable)
- Sampling Date and Time
- Name(s) of Individual(s) Collecting Samples.

No problems were encountered for field precision; therefore, no corrective actions were deemed necessary.

10.1.3 Completeness

Completeness is defined as the percentage of measurements made that are judged to be valid measurements.

To ensure completeness, all samples were duplicates (i.e., two samples were obtained for each designated sampling location). In complying with precision requirements, one duplicate sample for each medium sampled for analysis was randomly designated as a blind field duplicate. If the blind duplicate were damaged or tampered with, the duplicate from another location was designated as a blind field duplicate.

All necessary samples were collected in the field, received by the laboratory, and analyzed by the laboratory. No other problems with field completeness were encountered. Corrective actions were not necessary and therefore none were taken.

10.1.4 Representativeness

Representativeness is a measure of how closely the measured results reflect the actual concentration of distribution of the chemical compounds in the matrix sampled. The sampling plan design, standard operating procedures, sampling techniques, and sample handling protocols (e.g., storage, preservation, and transportation) have been developed to ensure the collection of representative samples. Representativeness of the data from samples collected as part of this investigation was provided by the sampling methods outlined in the Work Plan (CES, 2000).

All specified sampling protocols were followed. No problems were encountered in obtaining representative samples during the investigation conducted at the Site. Corrective actions were not necessary and therefore none were taken.

10.1.5 Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared to another. Sampling protocols and QA/QC procedures ensured the newly developed data was comparable to earlier sampling activities at the Site. Standard reporting units ensured comparability with previous studies mg/kg (ppm) was used for all soil and waste samples.

Data collected in the field such as depths, heights, and distances were verified for correct and consistent units. No problems were identified in units of measure of data collected from the field. Corrective actions were not necessary and therefore none were taken.

10.2 Laboratory QA/QC

The laboratory followed requirements for analysis and reporting under the EPA Level II protocols (EPA, 1987), including, laboratory blanks, laboratory duplicates, matrix spikes and matrix spike duplicates. All samples were analyzed within the holding times specified for the individual analytical procedure. All values between the minimum detection level (MDL) and the practical quantitation limit (PQL) were noted on the laboratory analytical reports. Analytical reports were reviewed to determine that all spikes, duplicates and lab blanks were within acceptable limits. Based on the review the following concerns were identified.

- Matrix spikes for antimony, arsenic, and cadmium were out of control limits. All of the corresponding analytical spikes were within control limits. Therefore, many of these values are reported as estimated due to matrix interference. The laboratory could not determine the cause of the matrix interference, although a typical explanation could be high concentrations of other metals in the sample, such as mercury.

- Laboratory control samples were reported as out of control limits for silver. These values were also estimated. The laboratory could not determine the cause of control samples being out of limits, although a typical explanation could be high concentrations of other metals in the sample, such as mercury.

- Many of the MDLs and PQLs were raised to levels above those listed in the Work Plan due to high concentrations of a particular metal in the sample. Upon further examination, none of the affected MDLs and PQLs were raised to levels above the relevant regulatory limits (refer to Section 8.2.1).

No problems were encountered for any of the other analyses performed.

11.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the foregoing assessment, CES has developed the following conclusions.

- According to the water well record database maintained by the Oregon Water Resource Department, no water wells exist within 4 miles of the Site. Also, no dwellings are located closer than 4 miles to the Site. Based on this, groundwater is not used for drinking within the vicinity of the Site. Beneficial water use of the area is likely to be solely to provide flow to Dear Creek and recharge the regional aquifer.

- In the summer and fall 2000, no surface water was present near the Site. A small dry channel is located downslope from the mill area, which appeared to transmit water during wetter times of the year. The unnamed intermittent creek to the north was also dry during the Site visits. This creek is farther from the Site (at least ¼ mile downslope) and could only be impacted by past activities from the mineshaft and ore loading. No other surface water or springs were noted near the Site.

- Based on observations, it is possible that groundwater may exist in the colluvial material above the bedrock, which thickens in the draws and bases of the canyons. However, given that the Site is near a ridge top and the Site can be quite dry during long the warmer summer and early fall months, shallow groundwater is not likely to be present year-round beneath the Site.

- Review of federal, state, and other records did not identify any recognized environmental conditions within the specified search distances from the Site.

- Although there are a number of threatened, endangered, and sensitive species in the watershed, the ODF&W wildlife biologist states that none exist at the mine site (ODF&W, 2001). In addition, due to the absence of mid-Columbia steelhead in the unnamed/unmapped intermittent creek and the distance from the Site to Deer Creek, impacts to this threatened species are not likely.

- The ODF&W indicated that Deer Creek is designated a critical habitat by the National Marine Fisheries Service, due to the threatened mid-Columbia steelhead. The biological evaluation conducted for the Deer Creek Watershed indicated that the Mid-Columbia River as an Evolutionary Significant Unit. Because the mine site is at distance from the nearest tributary (Deer Creek) to the listed river, impact to this sensitive environment is unlikely.

- Arsenic was detected in all of the samples, including background soil samples, collected from the Site. Concentrations ranged from 2.8 mg/kg in background soils to 11.1 mg/kg in soils beneath the abandoned condenser. Naturally occurring arsenic is expected in soils of the area, with naturally occurring background concentrations as high as 29.3 mg/kg reported at the Mother Lode Mine site (CES, 1997).

- Mercury was detected in all the samples collected from the Site. Concentrations of mercury ranged from 0.11 mg/kg in background soils to 7,300 mg/kg on equipment remaining at the Site. All mercury soil test results beyond the immediate equipment area are below the PRG industrial standard.

- The highest concentrations of mercury were identified near the processing equipment with levels exceeding the industrial PRG standard of 610 mg/kg. Specific areas are the fan housing, condenser tray, and soil below the condenser tray.
- Based on the soil sampling and Site reconnaissance, the surface area of soil exceeding the PRG industrial level of 610 mg/kg is estimated at approximately 12,500 ft^2. The actual volume

of soils exhibiting concentrations of concern cannot be determined without additional sampling.

- Because metal contaminated soil and waste rock material are not highly acidic, the potential for leaching metals to groundwater is low.

- Mercury was likely released to the air in the past during processing as vapors and particulate matter. Currently, the most likely air pathway may be due to inhalation of dust and particulate matter.

- Mine waste and mine-contaminated media are present at the Site and accessible to the general public. Tailing piles (ore and waste) and contaminated soil and equipment appear to be the sources of impact to the Site. Metal contamination, particularly mercury, is the concern for this Site.

CES recommends the following:

- To satisfy OAR 340-122-045(2)(e) (DEQ, 1997), the vertical and horizontal extent of moderate to high mercury contamination sources should be conducted. Further investigation (especially at depths) in the burnt tailing, ore crushing, and retort areas are recommended.

- Any remedy for the Site should consider that soil or waste rock with elevated mercury and arsenic concentrations that is removed from the Site would likely be considered a characteristic hazardous waste as defined under RCRA.

- Given the highly insoluble nature of mercury, soil and waste pHs primarily above 6.0, and intermittent, shallow groundwater, transport by groundwater for all practical purposes is unlikely and considered an incomplete pathway. Further investigation into the groundwater pathway is not recommended.

- Concentration of mercury in the soil sample collected from the unnamed/unmapped intermittent dry creek was at levels near background concentrations, indicating that surface water is not a likely complete pathway. Further investigation into the surface water pathway may be necessary and additional sampling is recommended.

- Although the mine waste and soil is present at the Site and is accessible to the general public, this Site is not currently occupied on a regular basis and may not be occupied for extensive periods. Therefore, the risk of long-term exposure to contaminants at the Site is low. However, the soil exposure pathway is nonetheless complete and, given the location and use of the Site, further assessment into site-specific levels is recommended.

- Currently, the most likely air pathway is due to inhalation of particulate matter. As with soil exposure, this pathway is complete and, given the location and use of the Site, further assessment into site-specific levels and associated risk is recommended.

12.0 LIMITATIONS

The data presented in this report is intended only for the purpose, location, and project indicated. The conclusions presented in this report are based on the assumption that Site conditions do not change from those observed during our investigation and as described in this report. This report is not a definitive study of the nature and extent of contamination and should not be interpreted as such. This report was prepared for the Malheur National Forest, and is accurate to the best of CES' knowledge and belief. This report is based, in part, on unverified information supplied to CES by third-party sources. While efforts have been made to substantiate this third party information, CES cannot guarantee its completeness or accuracy. CES staff participating in this PA are engineers and scientists, not attorneys. Therefore, it must be clear to all parties that this report does not offer any legal opinion, representation, or interpretation of environmental laws, rules, regulations, or policies of federal, state, or local government agencies.

CASCADE EARTH SCIENCES

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Appendix B.	**Photo Documentation**
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Appendix A.

Potential Hazardous Waste Site Preliminary Assessment Form

Appendix B.

Photo Documentation

Appendix C.

EDR Report

Appendix D.

Field Notes

Appendix E.

Laboratory Reports