3. PATHWAY AND ENVIRONMENTAL HAZARD ASSESSMENT

3.1 GROUNDWATER

3.1.1 Geology

Little site-specific information is available regarding the geology of the Idol City Mine area. The site occurs in the Harney or Idol City-Trout Creek Mining District (Brooks and Ramp 1968); this is a very small district apparently centered near the Idol City Mine site. Few of the formations in the area have been formally named and described, but they generally consist of lavas, tuffs, and alluvium (Forest Service 1968).

The geology of the Harney District is generally described by Brooks and Ramp (1968) as follows:

> "..The country rock is a porphyritic andesite of probable late Miocene age. The andesite underlies most of the larger hills in this region and presumably is a part of the Strawberry Volcanics (Brown and Thayer, 1966). Mineralization appears to be confined to a northwest-trending shear zone along which the andesite has been altered or bleached for a distance of at least a mile."

An inclined shaft was drilled in the main working area, near the northern end of the site. According to the 1968 Mineral Examination Report:

> "The inclined shaft on the Bullion claim is 70 feet deep on a 45° slope, and at the bottom a short drift extends 21 feet to the west along a structure that dips 43° to the south. This structure is supposedly the vein followed by the shaft."

Samples collected in 1968 from within the inclined shaft indicated the presence of localized lenses of quartz with visible heavy sulfides (mainly galena) and relatively high economic values; however, nearby samples from the same vein structure had little economic value. The 1968 Mineral Examination Report and the Supplemental Report of Mineral Examination both concluded that only minor values of ore were present at the site (Forest Service 1968, 1971). According to Operating Plans submitted for claims at the site, a number of small veins run through the site area and some can be traced along the bedrock surface.

Both placer and lode mining have taken place at the Idol City Mine site. In addition, shallow trenches have been excavated in several areas of the site to allow exploration of shallow bedrock. Based on information supplied in Operating Plans for claims at the site, bedrock occurs at a depth of less than 10 ft in portions of the site. Piles of waste rock, tailings, and soil are located throughout Gold Gulch; most of these are from placer mining or shallow excavations and have a coloration and composition similar to the surrounding soils. However, some of the waste rock piles are from lode mining; these typically are much lighter in color.

3.1.2 Hydrogeology

No discussion or documentation of groundwater conditions at the site or in the site vicinity was found. Shallow groundwater discharges as seeps or springs in the site area and flows to the local creeks. During the field investigation, evidence of seeps was observed onsite at several of the larger excavations and possible collapsed adits, although flow was minimal. Groundwater also was discharging (although at a flow so low that it was not measurable) from the open adit at the southern end of the site. Shallow groundwater likely does not form a laterally continuous aquifer in the site area due to the irregular

topography and presence of shallow bedrock. Underground mining in this area reportedly takes place within a shear zone which likely controls groundwater flow to some extent.

During a search for wells in the site vicinity (see section below), the closest well found occurred at the Joaquin Miller Campground, located on the west side of Highway 395, just over 4 mi from the Idol City Mine site. According to Oregon Water Resources Department (WRD) records, this well was installed in 1993 for the Ochoco National Forest. First water reportedly was encountered at a depth of 95 ft during drilling. The well was completed to a depth of 150 ft and the static water level, as measured upon well completion, was 52.6 ft. The reported water levels indicate that the well likely draws water from a deeper, confined or semi-confined aquifer.

No groundwater samples were collected during the SI. However, a water sample was collected from the discharge at the open adit. Because this discharge is more likely to impact surface water quality, analytical results for the sample are discussed with the surface water samples in Section 3.2.5.

3.1.3 Targets

The target distance for groundwater has been defined as a 4-mi radius from the site (Plate 1). Potential receptors include drinking water wells and wellhead protection areas. No records were found of drinking water wells, either public or private, within a 4-mi radius of the site, based on a search of the Oregon WRD database for water wells. There are no wellhead protection areas within a 4-mi radius of the site. Based on the above information, groundwater is not used for drinking within 4 mi of the site.

3.1.4 Groundwater Exposure Pathway Summary

Based on the available information, no release of hazardous substances from the mine to local groundwater systems is suspected. In addition, no evidence was found of the use of groundwater for drinking water within the target area. Therefore, the groundwater pathway appears to be incomplete. Groundwater that discharges from the adit(s) may impact nearby surface water bodies; these sources are discussed in the following section.

3.2 SURFACE WATER

3.2.1 Hydrologic Setting

The site occurs near the headwaters of Trout Creek, a tributary of Silvies River. An unnamed intermittent stream flows through Gold Gulch, along and through the Idol City Mine site. The stream flows generally northward and discharges into Trout Creek at the northern end of the site. Based on information from National Wetlands Inventory (NWI) maps, Trout Creek is characterized as an intermittent stream in the vicinity of the site, but as a perennial stream approximately 5 mi downstream of the Idol City Mine site.

According to USGS maps, the Gold Gulch watershed covers an area of less than 1 square mile. All of the site area occurs within this watershed. The unnamed stream in Gold Gulch originates a short distance south of the Idol City Mine site. It is fed by several springs and seeps upstream of the mine area. Pardee Spring, located northwest of the southern end of the Idol City Mine site, is one of the larger springs; it feeds into the stream in Gold Gulch near the center of the site (Figure 3). At the time of the SI field work, minimal flow was evident in some areas of the stream, but the streambed was dry in others. The average width of the stream in Gold Gulch was very narrow, at approximately 8-18 in. The average depth was only 2-4 in. in areas that contained water.

Several ponds of varying sizes are located along the Gold Gulch drainage. These were likely excavated during placer mining or trenching in the gulch. Piles of waste materials, from both placer and lode mining, are spread throughout the gulch. In one area, the piles extend almost completely across the gulch and have only a narrow cut allowing the stream to flow through (photo 17). Surface water and sediment samples were collected from 2 of the ponds for field and laboratory analyses. These included a large pond (sampling station 13, approximately 2-6 ft deep) near the center of the site area, and a small pond (sampling station 14, approximately 1 ft deep) further downstream, near the main working area. A large emergent wetland area surrounded the second pond; stream flow was not measurable in this area at stream station 05.

In the southern part of the site, the topography is fairly steep and the Gold Gulch stream flows along a narrow path down the hillside. The topography flattens out near the main mining area, at the north end of the site. In this area, the stream has a broad floodplain containing emergent wetland vegetation. The stream did not have a well-defined course directly upstream of and at the confluence with Trout Creek. The stream course appears to have been altered by mining activities throughout most or all of the site area and is dispersed by the wetland area leading into Trout Creek.

Water discharges from the open adit on the western slope of the gulch, at the southern end of the site. At the time of the SI field work, this discharge volume was very small (flow was not measurable) and the water was observed to flow down FS Road 630 for a short distance before it infiltrated the ground. At several other excavations or possible collapsed adits, evidence of drainage was observed, although the flow was minimal to nonexistent at the time of the field work.

Two locations along the unnamed stream in Gold Gulch and 1 location on Trout Creek were selected for sampling based on conversations with the OSC (Figure 1). The locations, from upstream to downstream, were as follows:

- The reference sampling station (Station 07) was located in the Gold Gulch stream, approximately 75 ft upstream of the southern (open) adit. Although this location is upstream of the Idol City Mine, it is downstream of several mining claims and at least 1 active claim (Jumping Jack placer mine). There were no unimpacted areas to use for reference. The stream at Station 07 flowed within a defined channel; however, the flow was minimal at the time of sampling. The current velocity was measured at 0.03 ft per second. Stream depth at this station averaged 4 in. and the width of the channel was 8 in. Exposed substrate indicated that increased flow volume must occur at other times of the year. Macroinvertebrate habitat was severely limited during the sampling event due to the lack of water in the stream.

- Station 05 was located adjacent to the main working area, in the northern portion of the site. While a very shallow and narrow stream channel existed at this location, evident by the existence of stream substrate within the channel, flowing water was non-existent. The stream width was approximately 8 in. Water sampling was conducted by creating a depression in the substrate and allowing it to fill with water. Macroinvertebrate sampling was conducted by hand picking organisms from the substrate.

- Station 06 was located approximately 300 ft downstream of the mine, on Trout Creek. Placer mining has historically taken place along this section of Trout Creek, as it has along much of the creek bed. During sampling, the creek had a depth of approximately 6 in. and a width of approximately 18 in. Water filled the channel at this location, but flow was not measurable. Substrate within the stream channel was similar to that found in Gold Gulch, mostly consisting of gravel, sand and silt. Macroinvertebrate sampling was conducted by kick netting and sweeping the disturbed fauna into the net by hand.

3.2.2 Targets

A target distance of 15 mi downstream has been identified for the surface water pathway. Potential targets include surface water intakes supplying drinking water, sensitive environments (i.e., wetlands), fisheries, and aquatic species of concern. The 15-mi target distance limit (TDL) is shown on Plate 2. The TDL extends approximately 12 mi along Trout Creek in a generally northwesterly direction, from its confluence with the Gold Gulch stream (at the northern end of the site) to the point where it discharges into the Silvies River. Approximately 3 mi of the Silvies River, downstream of the confluence with Trout Creek, are also included in the TDL.

Records obtained from the Oregon WRD indicate that there are no surface water intakes within the 15 mi downstream reach. According to the Forest Service, there are no designated, developed campsites within the TDL, however there are likely numerous dispersed campsites located along roads paralleling both Trout Creek and the Silvies River. A dispersed campsite is an unauthorized one developed by the user, is typically located next to an open road, and often consists of a parking spot and a fire ring. Such a campsite was observed in use by the EA field team on Trout Creek approximately 1.5 mi downstream of the site. Campers using this type of campsite, along with the occasional miner working a claim, may withdraw drinking water on an individual basis from streams within the TDL.

Prior to conducting the fieldwork, the following activities were performed to obtain background information:

- A list of Threatened and Endangered (T&E) species and Species of Concern (SOC) for Malheur National Forest, Harney County, and the Blue Mountain Ecoregion was generated based on information obtained from the Oregon Natural Heritage Program (ONHP 2001).

- Habitat information from *Flora of the Pacific Northwest* (Hitchcock and Cronquist 1973) was used to identify plant species that could potentially occur at the Idol City Mine site and to refine the list generated from the Malheur National Forest.

- The Oregon Natural Heritage Information Center (ONHIC) was contacted regarding any recorded observations of botanical or wildlife T&E species and SOC at or near the Idol City Mine site; there were no recorded observations within a 2-mi radius (the available search range) of the site (ONHIC 2003).

- Onsite wetlands were identified using the NWI 7.5 minute topographic map for Devine Ridge North (NWI 1994).

Lists of sensitive plants in Malheur National Forest and listed wildlife species in the Blue Mountain Ecoregion of Harney County are provided in Appendix E.

Habitat reconnaissance surveys were conducted at the Idol City Mine site along Gold Gulch, between the confluence with Trout Creek and approximately 1 mi south, on 21 and 22 July 2003. The surveys were performed to determine the existing habitat conditions, species composition, the presence of wetlands and other water features, and if T&E species or SOC currently exist at the site or background stations. One terrestrial background station was located offsite of the disturbed Idol City Mine site and 1 downstream station was located along Trout Creek. The habitat was characterized through documentation of dominant plant species observed (including canopy and understory species), aquatic resources present, habitat conditions observed, and photographic notes. The National Vegetation Classification Standards (NVCS) were used to consistently characterize the vegetation types.

Wetland area information was obtained by comparing information from NWI maps to field observations and the definitions of a wetland as defined by CERCLA (40 CFR 230.3). There are no wetlands mapped by the NWI onsite, including the intermittent streams in Gold Gulch and Trout Creek. However, of the 15-mi TDL, approximately 11 mi of Trout Creek is mapped either as a riverine wetland itself, or bordered by palustrine wetlands. Although not mapped by NWI, 3 palustrine emergent (PEM1) wetlands were observed and identified onsite in the field. The identified wetlands are the result of and supported by the creek in Gold Gulch; the water collects just south of the confluence with Trout Creek. Standing water, anoxic soil conditions, and aquatic and emergent obligate wetland vegetation were observed in these areas, supporting the CERCLA definition of a wetland. Aquatic vegetation observed within the wetlands included white water buttercup and American speedwell, both obligate, hydrophytic vegetation. Additional hydrophytes observed included creeping spikerush, bur-reed grass (*Sparganium emersum*), and various rush (*Juncus* spp.) and sedge (*Carex* spp.) species.

The ONHP database search identified two species of fish (Malheur mottled sculpin and bull trout) that occur in the high elevations of Harney County and could occur in the site area; however, no fish were observed during the sampling effort. According to an Oregon Fisheries Biologist, a light to moderate level of recreational fishing takes place in downstream portions of Trout Creek and in the Silvies River within the 15-mi reach. Fish caught in these areas typically include redband trout in Trout Creek and smallmouth bass, bluegill and perch in the Silvies River.

Four species of amphibians and reptiles were found in the ONHP database, but the high elevation of the mining sites eliminates most of these species except 2; Columbia spotted frog and western rattlesnake (see Appendix E). However, 2 additional amphibians not listed for Harney County but listed in other Oregon counties were found in the large pond at the site (near sampling station PD-13):

- Northern red-legged frog (*Rana aurora*) tadpoles – this species has a Federal Status of Species of Concern (SOC) and an Oregon Department of Fish and Wildlife (ODFW) Status of Vulnerable/Undetermined Status (SV/SU).

- Oregon spotted frog (*Rana pretiosus*) adults – this species has a Federal Status of Candidate (C) and an ODFW Status of Critical (SC).

Additional reptiles and amphibians collected at the large pond included garter snake (*Thamnophis sirtalis*), Pacific tree frog (*Hyla regilla*) tadpoles and adults, and rough-skinned newt (*Taricha granulosa*) larvae. The large pond where these species were collected provides water resources and high-quality habitat for aquatic vertebrates and invertebrates in a predominantly dry, arid region. At least 5 species of aquatic vegetation (white water buttercup, American speedwell, duckweed, water-starwort, and creeping spikerush) were observed at the pond. The large size of the pond and the diversity of aquatic vegetation provide an ideal habitat for amphibian and reptile species. It is unlikely that other water resources in the immediate area (including the smaller pond sampled) could support the observed, or additional, listed amphibian species.

3.2.3 Aquatic Survey Results

Aquatic surveys were conducted to assess the impact, if any, of the Idol City Mine site on the benthic macroinvertebrate community, presence of fish species, and habitat parameters. Most notable at the site was the limited habitat to support a healthy benthic macroinvertebrate or fish community. The intermittent nature of the stream severely limits the abundance and composition of the benthic macroinvertebrate community. Only taxa specifically adapted to this type of system would be expected to

compose a major percentage of the community. It was also apparent that the lack of water and limited habitat prevent the existence of a permanent fish community.

No fish species were collected or observed in the Gold Gulch stream, Trout Creek, or the 2 ponds sampled at the Idol City Mine site. At the time of sampling, the intermittent streams were both too small and shallow to support any type of fish species; therefore seining was not conducted. Due to the limited size and sometimes absence of free-flowing water at the stream locations, kick-netting to collect benthic samples could not be conducted in accordance with Oregon Department of Environmental Quality (ODEQ) methods at any of the stream stations. However, invertebrate species were collected by a combination of modified kick netting and handpicking of organisms from substrate material in the channel at the steam sites. Benthic macroinvertebrates were collected by these modified techniques in an effort to get some kind of qualitative view of the community at the site. These techniques provided the only available method to observe the community composition at the site, rather than eliminating the collection of macroinvertebrate data all together. Macroinvertebrates were also collected from the large pond sampled (Station 13), using the net to collect benthic samples from the available sediment and aquatic vegetation.

Laboratory sorting of benthic macroinvertebrate samples was conducted in accordance with ODEQ methods and evaluated using a multi-metric analysis, Level 3 Assessment (ODEQ 2001). However, since the field collection methods could not be performed using the ODEQ methods, the metrics were calculated, but scores were not assigned to the metric values or total scores calculated. The metric information is provided to facilitate basic comparisons among the sites without attempting to attach any significance to the results (i.e., compare them to regional or state data). Tables listing the number and relative abundance of the taxa collected, as well a summary of Level 3 metrics, are provided in Appendix E.

Three orders of insects, Ephemeroptera (mayflies), Plecoptera (stonefiles), and Trichoptera (caddisflies), collectively referred to as EPT, are considered to be the most sensitive or responsive to impairment within the system. Therefore, EPT richness or abundance is included in the multi-metric analysis. While EPT taxa were present at the site, 2 of the stream stations (Stations 06 and 07) were dominated by midges (Tanytarsini). Midges, in general, are a tolerant order of insects, and often predominate at sites with limited or marginal habitat. However, the area in general exhibits a decent diversity of taxa as well as a fairly low percentage of tolerant taxa, which indicates that if the site were **not** habitat limited, a healthy benthic macroinvertebrate community could exist. None of the areas sampled appeared to be impaired by effects from the site, but the macroinvertebrate community is certainly habitat limited.

Of the 3 stream sites sampled, Station 05 produced the least abundance and richness of taxa; this would be expected since this station was the most severely limited by its habitat. The station consisted of no free-flowing or standing water and was only wet when substrate material was flipped over and removed. Following is a summary of the general findings of the macroinvertebrate sampling:

- Gold Gulch and Trout Creek (in the site area) are intermittent streams.
- The streams are not biologically dead as evidenced by the existing benthic macroinvertebrate community.
- The area is probably supporting the best community the limited habitat will allow.
- The limited habitat is driving the benthic macroinvertebrate community at this site. Therefore, the community should not be used as an indicator of the mine' s effects on the stream.

Habitat was evaluated at each of the 3 stream stations, in accordance with the methods stated in the project plans; habitat scores are presented in Appendix E. As mentioned previously, habitat to support aquatic organisms is severely limited at this site. All 3 sites rank as marginal habitat using the USEPA Rapid Bioassessment Protocol (RBP; Barbour 1999).

3.2.4 Previous Investigations

Four surface water samples were collected at the site during performance of an APA in October 2002 (CES 2002). The samples were analyzed *in situ* using a Horiba U-22 meter. Samples were collected from the open shaft, a trench south of the shaft, "Adit 1" (the southernmost or open adit), and "Adit 4" (an apparent collapsed adit on the east side of the drainage). Sample analyses and results were as follows:

Location	pH	Specific Conductance (uS/cm)	Turbidity (NTUs)	Dissolved Oxygen (mg/L)	Temperature (^{o} Celsius)	Total Dissolved Solids (mg/L)	Redox Potential (millivolts)
Shaft	7.84	0.505	87.4	2.86	5.68	320	57
Trench	8.8	0.964	438	7.83	1.64	630	16
Adit 1	7.7	1.08	101	2.75	5.69	700	-12
Adit 4*	8.02	0.782	NA	3.51	4.79	500	120

NOTE: uS/cm = Microsiemens per centimeter.
NTUs = Nephelometric turbidity units.
mg/L = Milligrams per liter.
NA = Instrument was not working properly.
* No deep pools of seep water were available for this reading: this may affect some results.

3.2.5 Analytical Results

Locations of stream and pond samples collected during the SI are indicated on Figures 1 and 2. Photographs of selected sample locations are provided in Appendix B. Analytical results for surface water, pore water, and sediment samples are presented in Tables 1, 2, and 3, respectively. Only those constituents detected in 1 or more samples are included in the summary tables. Dissolved metals concentrations were used for comparison with surface water screening criteria, and are included in Tables 1 and 2. Total metals concentrations for surface water samples are presented in a summary table in Appendix G, along with copies of the laboratory reports.

Six surface water samples, 3 pore water samples, and 6 sediment samples were collected during the SI including the following:

- Three stream surface water samples
- Two pond surface water samples
- One adit surface water sample
- Three stream pore water samples
- Three stream sediment samples
- Two pond sediment samples
- One adit sediment sample.

Field analyses performed on surface water and pore water samples included temperature, pH, dissolved oxygen, specific conductance, turbidity, and redox potential. Laboratory analyses performed included the following:

- Surface water – pH, Target Analyte List (TAL) metals (total and dissolved), cyanide, total dissolved solids (TDS), total suspended solids ([TSS], organic and inorganic), hardness, alkalinity, specific conductance, redox potential (Eh), and sulfate

- Pore water – pH, dissolved TAL metals, cyanide, TDS, hardness, alkalinity, specific conductance, Eh, and sulfate

- Sediment – TAL metals, cyanide, total organic carbon (TOC), and grain size.

Field water quality measurements were obtained in water samples collected at each stream station and from the ponds. Field water quality measurements are presented in Tables 1 (surface water) and 2 (pore water). Trends observed include the following:

- All pH measurements fell between 6.8 and 7.8, including the water sample from the adit. No evidence of acid mine drainage (AMD) was observed.

- Specific conductivity was high at the open adit, but measurements did not vary widely among the other samples (from streams and ponds).

- Dissolved oxygen measurements were below 6 mg/L in samples collected at the open adit (1.33 mg/L), Station 05 (5.48 mg/L) and Station 06 (3.44 mg/L). The low measurements obtained in the two stream samples likely were due to the stagnant nature of the sampled water.

Criteria for comparing measured concentrations of metals in surface water and pore water consist of the following human health and ecological screening values:

- ODEQ Water Quality Criteria, Protection of Aquatic Life, Fresh Chronic Criteria (Oregon Administrative Rules [OAR] 340-041-001); hardness-dependent values (cadmium, copper, lead, nickel, silver, and zinc) were calculated based on the hardness for each sample, and the range of values is provided in the data tables.

- ODEQ Water Quality Criteria, Protection of Human Health, Water, and Fish Ingestion (OAR 340-041-001).

- ODEQ (1998) Guidance for Ecological Risk Assessment, Level II Screening Values for surface water; these values are based on previous USEPA water quality criteria that have been superceded by the USEPA (2002) recommendations for ambient water quality criteria for freshwater organisms.

- USEPA (2002) recommended ambient water quality criteria for freshwater aquatic organisms, chronic; hardness-dependent values were calculated separately for each sample.

- USEPA (2002) recommended ambient water quality criteria for freshwater aquatic organisms, Tier II secondary chronic values calculated by Oak Ridge National Laboratory (Suter & Tsao 1996).

- USEPA (2002) recommended ambient water quality criteria for protection of human consumption of fish; hardness-dependent values were calculated separately for each sample.

- Oak Ridge National Laboratory, U.S. Department of Energy (Efromyson, et. al. 1997), PRGs.

Of these screening values, comparisons were made with the lowest value available. Criteria for comparing measured concentrations of metals in sediments consist of the following values:

- Threshold Effects Level (TEL) and Probable Effects Level (PEL) from USEPA National Sediment Quality Survey, Screening Values for Chemicals Evaluated http://www.epa.gov/waterscience/cs/vol1/appdx_d.pdf).

- Effects Range-Low (ER-L) and Effects Range-Medium (ER-M), National Oceanic and Atmospheric Administration (NOAA), from USEPA (1997) National Sediment Quality Survey, Screening Values for Chemicals Evaluated.

- ODEQ (1998) Guidance for Ecological Risk Assessment, Level II Screening Values for freshwater sediment.

Results of the metals analyses for surface water, pore water, and sediment samples are provided in Tables 1, 2 and 3, respectively, and are discussed in the following table.

Summary of Surface Water, Pore Water, and Sediment Sample Metals Data

Sample Type	Table/ Sample No.	Dissolved Metals Exceeding One or More Comparison Criteria	Trends Observed and Comments
Surface Water	Table 1		
Upstream	(SFW-07)	Barium only	Except for barium, the metals of concern were detected at higher concentrations in the sample collected adjacent to the main working area (SFW-05).
At the mine	(SFW-05)	Arsenic, barium, cadmium, lead, manganese, and zinc	
Downstream	(SFW-06)	Barium only	
Big Pond	(SFW-13)	Arsenic, barium, and manganese	Arsenic and manganese were detected at higher concentrations in the big pond.
Small Pond	(SFW-14)	Barium only	
Adit Discharge	(SFW-12)	Arsenic, barium, calcium, iron, and manganese	All metals of concern, except barium, were detected at the highest concentrations in surface water collected at the adit.
Pore Water	Table 2		
Upstream	(PW-07)	Barium only	Sample PW-05 had the highest concentrations of aluminum, cadmium, lead, and zinc, while sample PW-06 had the highest concentrations of barium, iron, and manganese.
At the mine	(PW-05)	Aluminum, barium, cadmium, lead, and zinc	
Downstream	(PW-06)	Barium, iron, and manganese	
Sediment	Table 3		
Upstream	(PSD-07)	Arsenic, copper, and mercury	Concentrations of most of the metals exceeding criteria were highest in the samples collected from the stream adjacent to the main working area (SSD-05) and from the small pond (SSD-14) in the same area.
At the mine	(SSD-05)	Antimony, arsenic, cadmium, copper, lead, mercury, nickel, silver, and zinc	
Downstream	(SSD-06)	Arsenic, copper, and mercury	
Big Pond	(PSD-13)	Arsenic, copper, and mercury	
Small Pond	(SSD-14)	Antimony, arsenic, cadmium, copper, lead, mercury, nickel, silver, and zinc	
Adit	(PSD-12)	Antimony, arsenic, copper, manganese, and mercury	Arsenic, antimony, and manganese concentrations were highest in the sample collected at the adit.

In sediment samples, the percentage of fine material (clay and silt) was higher in the 2 pond samples and in the sample collected at the adit. Sample SSD-14, collected from the small pond near the main mining area, was composed of 94 percent fines. Sediments collected from the streambed were coarser and were composed primarily of gravel.

3.2.6 Surface Water Exposure Pathway Summary

There is evidence of an ongoing release of chemicals to surface water from the Idol City Mine site. Only barium was detected at a concentration exceeding the comparison criteria in upstream and downstream surface water samples. In the surface water sample collected in the main mining area, additional metals detected at concentrations above the criteria included arsenic, cadmium, lead, manganese, and zinc. Sediment samples with the most exceedences of comparison criteria included those collected at the open adit, and from the stream and pond sampling stations in the main working area.

No evidence of AMD was observed and all stream and pond samples had neutral pHs. Benthic habitat was severely limited due to the small size and limited flow of the streams; no clear impacts from the mining activities could be determined.

The lack of water and limited habitat in the streams prevented the existence of a fish community on or adjacent to the site; however, fish occur downstream of the site within the 15-mi TDL. Two listed species of amphibians were observed in a pond at the site; the Northern red-legged frog and the Oregon spotted frog.

3.3 SOIL

3.3.1 Targets

There are no onsite workers and no people who live onsite or within 200 ft of areas of suspected contamination related to the site. A small, windowless wooden building is present a little over 200 ft from the site, on the north side of FS Road 600, on a privately owned parcel. The use of this structure is unknown. The closest regularly occupied building appears to be at least 3 mi from the site. It is estimated that less than 10 people live within a 4 mi radius of the site.

The Idol City Mine site is open to public access. A warning sign citing potential site hazards is present at the north end of the site, near the main building. Because the mine area is adjacent to a Forest Service Road, the site has road traffic including all-terrain vehicles. Land uses in the site area include recreation (hiking, hunting, camping, etc.), cattle grazing, and mining on nearby claims.

According to NWI maps, approximately 200 acres of wetlands occur within a 4-mi radius of the site. This corresponds to approximately 8 percent of the 4-mi radius consisting of wetlands. They occur either in the pockets of hollows or other low-lying areas, or along streams and other surface water bodies. The closest wetland is located approximately ¼ mi west of the site in a low-lying area. The types of mapped wetlands (identified within the 4-mi radius) corresponding to a CERCLA wetland consist of:

- PEMA, B, and C - Palustrine Emergent Temporarily Flooded/Saturated/Seasonally Flooded
- PSSB and C - Palustrine Scrub/Shrub, Saturated/Seasonally Flooded
- PFOB - Palustrine Forested, Saturated
- R4SBA and C - Riverine Intermittent Streambed, Temporarily/Seasonally Flooded (if emergent vegetation is present).

Plant and Wildlife Surveys

Lists of T&E species, SOC, and sensitive species were generated and refined prior to conducting the fieldwork, as described in Section 3.2.2. Lists of sensitive plants in Malheur National Forest and listed wildlife species in the Blue Mountain Ecoregion of Harney County are included in Appendix E. The ONHIC search provided no records of observations of botanical or wildlife T&E species or SOC within a 2-mi radius of the site.

Habitat reconnaissance surveys were conducted in the site area to establish existing habitat conditions, species composition, and the presence of wetlands and T&E species. Reconnaissance-grade informal wildlife surveys were conducted at the site in conjunction with other field activities and sampling. In addition, the timed meander search (TMS) procedure was used to conduct botanical examination of distinct habitat types using an approach established by Goff (1982) to determine the presence of T&E species and SOC. The approach is a semi-quantitative procedure that documents the level of effort at each station as well as in the discrete habitat types.

Vegetation

The area including and surrounding the mine site contained both scattered and dense scrub, and herbaceous vegetation in the disturbed, open areas and waste piles. Sparse, scrub vegetation was observed growing on the waste and rock piles. Canopy and understory species were dispersed throughout the disturbed area, but predominantly along the edges of the site in the steep adjacent hillsides. The dominant scrub vegetation onsite included squaw current (*Ribes cereum*), snowberry (*Symphoricarpos albus*), sagebrush species (*Artemisia* spp.), immature Douglas fir and ponderosa pine. Herbaceous vegetation observed onsite included lupine (*Lupinus sericeus*), cinquefoil (*Potentilla gracilis*), and Western yarrow (*Achillea millefolium* var. *lanulosa*). A list of plant species observed onsite is included in Appendix E.

Some plant species observed on the waste piles and at the southern (open) adit, including squaw currant and silky lupine, appeared stressed. Visual stress indicators in this vegetation included yellow leaves with green veins (could indicate toxicity or lack of nutrients), leaves with brown tips (could indicate burning), and stunted growth (compared to background areas). The visual lack of vegetation in the disturbed portion of the site, including the waste and rock piles, can most likely be attributed to steep slopes and the lack of organic matter and nutrients on waste and rock.

Three distinct habitat types were observed in the site area:

- Coniferous hillsides – onsite
- Emergent wetland areas – onsite surrounding Gold Gulch
- Evergreen shrubland – offsite, but observed from the mine area

The coniferous hillsides had moderate east- and west-facing slopes with a dry, rocky open understory and a canopy co-dominated by Douglas fir (*Pseudotsuga menziesii*) and ponderosa pine (*Pinus ponderosa*). This area could be classified as a temperate or subpolar needle-leaved evergreen forest (I.A.8.N) based upon NVCS. The surrounding, moderately steep and dry, rocky hillsides adjacent to the site were co-dominated by the canopy species Douglas fir and ponderosa pine, and sub-dominated by Western juniper (*Juniperus occidentalis*). The mature conifers were approximately 100 ft tall with an average diameter at breast height (DBH) of 36 in. The understory was open with little vegetation and included the species yellow hawkweed (*Hieracium albertinum*), western meadow rue (*Thalictrum occidentale*), and sedge species (*Carex* spp.). Some downed trees and snags were observed in the coniferous forest.

The stream in Gold Gulch is intermittent and less than a foot wide in the areas where stream samples were collected. The areas immediately surrounding the intermittent stream were characterized as emergent wetlands with scattered Pacific willows (*Salix lasiandra*). Based upon the NVCS, these areas could be characterized as semi-permanently flooded temperate perennial forb vegetation (V.B.2.N.e). Further upstream along Gold Gulch south of the mine site, scattered evergreens and Pacific willow provided a more substantial riparian canopy to the stream. The wetland areas were dominated by the aquatic vegetation white water buttercup (*Ranunculus aquatilis)* and American speedwell (*Veronica Americana);* emergent vegetation included creeping spikerush *(Eleocharis palustris*) and various rush (*Juncus* spp.) and sedge species (*Carex* spp.). Other aquatic vegetation that was observed only in the large pond included duckweed (*Lemna minor*) and a water-starwort species (*Callitriche sp.*), which was not flowering at the time and therefore could not be identified to the species level. Both species are classified as obligate wetland vegetation.

Offsite of the mine area, directly to the north (across FS Road 600), a steeply-sloped evergreen shrubland (III.A.4.N.a) dominated by sagebrush (*Artemisia* sp.) and sub-dominated by kinnikinnick (*Arctostaphylos uva-ursi*) was observed.

Wildlife

The wetland vegetation and ponds surrounding Gold Gulch and the confluence with Trout Creek represent a unique habitat compared to the surrounding dry, arid regions. Many wildlife species, predominantly avian species, were observed at the site and in the vicinity of the mine, most likely taking advantage of the water resources at the site (see list in Appendix E).

Numerous least chipmunks (*Euatamius minimus*) and golden-mantled squirrels (*Citellus lateralis*) were observed at the site in the understory of the coniferous habitat. Mule deer (*Odocoileus hemoinus*) were observed both on and offsite. A coyote (*Canis latrans*) was observed offsite and the OSC reported observing a badger near the site. Nine species of bats are listed for Harney County, but only 6 of the 9 species might use mine sites for roosting. During the terrestrial surveys, no visual or olfactory evidence of bats was observed onsite or at the open (southern) adit. However, it is possible that the Idol City Mine site may provide habitat suitable for bat species.

Many avian species were observed during an early morning site reconnaissance, when little anthropogenic or other disturbing activities were taking place. Avian species commonly observed using the disturbed scrub vegetation of the site and adjacent conifers included brown creeper (*Certhia americana*), dark-eyed junco (*Junco hyemalis*), Clark' s nutcracker (*Nucifraga columbiana*), black-capped chickadee (*Parus atricapillus*), black-headed grosbeak (*Pheucticus melanocephalus*), green-tailed and spotted towhees (*Pipilo chlorurus* and *P. maculatus*), red-breasted and white-breasted nuthatches (*Sitta canadensis and S. carolinensis*), red-naped sapsucker (*Sphyrapicus nuchalis*), and white-crowned sparrow (*Zonotrichia leucophrys*). Other common species included American goldfinch (*Carduelis tristis*), common raven (*Corvus corax*), Steller' s jay (*Cyanocitta stelleri*), and American robin (*Turdus migratorius*). The OSC also reported observing several wild turkeys (*Meleagris gallapavo*) onsite one morning. A prairie falcon (*Falco mexicanus*) was observed flying over the site and not necessarily using the habitat. In the surrounding coniferous habitat 3 species of woodpeckers were observed, including pileated (*Dryocopus pileatus*), black-backed, and hairy woodpeckers (*Picoides arcticus* and *P. villosus*). Two of these are listed as state sensitive species:

- Pileated woodpecker – ODFW Status of SV
- Black-backed woodpecker – ODFW Status of SC

The dead snags and open understory of the coniferous forest provide good quality habitat for woodpecker species at the site and surrounding areas. During the water quality collection effort at the upstream sampling station, a large and unidentifiable hawk species, possibly a Northern goshawk, was observed using the wetland areas. The Northern goshawk has a federal status of SOC.

The physical disturbance of the mine site area appears to have affected the quality of habitat available to potential wildlife species; however, additional and undisturbed habitat is available in the areas immediately surrounding the mine site. A complete list of wildlife species observed at the site during the site reconnaissance is included in Appendix E.

3.3.2 Previous Investigations

Shallow soil and waste samples (approximately 4-6 in deep) were collected from waste rock piles at the site during performance of an APA in October 2002 (CES 2002). The samples were analyzed for metals content using a Niton Dual Source X-ray fluorescent unit and *in situ* field screening methods. Metals concentrations detected in 9 samples were compared to 2002 USEPA Region 9 PRGs for industrial soils. Arsenic and lead were detected at concentrations exceeding the PRGs in multiple samples. Specific sampling locations were not identified in the report. Samples with arsenic or lead concentrations exceeding the PRGs included the following:

Location	Constituent	Result (mg/kg)	PRG (mg/kg)
Waste rock pile 1 (north of shaft)	Arsenic	305	1.6*
	Lead	1,780	750
Waste rock pile 3 (at shaft)	Arsenic	562	1.6*
	Lead	1,630	750
Waste rock pile 6 (west of shaft, across Gold Gulch drainage)	Arsenic	170	1.6*
Waste rock pile 8 (east of 2 buildings near Trout Creek)	Arsenic	91	1.6*
Waste rock pile 9 (near Adit 1)	Arsenic	83	1.6*
Waste rock pile 9 (near Adit 1)	Arsenic	488	1.6*
Waste rock pile 10 (near Adit 4)	Arsenic	217	1.6*

* For cancer endpoint, the PRG for arsenic was 1.6 mg/kg; for noncancer endpoint it was 260 mg/kg. (These concentrations are revised annually.)

NOTE: PRG = Preliminary Remediation Goal.
mg/kg = Milligrams per kilogram.

Based on their assessment, CES suggested that waste material may be impacting the Gold Gulch stream and Trout Creek, and recommended performance of an SI.

3.3.3 Analytical Results

The following soil, waste, and associated plant tissue samples were collected during the SI:

- Twelve surface soil/waste samples, including 1 background sample
- Five subsurface soil samples
- Four plant tissue samples: 3 co-located with onsite soil samples and 1 co-located with the background soil sample.

Sample locations are indicated on Figures 2 and 3. A soil sample log, including sample descriptions, is provided in appendix F.

Soil and Waste Samples

Samples labeled "TA" were collected from onsite soil in potentially impacted areas, and from soil piles suspected to be from placer mining or surface excavations. Samples labeled "WP" were collected from piles suspected to be waste rock from underground mining. Surface soil samples generally were collected from the 4 to 6 in. depth interval.

In general, soil samples were analyzed for pH, TAL metals, and cyanide. Approximately 25 percent of the soil samples were also analyzed for Synthetic Precipitation Leaching Procedure (SPLP) metals and Acid Base Accounting (ABA). Analytical results for soil and plant tissue samples are presented in Tables 4 and 5, respectively. ABA results are summarized in a table in Appendix G.

Criteria for comparing measured concentrations of metals in soils consisted of the following human health and ecological screening values:

- ODEQ (1998) Guidance for Ecological Risk Assessment, Level II Screening Values.
- USEPA Region 9 PRGs for Industrial Soils (http://www.epa.gov/region09/waste/sfund/prg/index.htm).
- USEPA (2000a) Generic Soil Screening Levels (SSLs), for protection of human health.
- USEPA (2000b) Ecological Soil Screening Levels (EcoSSLs).
- Oak Ridge National Laboratory PRGs for protection of plants, wildlife, or soil invertebrates, U.S. Department of Energy (Efroymson et al. 1997).

Analytical data were compared to the lowest available screening criteria (Table 4). Surface soil sample analytical results indicated the following:

- Soil pH measurements ranged from 2.7 to 8.5. Except for 1 sample, the pH of waste pile materials ranged from 2.7 to 4.2, while site soils and background ranged from 6.4 to 7.6.
- Metals exceeding one or more of the comparison criteria in the background soil sample include aluminum, antimony, arsenic, barium, beryllium, chromium, lead, manganese, mercury, selenium, thallium, vanadium, and zinc.
- In the onsite soil samples, the following additional metals exceeded one or more of the comparison criteria: cadmium (2 samples), cobalt (1 sample), copper (1 sample), and silver (2 samples).
- Sample WP-SSS-01, collected at 0.5 ft below ground surface from a waste pile on the west side of the gulch in the main working area, had the highest concentrations of many of the metals detected; some of these concentrations were significantly higher than in any of the other samples collected. Metals occurring at significantly elevated concentrations in this sample included antimony, arsenic, barium, cadmium, copper, lead, mercury, silver, thallium, and zinc. Lead in this sample was reported at a concentration of 25,300 mg/kg.

- Excluding sample WP-SSS-01, the following metals (detected at concentrations exceeding comparison criteria) were detected in one or more samples at concentrations significantly exceeding (greater than 3 times) background: arsenic (1 WP sample), barium (1 WP sample), cadmium (1 WP sample), lead (3 WP samples), mercury (3 TA and 8 WP samples), silver (2 WP samples), and zinc (1 WP sample).

- Elevated concentrations of several metals were detected in sample TA-SSS-19, including barium, lead, and mercury. This sample was collected from the wetland area at the toe of a large waste rock pile on the east side of the main working area (see Figure 2). These results, along with visual observations of soil discoloration in this area, indicate that waste material has eroded from the pile into the wetland area.

- Sample WP-SSS-21 was collected from a possible waste rock pile in the center of Gold Gulch, toward the south end of the site. Although most of the metals concentrations detected in this sample did not exceed those in the background sample, this sample had the highest arsenic concentration (961 mg/kg) detected during the SI. This sample had a pH of 8.5.

- In locations where both shallow and deeper soil samples were collected from waste piles, there was no distinct correlation between metals concentration and depth.

Waste pile volumes were calculated for 15 waste rock piles at the site. Individual pile locations and volumes are provided in Appendix H. The total volume for the 15 waste piles identified is approximately 2,000 cubic yards.

Plant Tissue Samples

Plant tissue specimens were collected and analyzed for cyanide and TAL metals. Targeted plant species included ecologically important forage species for wildlife that could be used in a food chain analysis of ecological risks, if required in the future. The collected plant species at the Idol City Mine site was squaw current; in addition to being considered important browse material for wildlife, the plants were fruiting at the time of sampling. Squaw currant also was one of the few plant species that was repeatedly found growing on the waste and rock piles and also in the adjacent undisturbed areas, although some onsite examples exhibited signs of vegetative stress. Plant tissue samples were co-located with soil samples and were collected from 4 locations:

- A background, or reference, location on the hillside south of the mine area (BG-PLT-08)
- An onsite waste rock pile (WP-PLT-09)
- Onsite soil in the main working area (TA-PLT-10)
- Downgradient of the mine, adjacent to the downstream sampling location (TA-PLT-11).

A summary of the plant tissue analytical data is provided in Table 5. No comparison criteria are available for plant tissue. For most metals, concentrations detected in the 4 samples did not vary significantly. In sample WP-PLT-09, collected from the waste rock pile, manganese was detected at a concentration roughly an order of magnitude higher than in the other samples, while barium was detected at a concentration an order of magnitude less than in the other samples. Lead was also detected in this sample at a slightly higher concentration than in the other samples.

3.3.4 Soil Exposure Pathway Summary

There is evidence of releases of site-related contaminants to soil at the Idol City Mine site. A number of metals were detected in onsite surface soil and waste rock pile samples at concentrations exceeding comparison criteria. Although the background surface soil sample also exceeded comparison criteria for a number of metals, the following metals were detected at concentrations exceeding the comparison criteria and at elevated concentrations compared to background; aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, manganese, mercury, selenium, silver, thallium, vanadium, and zinc.

Erosion of fine-grained waste material was evident at the site adjacent to the waste piles along the wetland area in the northern portion of the site. These eroded waste materials likely enter the Gold Gulch stream during periods of high rainfall and snowmelt.

Two listed avian species, the pileated woodpecker and the black-backed woodpecker, were observed on or immediately adjacent to the site.

3.4 AIR

3.4.1 Targets

The target distance for air has been defined as both 1 and 4 mi radii from the site. There are no residences within 1 mi of the site. It is estimated that less than 10 people live within a 4-mi radius. The shortest distance between a regularly occupied structure and the site is estimated to be approximately 3 mi. Sensitive environments, including wetlands, which are located within 4 mi of the site are indicated in Section 3.3.1.

3.4.2 Air Pathway Summary

Air samples were not collected as part of this SI. The most likely current air exposure pathway is via inhalation of particulate matter. Arsenic was detected in 2 shallow soil samples (WP-SSS-01 and WP-SSS-21) at concentrations exceeding the USEPA soil screening level for inhalation of particulates (750 mg/kg); therefore, the potential exposure pathway is considered complete. Because the air pathway is directly related to the soil exposure pathway, addressing and/or eliminating contaminated soils at the site would likely render the air pathway incomplete.