

## EXECUTIVE SUMMARY

The Blue Ledge Mine site (Site) is an inactive copper mine site located primarily on patented land within the Rogue River-Siskiyou National Forest in Siskiyou County, California. The Site is located approximately three miles south of the Oregon-California border, approximately thirty-three miles southwest of Jacksonville, Oregon as shown on Figure 1. The Site lies at the upper headwaters of the Joe Creek watershed, on a steep, generally north-facing hillslope above the confluence of Joe Creek and an unnamed tributary to Joe Creek. Joe Creek flows north to Elliott Creek, which in turn is a tributary to the Middle Fork of the Applegate River. The Applegate River flows north across the California-Oregon border to Applegate Reservoir, and from there to the Rogue River near Grants Pass, Oregon as shown on Figure 2.

The mine includes at least six adits as well as two large deposits of mine waste rock and two smaller waste rock deposits as shown on Figure 5. These deposits have been estimated to weigh approximately 44,000 tons. One of the two large deposits extends down a north-facing slope to Joe Creek below its confluence with Tributary 4. The other large deposit extends down a northeast-facing slope towards Tributary 4 above its confluence with Joe Creek. The two small deposits are located north and south of the larger deposits, on slopes leading directly to Joe Creek or the tributary. Groundwater discharges from the adits and from seeps. One seep was observed to flow directly into the channel that diverts flow from the lower adit to the settling pond and over the log dam ultimately discharging into Joe Creek.

Prior investigations demonstrated that releases of acid mine drainage (AMD) are a historic and ongoing condition at the mine that have adversely impacted groundwater, surface water, soil, and sediment. URS Corporation (URS) work conducted in 2008 confirms these previous findings. Mine waste rock has been described as being highly productive in terms of creation of AMD and releases of metals and sulfuric acid. Exceedances of primary drinking water standards have been documented previously for cadmium, copper, and acidity, and additional exceedances of secondary drinking water standards have been documented for copper, iron, and zinc. As part of the Blue Ledge Site Investigation (SI) drinking water source samples were collected from residences' nearest the Site in Joe Bar. No parameters exceeded either the Federal or California State regulatory Maximum Contaminant Levels (MCLs). All samples exceeded the conservative United States Environmental Protection Agency (USEPA) Regional Screening Levels (RSLs) for tap water for arsenic. However, there is not enough data at this time to determine the source of arsenic in these drinking water samples.

Investigations identified numerous exceedances of aquatic life criteria (ALCs). In particular, metals concentrations in Joe Creek and Elliott Creek surface water are much higher than those found to result in adverse affects and high mortality rates in rainbow trout and other fish (Environmental International Ltd., 2002). The adverse affects to aquatic organisms indicated by the surface water chemistry have been confirmed by surveys of fish, amphibians, and macroinvertebrates. Fish survey data confirmed there are no fish in Joe Creek. Macroinvertebrate populations in Joe Creek downstream of the Site are also significantly degraded. Two amphibians were observed in the lowest reaches of Joe Creek during this investigation, near locations where previous surveys also observed them. However, when compared to observations of amphibian populations above the mine, it is apparent that these populations are also significantly impacted due to AMD releases from the Site.

Migration pathways associated with affected media are resulting in risk to human and ecological receptors. The absence of fish in Joe Creek provides conclusive evidence that mine-related impacts to sediment and/or surface water quality are preventing fish species, which are known to be present in Elliott Creek and the Middle Fork of the Applegate River, and all other similar stream classes in the Elliott Creek watershed, from occupying Joe Creek. Significant impact to Joe Creek is also demonstrated by macroinvertebrate surveys which show significant reductions in macroinvertebrates between the Site and the confluence of Joe Creek and Elliott Creek.

The objectives of the SI include addressing data gaps remaining from the previous investigations, assessing risk associated with mine-affected media, and evaluating three potential disposal sites (referred to herein as “repositories”) for mine-affected media as part of an Engineering Evaluation/Cost Analysis (EE/CA) of potential removal options. To meet this objective, the SI included the following three major elements:

- Further assessment of ongoing or potential mine-related impacts to upland and freshwater aquatic habitats and their associated media via collection and laboratory analysis of groundwater, surface water, soil, waste rock, sediment, and fish tissue samples.
- Assessment of the ongoing or potential risk to human and ecological receptors from exposure to contaminated media via completion of screening-level human health and ecological risk evaluations.
- Subsurface investigation of the repositories and collection of soil samples from these areas and waste rock samples from the Site for geotechnical laboratory analysis.

The results of the geotechnical analysis of the repository area will be used and presented as part of the EE/CA. Concerning the assessment of mine-related impacts and their associated effects on human and ecological receptors, the SI resulted in the following conclusions:

#### Groundwater Pathway

Groundwater discharges from seeps and adits at the Site and flows overland as surface water directly into Joe Creek. URS sampled groundwater as it emerges from two adits and two seeps. Dissolved metals in groundwater discharging from seeps and adits are present at high concentrations that result in an unacceptable risk to human and ecological receptors.

In addition to the observed discharge of contaminated groundwater from the adits and seeps directly to surface water, an additional likely complete migration pathway for the discharge of contaminated groundwater to Joe Creek is through the infiltration of precipitation into waste rock. As the precipitation infiltrates through the waste rock it becomes contaminated with metals, the downslope flow of that precipitation as groundwater discharges directly to Joe Creek as base flow. So long as waste rock remains at the Site, discharge of contaminated groundwater to Joe Creek will likely continue into the foreseeable future.

#### Surface Water Pathway

The surface water pathway is complete for both human and ecological receptors. Plots of cadmium, copper, and zinc concentrations in Joe Creek surface water clearly indicate that the Site is a significant source of these metals in Joe Creek. Surface water at the Site and in Joe Creek downstream of the Site exceeds ecological surface water criteria for copper, cadmium and zinc. Elevated concentrations of cadmium, copper and zinc are also detected in the emerging groundwater below the log dam in the run-off channel that discharges to Joe Creek. Due to these elevated concentrations, these locations should be considered as potential hot spots for ecological risk.

For human health risk from exposure to surface water, only consumption of fish was considered a significant exposure pathway. Fish collected in Elliott Creek, the Middle Fork Applegate River downstream of the mouth of Elliott Creek, and the head of Applegate Reservoir contain unsafe concentrations of arsenic in regard to human consumption, and only arsenic was present in surface water at concentrations that exceeded the related screening criteria at a number of locations.

#### Soil Pathway

The pathway for riparian soils is complete for both ecological and human receptors. Riparian soils adjacent to Joe Creek contain arsenic at concentrations that result in unacceptable ecological risk. Excess cancer risks, as calculated in the risk evaluation (Appendix B), are present for arsenic in riparian soils

along Joe Creek, Elliott Creek, and the Middle Fork Applegate River. However, surface water and sediment data indicate that the Site is not a source of arsenic.

#### Waste Rock Pathway

Site workers moving or removing waste rock could be exposed to metals through incidental ingestion of waste rock particles, dermal contact with waste rock materials, and inhalation of fine particles of waste rock or dust containing metals from the waste rock. These same exposures are possible for short-term visitors, although the exposure durations are likely to be less for visitors than for workers.

#### Sediment Pathway

The sediment pathway is complete for human and ecological receptors. Plots of cadmium, copper, lead, and zinc concentrations in Joe Creek sediment clearly indicate that the Site is a significant source of these metals in Joe Creek. Cadmium, copper, and zinc in Joe Creek sediments are present at concentrations that result in an unacceptable risk to ecological receptors. Copper is also present in Elliott Creek, the Middle Fork Applegate River, and the Applegate Reservoir sediments at concentrations that result in an unacceptable risk to ecological receptors.

#### Removal Action Justification

The results of the SI, combined with the results of previous investigations, clearly demonstrate that a removal action is justified. Factors required for consideration in determination of the appropriateness of a removal action as stated in 40 CFR 300.415 (shown in italicized bold font) and the associated justifications are summarized below.

- ***Actual or potential exposure nearby human populations, animals, or the food chain from hazardous substances or pollutants or contaminants.***

The Site is a historic and ongoing source of AMD from adits and waste rock areas resulting in impacts to groundwater, surface water, and sediment quality. Releases of AMD pose unacceptable human health and ecological risks within the immediate area and downstream to Applegate Reservoir. These impacts are already apparent through the absence of fish and amphibians and significant reductions in the macroinvertebrate populations in Joe Creek, demonstrating the watershed-scale level of impacts that the Site is having. Barring a removal action, fish are unlikely to return to Joe Creek in the foreseeable future.

- ***Actual or potential contamination of drinking water supplies or sensitive ecosystems.***

Sensitive, threatened and endangered species have been identified in the vicinity of the Site. The northern goshawk is a United States Fish and Wildlife Service (USFWS) candidate species. The Siskiyou Mountain salamander is listed as a United States Forest Service (USFS) sensitive species and a California-endangered species. The northern bald eagle and the northern spotted owl also reside in the area and are both federally listed threatened species.

Besides those impacts already observed, continued discharge of contaminants from the Site combined with downstream transport of contaminants in surface water and sediment could potentially result in future elevated levels of contamination in aquatic environments and risk to human and ecological receptors as far downstream as Applegate Reservoir.

- ***Hazardous substances or pollutants or contaminants in drums, barrels, tanks, or other bulk storage containers that may pose a threat of release.***

A log dam is located at the bottom of the waste rock covered slopes in the run-off channel that discharges to Joe Creek. Eroded waste rock has settled and accumulated behind this dam, if it were to fail these wastes would be released into Joe Creek.

- ***High levels of hazardous substances or pollutants or contaminants in soils largely at or near the surface, that may migrate.***

Metals are transported from the Site via sediment transport. Cadmium, copper, lead and zinc concentrations in sediments along the segment of Joe Creek between the Site and Elliott Creek are significantly elevated compared to background samples, indicating the Site is a significant source of the metals in Joe Creek sediment. The sediment transport mechanism is further substantiated by the trend of these same metals also increasing in the reach of Joe Creek between the Site and Elliott Creek.

Barring a removal action, all of the impacts, contamination, and human and ecological risk will continue into the indefinite future due to the discharge of groundwater, surface water, and sediment from the Site.

- ***Weather conditions that may cause hazardous substances or pollutants or contaminants to migrate or be released.***

Periods of high precipitation and surface runoff erode the waste rock and transport waste material as sediment to Joe Creek.

- ***The availability of other appropriate federal or stated response mechanisms to respond to the release.***

Previous actions by the USEPA have attempted to mitigate the release of metals from the Site, but these actions do not appear to have been fully effective as metals continue to be found in surface water downstream from the Site. These actions included the resurfacing of the waste rock piles, redirection of AMD into a marble lined channel, and creation of a settling pond behind a log dam. Within one year of its' construction, the detention pond behind the dam was filled with sediment.

- ***Other situations or factors that may pose threats to public health or welfare of the United States or the environment.***

Continued discharge of contaminants from the Site combined with downstream transport of contaminants in surface water and sediment could potentially result in future elevated levels of contamination in aquatic environments and risk to human and ecological receptors as far downstream as Applegate Reservoir. The reservoir was constructed in 1980, and now acts as a trap and accumulation point for contaminated sediments.