Executive Summary

The U.S. Environmental Protection Agency (EPA) is conducting a remedial investigation and feasibility study to address contamination associated with the Lava Cap Mine Superfund Site. The Lava Cap Mine is located in Nevada County, California, approximately 5 miles southeast of the town of Nevada City. This executive summary presents a general summary of the remedial investigation in the following three sections: site background and setting, remedial investigation activities, and remedial investigation results. These topics are described in more detail in main body of this Remedial Investigation Report.

The primary objectives of the Lava Cap Mine remedial investigation are to:

- Characterize physical conditions in the vicinity of the Lava Cap Mine;
- Characterize the nature and extent of contamination associated with the mine in soil, sediment, surface water, groundwater, air, and biota;
- Collect sufficient data to support informed risk management decisions regarding human health and the environment; and
- Collect sufficient data to support preparation of the Feasibility Study

Based on the information gathered during the remedial investigation, potential remedial alternatives will be developed to address any areas requiring remediation. The feasibility study will provide detailed evaluations of alternative remedial actions. The remedial investigation/feasibility study process at the Lava Cap Mine Site will lead to a Record of Decision. In the Record of Decision, EPA will describe the environmental cleanup actions selected to mitigate risks to human health and the environment from Lava Cap Mine Site contamination.

Site Background and Setting

Site Background

Lava Cap Mine occupies approximately 30 acres in a rural residential area of the Sierra Nevada foothills. The mine property is bordered on all four sides by forest and low-density residential areas. There are several structures at the mine, including the former mill building, the former cyanide treatment building, a number of other old mine buildings, and several residences.

Gold and silver mining activities were initiated at the Lava Cap Mine (formerly known as the Central Mine) in 1861. The Banner Mine began operation in 1860. The Banner Mine is approximately 1.5 miles north of the Lava Cap Mine. These two mines were later operated by the Lava Cap Gold Mining Corporation (starting in 1934), and at that time, the Central Mine became known as the Lava Cap Mine.

The initial operating period at the mines was from 1860 to 1918. Relatively small-scale mining operations occurred during this initial period. The Banner and Central Mines were inactive from 1918 until 1934. Prior to resuming mining, a flotation plant was built to process the ore at the renamed Lava Cap Mine property. At some point after the mines were reopened, the Banner and Lava Cap Mines were connected underground and all ore was processed in the Lava Cap mill. Once operations resumed, Lava Cap Mine was one of the largest gold mines operating in California, processing approximately 300 to 400 tons of ore a day during this period.

In 1940, a cyanide plant was built to recover gold from the concentrates onsite, but this operation was relatively ineffective. From 1941 to 1943, the cyanide plant handled only the middlings (a process intermediate that is normally recycled in the mill to recover residual values) and tailings from the flotation plant, and did not handle the higher grade flotation concentrates.

Tailings from flotation and cyanidation processes were deposited in a ravine on the Lava Cap Mine property. A log dam, approximately 30 feet high, was built to hold the tailings in place where the ravine steepened and narrowed. The waste rock and overburden were deposited in two piles between the mine shaft and the tailings pond that formed above the log dam.

The Lost Lake Dam, reportedly constructed in 1938, is approximately 50 feet high and located approximately 1.25 miles downstream of the Lava Cap Mine. The dam was constructed as a mine tailings impoundment and created Lost Lake. Lost Lake is a private lake with a surface area of approximately 5 acres. During mining operations, mine tailings were released into Little Clipper Creek where they were transported to Lost Lake. In 1943, Lava Cap Mine was closed because the federal government prohibited the production of non-strategic metals during World War II.

During a major winter storm in January 1997, the upper half of the log dam collapsed, releasing over 10,000 cubic yards of tailings into Little Clipper Creek. Following the dam failure, extensive deposits of tailings were observed in Little Clipper Creek, in Clipper Creek below the confluence with Little Clipper Creek, and in Lost Lake. The tailings were also observed in wetland areas contiguous with these water bodies, in some cases, reportedly covering the vegetation.

In October 1997, EPA determined that conditions associated with the tailings release from the Lava Cap Mine met the criteria for a removal action. The primary concern was the potential for additional releases of tailings from the tailings pile. Starting in October 1997, 4,000 cubic yards of tailings were removed from just upstream of the damaged log dam and stockpiled on the waste rock pile to the north of the tailings pile. The oversteepened slopes of the tailings pile immediately behind the dam were graded, and the entire tailings pile was covered with waste rock to improve stability. Stream diversions were also constructed around the waste rock and tailings piles.

EPA formally listed the Lava Cap Mine Site on the NPL in February 1999, allowing Superfund funding to be spent on investigation and cleanup of the Site.

Site Setting

Lava Cap Mine is on the southern slope of Banner Ridge at approximately 2,800 feet above mean sea level (msl). The Little Clipper Creek drainage below the log dam is relatively steep, dropping to approximately 2,468 feet above msl at the confluence of Little Clipper Creek and Clipper Creek located 1 mile downstream.

Nevada County generally has warm, dry summers and mild, wet winters. Most of the precipitation comes during the 6 month period from November through April. Annual precipitation is approximately 53 inches in Nevada City, California.

Surface Water

The Lava Cap Mine property is located entirely within the Little Clipper Creek drainage basin. The upper reaches of Little Clipper Creek above the mine are seasonally dry and become perennial (year-round flow) below the mine where Little Clipper Creek is fed by mine discharge. Little Clipper Creek flows downstream from the Lava Cap Mine log dam for approximately 1 mile to the confluence with Clipper Creek in the Deposition Area above Lost Lake. Clipper Creek continues downstream through the Deposition Area and into Lost Lake, which is contained by the Lost Lake Dam. There is constant seepage beneath the Lost Lake Dam into the Clipper Creek channel below the dam. In addition, during most of the year, there is at least some flow over the spillway on the dam. Clipper Creek continues for less than a quarter of a mile below Lost Lake before it enters Little Greenhorn Creek.

Water discharges continuously from the caved-in adit, located in the waste rock pile area at the mine. Under normal, non-storm conditions, the flow rate from the adit was estimated to range from a low of around 50 gpm (approximately 0.1 cfs) to a high of about 200 gpm (or around 0.5 cfs). Normal flows in Little Clipper Creek and Clipper Creek are fairly low (typically no more than between 5 and 15 cfs for much of the year), but these creeks can experience significant increases in flow during winter storm events. Estimated peak flows in the winter of 2000 exceeded 300 cfs in both Little Clipper Creek and Clipper Creek.

Geology

The Lava Cap Mine Site is located in the Sierra Nevada physiographic province, which is characterized by intrusive and volcanic igneous rocks as well as metamorphosed sedimentary rocks that are faulted and fractured. In general, these rocks are highly weathered at the surface.

The key rock types in the Lava Cap Mine area, include: mine deposits, including waste rock and tailings; tertiary volcanic breccias commonly referred to as lava; zones of Tertiary conglomerates or gravels; and Paleozoic to Upper Jurassic metasedimentary rocks, including argillites, slates, conglomerates, thin-bedded cherts and other metasediments (Cole / Mills Associates, 1985).

In the vicinity of the historic mining activities at the Lava Cap Mine, the surface is covered by waste rock, underlain by tailings at the southern end of the mining area. The waste rock is a gravel and rock mixture, comprised primarily of metasedimentary unit rocks. The tailings range from fine sand to (more commonly) clay that is dark gray when wet and unoxidized. The metasedimentary rocks encountered beneath the waste rock / tailings pile

were observed to be a greenish-gray argillite with evidence of quartz, feldspar, and sulfide minerals present in small amounts.

The mine workings are located entirely within the metasedimentary unit. Gold-bearing quartz veins averaging 5 feet in width occur along inactive reverse faults that are oriented north-northwest and dip about 51 degrees to the east (Cole / Mills Associates, 1985). The ore material contains abundant carbonate material cut by igneous dikes of varying origin. The silver- and gold-rich ore also contains relatively high concentrations of sulfides rich in iron and arsenic.

Hydrogeology

Groundwater flow is primarily to the south-southeast between the mine and the Lost Lake area (Cole / Mills Associates, 1985), based on data from a regional domestic well survey (Hydrosearch, 1984). Shallower domestic wells, less than 200 feet deep, have an average yield of 18 gpm. Deeper domestic wells generally penetrate 300 to 570 feet, producing from 0.25 to 140 gpm (Cole / Mills Associates, 1985).

Potable groundwater throughout the Lava Cap Mine Site is contained in secondary openings (fractures and joints) of the metasedimentary bedrock unit. This fractured rock aquifer is the source of domestic water supply throughout the Site vicinity.

Water levels measured in monitoring wells completed through the waste rock / tailings pile and into the upper portions of the metasedimentary unit suggest there is a downward hydraulic gradient in the shallow bedrock aquifer. The downward gradient indicates the potential for impacted water in the shallowest portions of the aquifer beneath the tailings pile to migrate downward and deeper into the bedrock aquifer.

Groundwater also occurs in the fractured volcanic breccia (the “lava cap” on the ridge), that overlies the metasedimentary rocks north of the mine. Several springs are identified at the surface contact between the volcanic and metasedimentary units. The springs suggest that groundwater may be perched in the lava unit, with limited flux into the underlying metasedimentary unit. However, there are no direct measurements to verify this.

At the mine, shallow saturated zones are present within the waste rock / tailings pile and discharging from the mine adit. Shallow saturated zones are also present in the upper portions of the metasedimentary unit, immediately beneath the waste rock / tailings pile. This shallow water was sampled at several locations during the RI field effort, including the mine discharge from the adit, seeps from the tailings pile, and shallow monitoring wells completed beneath the waste rock / tailings pile. Elevated concentrations of arsenic are found in all of these locations suggesting that the two systems (the saturated mine wastes / workings and the underlying shallow metasedimentary unit) may be interconnected.

Remedial Investigation Activities

The remedial investigation at the Lava Cap Mine Site included geologic, hydrogeologic, air, and ecological investigations that involved collection of soil, sediment, surface water, groundwater, air, and biota samples. Samples were collected in the following general areas:

- Reference Areas –Includes areas upgradient or upstream of potential impacts from Lava Cap Mine contaminants. Samples are collected from reference areas to provide a baseline for comparison to samples collected in areas potentially impacted by contamination from the mine.
- Lava Cap Mine Source Areas –Covers the portions of the mine property where tailings, waste rock, and other waste from the historic mining operations are located and ongoing discharge of water from the mine occurs.
- Lava Cap Mine Area –Includes the portion of the mine property that is potentially impacted by mine contaminants, but does not specifically contain source materials.
- Downgradient of Lava Cap Mine –This area includes everything downstream of the mine where contaminants from the Lava Cap Mine could potentially have been transported during historic and ongoing contaminant releases. In particular this covers portions of Little Clipper Creek, Clipper Creek, Lost Lake, Little Greenhorn Creek and land adjacent to these water bodies.

The Lave Cap remedial investigation field program included three rounds of data collection. In addition, selected surface water locations were sampled approximately monthly. The following table (Table ES-1) provides a summary of the types of environmental samples collected in each area by media.

TABLE ES-1
Summary of Sample Collection Activities for the Lava Cap Mine Remedial Investigation
Lava Cap Mine, Nevada County, California

Location	Surface Soil	Subsurface Soil	Air	Groundwater	Surface Water	Sediment	Biota[1]
Reference Areas	X	X	X	X	X	X	X
Source Area	X	X	X	X	X	X	X
Mine Area	X		X	X	X	X	X
Downgradient- LCC[2]	X			X	X	X	X
Downgradient- Dep. Area[3] & Lost Lake	X	X	X	X	X	X	X
Downgradient- Below Lost Lake	X				X	X	X

Notes:
[1] Biota sampling includes collection of fish, aquatic invertebrates, terrestrial plants, terrestrial invertebrates, small mammals, frogs, and bioassay (surface water, sediment, and soil) samples.
[2] LCC – Refers to Little Clipper Creek below the mine but above the Deposition Area
[3] Dep. Area – Refers to the large Deposition Area above Lost Lake

The initial round of field activities (Round 1) was completed during October and November of 1999. Round 1 included sampling surface soil, subsurface soil, sediment (sediment is surface soil located within or adjacent to surface water bodies), air, surface water, and groundwater. Groundwater samples were collected from residential wells in the area, from new monitoring wells installed as part of the field program, and as in-situ grab samples from soil borings. Surface water samples were collected from sumps in the mine buildings,

mine discharge, ponds (at the mine and in the Deposition Area), stream channels, and Lost Lake. Other information critical to the ecological risk assessment was also gathered, including site-specific characterizations of terrestrial and aquatic habitats and potential ecological receptors.

The second round of field activities (Round 2) was conducted during January 2000. Round 2 included re-sampling all surface water locations and monitoring wells and surface soil sampling.

The third round of field activities (Round 3) was completed during May and June of 2000. Round 3 included collecting numerous bioassay and biota samples and re-sampling most surface water and monitoring and residential well locations.

A supplemental round of groundwater sampling was conducted in September 2000 at each of the monitoring wells installed during the field investigation.

Remedial Investigation Results

The samples collected during the remedial investigation field investigation indicate that impacts from Lava Cap Mine releases are prevalent throughout the Lava Cap Mine area and downgradient areas along the Little Clipper Creek and Clipper Creek drainages. The following summarizes the results of the remedial investigation.

The finely ground tailings associated with mining activities at the Lava Cap Mine contain elevated concentrations of inorganic constituents, including arsenic and various other metals. Without exception, tailings-impacted areas are uniformly high in arsenic, while reference area concentrations are consistently much lower. Arsenic contamination occurs at levels that pose a significant threat to human and ecological receptors at the mine and in areas downgradient of the mine directly impacted by tailings and mine discharges. Based on the results of the Human Health Risk Assessment (discussed below), arsenic is the only significant risk driver identified in the areas impacted by releases from the Lava Cap Mine Site. Arsenic also is the primary risk driver in the ecological risk assessment, although numerous other inorganic constituents also represent potential risks to ecological receptors in different areas and media at the Site.

Transport of tailings as suspended and/or dissolved constituents in Little Clipper Creek and Clipper Creek surface water appears to be the most significant migration pathway at the Lava Cap Mine Site. The extent of flooding along Little Clipper Creek, associated with the January 1997 flood event and the extent of arsenic impacts around the Deposition Area and Lost Lake (based on samples from upslope areas) have been used to determine the approximate extent of Lava Cap Mine impacts downstream of the mine.

Elevated arsenic levels are detected in surface soils, sediments, and surface water along the Little Clipper Creek/Clipper Creek drainage below the mine. The concentrations are uniformly high in areas where deposition of tailings-impacted sediment has occurred along the Little Clipper Creek/Clipper Creek drainage. In particular, soil and sediment in the large Deposition Area above Lost Lake and in Lost Lake itself contain high arsenic concentrations.

Arsenic concentrations in Little Clipper Creek, Clipper Creek, and Lost Lake fluctuate with surface-water flow rates throughout the year. Periods of low water flows (i.e., late summer) correspond to the highest arsenic concentrations in these downstream surface water bodies. Conversely, high flow periods have the lowest arsenic concentrations. This is because during the low-flow periods, nearly all the flow in the Little Clipper Creek / Clipper Creek drainage comes from mine discharges.

Summaries of the analytical results from testing of environmental media (soils, sediments, surface water, groundwater, and air) for arsenic follow. Table ES-2 presents a summary of arsenic concentrations detected in surface soil, sediment, surface water, and groundwater throughout the Lava Cap Mine Site and surrounding areas, including the reference areas.

Reference Areas

As expected, nearly all the metals and other inorganic constituents detected in mine tailings and source area samples are also present in samples collected from the reference areas, but at lower levels. This was expected because all of the inorganic metals are naturally occurring in geologic materials from the Lava Cap Mine area. Arsenic concentrations in Reference Area surface soil and sediment are relatively uniform. Arsenic concentrations are very low in Little Clipper Creek above the mine. The upgradient monitoring well does have elevated levels of arsenic. This upgradient well is completed in a different formation (the lava formation present along the ridge line) than the rest of the monitoring and residential wells sampled at and downgradient of the mine. Most of the residential wells sampled downgradient of the mine have little or no arsenic. This implies that the upgradient well may not be a representative reference location for all areas of the site.

Source Areas

Contaminant source areas at the site include those areas where mine tailings and other mining wastes are present. This includes the waste rock / tailings pile and soil and water in historic mine buildings. The source area also incorporates mine discharge from the collapsed adit (continuous), tailings pile seeps (seasonal), and discharge from the base of the log dam (continuous). The current volume of tailings and waste rock below the adit discharge point is estimated at approximately 167,000 cubic yards. More than 10,000 cubic yards (estimated) of tailings were released during the January 1997 dam collapse and storm event.

As Table ES-2 illustrates, arsenic concentrations are highest in surface soil inside the mine buildings and adit discharge sediment.

Subsurface soil samples from borings in the tailings / waste rock areas contain elevated arsenic concentrations that tend to decrease with depth. Arsenic concentrations of the deepest samples in all but one boring are below 100 mg / kg.

A sample of ponded water from sumps in the historic mine building yield the highest arsenic concentrations detected during the remedial investigation. There are three other surface water sources at the mine with elevated arsenic levels: the adit discharge, the waste rock / tailings pile seep, and the tailings pile underflow that discharges from the base of the log dam. Monthly sampling of selected source area surface water shows that arsenic

Insert Table ES-2

concentrations fluctuate with the volume of water discharged. Arsenic concentrations are highest during the low flow periods (late summer) and lowest during the high flow periods (winter to early spring).

Arsenic concentrations in groundwater beneath the waste rock/tailings pile portion of the source area are variable, but generally fall in the 100 to 500 µg/L range.

Arsenic is detected in one of four air samples collected in the source area at the mine. The concentration exceeded the EPA PRG.

Mine Area

The mine area refers to all areas at the mine outside of the specific source areas discussed above. Mine area samples include surface soil, sediment, surface water, groundwater, and air. Samples were collected from the vicinity of mine residences, areas surrounding the historic mine buildings, and areas outside the waste rock/tailings piles. Arsenic results for the mine area samples are summarized in Table ES-2.

All groundwater samples collected from residential wells at the mine contain arsenic. The highest concentration (528 µg/L) is from a well installed to supply a newly-constructed residence at the mine. Based on water quality data, it appears that this well likely intersects the subsurface mine workings (arsenic concentrations are similar to those in the mine discharge from the adit) and it is not being used for domestic supply. Maximum arsenic concentrations detected in the other residential wells at the mine range from 17.6 µg/L to 56.8 µg/L.

One of the air samples collected in the mine area contained arsenic at nearly 150 times greater than the EPA PRG.

Data show that elevated concentrations of arsenic are present around both the historic mine buildings and the residences. Sampling away from the waste rock/tailings pile areas indicates that arsenic concentrations in surface soil are reduced to near reference area levels a relatively short distance (10s of feet) from the areas covered with waste rock or tailings.

Little Clipper Creek below the Log Dam

In the areas along Little Clipper Creek below the log dam, tailings were carried in the January 1997 floodwater as suspended solids and dissolved constituents in the Little Clipper Creek surface water flows. These tailings and associated constituents were deposited on the ground surface as the floodwaters receded to normal levels. A relatively thin coating of tailings was probably deposited over the entire area reached by the floodwaters. Three smaller deposition areas have been identified along Little Clipper Creek between the log dam and the Little Clipper Creek/Clipper Creek confluence.

In the stream channel itself, there are limited areas with sediment accumulation. However, the results indicate that wherever sediment can accumulate in the Little Clipper Creek channel, tailings impacts are present.

Samples collected along the Little Clipper Creek drainage between the log dam and the Little Clipper Creek/Clipper Creek confluence indicate that arsenic concentrations for surface soil, sediment, and surface water are elevated above reference levels but are lower

than those detected at the mine (Table ES-2). Elevated levels of arsenic have also been detected in groundwater samples from one residential well located along the Little Clipper Creek drainage below the mine.

Deposition Area and Lost Lake

In the Deposition Area and around Lost Lake, the data indicate that throughout this area, all samples below an elevation of 2,468 feet above msl have been impacted by releases from the mine.

The remedial investigation results indicate that the materials present from the ground surface all the way down to the bedrock beneath the Deposition Area are comprised primarily of tailings. The total thickness of tailings-impacted soil ranges from 22 to 28 feet in the upper end of the Deposition Area. Based on site history (Lost Lake was created as a tailings impoundment) and data from Deposition Area borings, it is presumed that all sediment filling Lost Lake is also tailings-impacted. Using the approximate shape of the original stream canyon and the current ground surface elevation, the estimated volume of tailings-impacted sediments deposited in the Deposition Area and Lost Lake is approximately 500,000 cubic yards.

Surface water samples collected from the permanent pond near the Little Clipper Creek/Clipper Creek confluence have elevated arsenic concentrations ranging from 599 to 1,160 µg/L. Groundwater samples collected from shallow monitoring wells completed in the tailings-impacted soils of the Deposition Area also contain elevated arsenic concentrations, ranging from 235 to 2,430 µg/L. However, none of the residential wells sampled around Lost Lake and Deposition Area contain arsenic above 1 µg/L.

Arsenic was not detected in air samples collected from the two Deposition Area locations sampled. However, conditions at the time of sampling were not ideal for detecting air particulate transport (i.e., there was little wind and conditions were not particularly dry).

Surface soil samples collected from lower elevations (generally within 25 feet of the lake shoreline) on residential properties around Lost Lake generally have elevated arsenic concentrations, ranging up to 848 mg/kg. Most of these samples were collected below the elevation of 2,468 feet above msl, which delineates impacted from non-impacted surface soil. Arsenic concentrations in the samples collected upslope from the lake (above elevation 2,468 feet) and towards the residences around Lost Lake and the Deposition Area range from 6.6 to 38.4 mg/kg. This concentration range is similar to reference area concentrations.

All sediment samples collected from Lost Lake, shallow and deep samples from both the northern and southern lobes, contain elevated arsenic concentrations ranging from 304 to 1,140 mg/kg.

Surface water samples collected from Lost Lake have arsenic concentrations ranging from 5.8 to 70.6 µg/L. Arsenic concentrations generally are higher in the southern lobe of the lake than in the northern lobe. Arsenic concentrations in surface water samples from Clipper Creek through the Deposition Area and in Lost Lake were highest during the October 1999 sample event, when flow rates and lake levels were the lowest.

Downgradient of Lost Lake

The area downgradient of Lost Lake is also impacted by releases from Lava Cap Mine. The majority of suspended solids present in Little Clipper/Clipper Creeks below the mine likely settle out in Lost Lake and the Deposition Area. However, in the 1997 flood event, the surface water flowing over the Lost Lake Dam reportedly was milky in appearance indicating that tailings entered the drainages beyond Lost Lake Dam. Surface soil sample results from the relatively large, flat area near the confluence of Clipper Creek and Little Greenhorn Creek indicate that deposition of tailings occurred in this area. Additional tailings associated with the 1997 event most likely were carried further down the watershed. Although downstream concentrations are much lower than those detected further upstream towards Lost Lake, the data indicate that Lava Cap Mine-related impacts likely extend some distance downstream into Little Greenhorn Creek. Additional sampling downstream in Little Greenhorn Creek will be performed to better delineate the downstream extent of Lava Cap Mine impacts.

The arsenic concentration detected in the furthest downstream surface water sample (collected from Little Greenhorn Creek just down from the Clipper Creek) was the lowest of any non-reference area surface water sample collected during the May 2000 sampling event (15.9 µg/L). However, this data point and those at the base of the Lost Lake Dam confirm that there is continuous loading of arsenic from the Lava Cap Mine Site into the Little Greenhorn Creek drainage.

Risk Assessments

The baseline human health and ecological risk assessments indicate that many areas at and downgradient of the mine, impacted by mine-related contamination, contain levels of inorganic constituents, particularly arsenic, that pose a significant potential risk to human and ecological receptors.

Human Heath Risk Assessment

The Human Health Risk Assessment concludes that arsenic is the primary risk driver in impacted areas and is the only constituent that contributes significantly to the estimated risks to human receptors. The Human Health Risk Assessment evaluates potential risks to mine workers, mine resident, residents/recreational users along Little Clipper Creek below the mine, residents/recreational users around Lost Lake, recreational users of the Deposition Area, and recreational users of Clipper Creek below Lost Lake. Six exposure units at the mine and in downgradient areas were identified for estimating potential risks.

Results of the baseline risk assessment for the six exposure units indicate that potential cancer risks for both current receptors and future hypothetical receptors exceed EPA's risk management range of 10^{-6} to 10^{-4}. The estimated potential cancer risks in all exposure units range from 10^{-5} to 10^{-3} with most of the scenarios having risk estimates that are greater than the corresponding background cancer risks. Noncancer HI estimates for all exposure units exceed one and most exceed their respective background noncancer HI, indicating the potential for noncancer health impacts. The risk driver for all exposure units and media is arsenic. The estimated risks for residents around Lost Lake and along Little Clipper Creek do not exceed background as long as the residents <u>do not</u> participate in recreational activities around the lake or creek and <u>do not</u> have elevated arsenic in their residential well.

Ecological Risk Assessment

The Ecological Risk Assessment evaluates risks to fish, sediment biota (benthic invertebrates), amphibians (e.g., red-legged frogs), terrestrial plants, soil invertebrates (earthworms), soil microbial processes, and several species of birds and mammals (e.g., American dipper, red-tailed hawk, green heron, California quail, mink, ornate shrew, California vole, and long-tailed weasel) from mine-related contaminants in surface water, sediment, and soil. The ERA concludes that multiple mine-related contaminants in soil, sediment and surface water pose a potential risk to multiple ecological receptors at the Lava Cap Mine and in all downgradient areas impacted by mine releases.

Overall, arsenic impacts the most potential receptors in all areas and is considered the primary risk driver (although other constituents may represent higher risks for specific receptors). Antimony, cadmium, copper, cyanide, lead, mercury, silver, and zinc are also dominant risk drivers in the Mine Area. In the Little Clipper Creek, Deposition Area, Lost Lake, and Downgradient of Lost Lake areas, arsenic is the only constituent that represents a potential risk to 5 or more receptors and, thus, is considered the most significant risk driver. Other constituents represent potential risks to individual receptors in different areas, but they are generally more isolated to a specific area or receptor.

Ongoing Remedial Investigation Activities

The remedial investigation field program was executed in a phased manner to focus sampling and field efforts in a scientifically sound and cost-effective manner. Limited additional sampling and analysis is continuing to address data gaps or uncertainties that could affect evaluation of remedial alternatives in the Feasibility Study or decisionmaking for selection of a cleanup remedy. In addition, EPA is making plans to perform additional remedial investigation fieldwork to further assess potential migration of contaminated groundwater away from the mine.

The ongoing activities fall into three categories: routine quarterly groundwater and surface water monitoring, investigation to fill data gaps for the Feasibility Study, and investigation to fill data gaps in the understanding of groundwater conditions. Each of these is summarized below:

- **Routine Quarterly Monitoring -** A quarterly monitoring program for selected groundwater (monitoring wells and residential wells) and surface water locations is being implemented to track the seasonal and temporal variability of physical and chemical conditions in these two media.
- **Feasibility Study Data Gaps Investigation** - The data gaps investigation is intended provide data in several areas that affect the development and cost of various remedial options that may be considered in the Feasibility Study.
- The downgradient extent of Lava Cap Mine impacts in Little Greenhorn Creek has not been determined. Additional surface water and sediment samples will be collected.
- Additional information is needed on the geotechnical properties of the Lost Lake Dam, the log dam abutments at the mine, and the waste rock/tailings piles to fully develop and cost various remedial options.

- Potential off-site disposal options for mine tailings are impacted by toxicity characteristics of the material. Samples will be analyzed to provide this information.
- **Groundwater Investigation** - EPA is planning to perform supplemental remedial investigation activities specifically to further evaluate groundwater conditions and the mine. The additional data collection and evaluation will help EPA determine if groundwater contamination is migrating away from the mine and if mine-related contamination is impacting residential wells at or downgradient of the mine. Currently, the lack of information on groundwater flow paths limits how well contaminant movement can be defined within this media.

  Additional data collection activities may include:

  – Installation of additional monitoring wells in the upgradient reference area, in deeper bedrock locations beneath the waste rock/tailings pile and the Deposition Area, and in areas between the tailings pile and residential wells

  – Sampling of additional residential wells immediately downgradient from the mine

  – Gathering information on residential well construction and stratigraphy

  – Broader analyses of groundwater chemistry