ENGINEERING EVALUATION/COST ANALYSIS
For The
SISKON MINE
TAILINGS AND MILL SITE

Six Rivers National Forest
1330 Bayshore Way
Eureka, CA 95501
U.S. D. A. -- Forest Service, Pacific Southwest Region

Report Date: May 12, 2003

Siskon Mine Tailings Pond, circa. 1970

Siskon Mine Tailings Pond and Mill, 1993

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List of Acronyms

ABA	Acid-base accounting
ACS	Aquatic Conservation Strategy
AMSL	Above mean sea level
ARARs	Applicable, Relevant and Appropriate Requirements
ATV	All-terrain Vehicle
AWQC	Ambient water quality criteria
BE/BA	Biological Evaluation/Biological Assessment report
Cal-WET	California Waste Extraction Test
CARB	California Air Resources Control Board
CCR	California Code of Regulations
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CDFG	California Department of Fish and Game
CFR	Code of Federal Regulation
cfs	cubic feet per second
CH	Critical Habitat
cyds	cubic yards
CFS	Cubic Feet per Second
DTSC	Department of Toxic Substances Control
EE/CA	Engineering evaluation/cost assessment
EFH	Essential Fish Habitat
EPA	United States Environmental Protection Agency
ERA	Ecological risk assessment
ESU	Evolutionary Significant Unit
KMP	Klamath Mountains Province
MCL	Maximum contaminant level
MSA	Magnuson-Stevens Act
NCP	National Oil Spill and Hazardous Substances Contingency Plan
NCRWQCB	North Coast Regional Water Quality Control Board
NOAA	National Oceanic and Atmospheric Administration
NRHP	National Register of Historic Places
OHV	Off Road Vehicle
OSC	On-Scene-Coordinator
PA	Preliminary Assessment
PA/SI	Preliminary Assessment/Site Inspection
PRG	Preliminary Remediation Goal
RMC	Risk Management Criteria
SOPA	Schedule of Proposed Actions
SCAPCD	Siskiyou County Air Pollution Control District
SONCC	Southern Oregon Northern California Coasts

SQRT	Screening Quick Reference Tables
STLC	Soluble threshold limit concentration
TEL	Threshold Effects Level
TSD	Treatment, Storage and Disposal facility
TTLC	Total threshold limit concentration
UKTR	Upper Klamath Trinity River
USDA	United States Department of Agriculture
USFS	United States Department of Agriculture Forest Service
USGS	United States Geological Survey
WAD	Weak acid-dissociable

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This Engineering Evaluation/Cost Analysis (EE/CA) was prepared by the Klamath National Forest, which has responsibilty for the technical oversight of the Siskon Mine Project, located on National Forest Lands (Ukonom Ranger District, Klamath National Forest) that have been administered by the Six Rivers National Forest since 1999. The EE/CA was prepared under the authority of Comprehensive Environmental Response, Compensation, Liability Act of 1980 (CERCLA) and the Superfund Amendments and Reauthorization Act of 1986. The Klamath and Six Rivers National Forest team involved in the technical and resource analysis included:

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Staff from the Six Rivers National Forest, and the Pacific Southwest Regional Office CERCLA Coordinating Committee have provided reviews and comments which have been incorporated into the EE/CA. Reviewers included: Alan Olson, Aquatics/Earth Program Manager, Klamath National Forest; Jan Ford, Planning/Heritage/Recreation Staff Officer, Klamath National Forest; Ed Rose, Northern Province Geotechnical Engineer and On-Scene Coordinator; William Heitler, Orleans District Ranger, Six Rivers National Forest; S. E. “Lou” Woltering, Forest Supervisor, Six Rivers National Forest; Margaret Boland, Forest Supervisor, Klamath National Forest; Belinda Walker, Assistant Regional Environmental Engineer, Pacific Southwest Region; and Dennis Geiser, Regional Environmental Engineer, Pacific Southwest Region.

EXECUTIVE SUMMARY

The Siskon Mine (Site) is an abandoned gold and silver mine on the Klamath National Forest on Ukonom Ranger District, Siskiyou County, California. Since 1999, the Ukonom Ranger District has been administered by the Orleans Ranger District of the Six Rivers National Forest. Mine tailings present at the former tailings pond and the mill at the Site from mining from 1953-1960 are being released into the envrironment, and are the source of contamination under evaluation in this Engineering Evaluation/Cost Analysis (EE/CA).

The Siskon Mine Site is located in the Klamath National Forest approximately 20 miles northwest of the town of Somes Bar, California (Figure 1). The Site is within Copper Creek drainage, which is a tributary to Dillon Creek and the Klamath River (Figure 2). The Site is within Township 14 N, Range 5 E, sections 20, and 29, Humboldt base and meridian (41° 35' 6.6" north latitude and 123° 37' 43.5" west longitude at Copper Creek road crossing) (Figure 3). The former tailings pond and mill occupy an area of approximately 2 acres along Copper Creek, just upstream from the mouth of Medicine Creek.

There are approximately 11,400 cubic yards (cyds) of tailings in the former tailings pond, 80 cyds of tailings in a remnant ore thickener vat, and 20 cyds in piles at the mill. The tailings are a fine-grained reddish brown soil, typical of final process tailings slimes after milling and leaching out the gold and silver. The contaminants of concern associated with the tailings are the following heavy metals: arsenic, cadmium, copper, iron, lead, mercury, molybdenum, selenium, silver, and zinc. The metals are characteristic of the tailings as their high concentrations exceed background (uncontaminated) levels of metals of soils from 7 to 640 times. The tailings contain elevated concentrations of arsenic and copper which exceed the values used by the State of California to classify a material as a toxic hazardous waste (California Code of Regulations (CCR) Title 22, § 66.261.24(a)(2)(A). The tailings show a very low leaching potential, a high neutralizing potential, and consequently very low potential to generate acid drainage.

Sediment from the mill tailings in the former mill tailings pond discharges directly into Copper Creek during the rainy season (November-March) and during large rain storms at other times of the year. Mill tailings have been observed directly eroding into Copper Creek, and the streambed in the downstream of the tailings discharge point is discolored with the fine-grained reddish tailings sediment. Surface erosion estimates made within the subwatershed of the mill and tailings pond indicates that annually, 17 cubic yards of sediment are mobilized of which 10 cubic yards per year are delivered into Copper Creek (USDA-Forest Service, 2002b). In simple terms, this equates to about one 10 cubic yard dump truck of contaminated sediment being deposited into the stream system every year from the tailings pond area. The high levels of metals in the tailings sediment are hazardous substances, which are chronically being released into a surface water target. Another 500 cubic yards of mine tailings mixed with channel

alluvium sediment is proximal to the Copper Creek stream channel within the estimated 100-year flood zone. This tailings sediment poses a potential large volume release into the stream system in a major flood.

The Siskon Mine has been evaluated as a historical archeological site and recommended to be ineligible for the National Register of Historic Places. Parts of the mine road, former tailings pond and mill are within the Helkau Cultural Area, which was determined to be eligible to the National Register of Historic Places in 1981. Medicine Mountain, which is located north of Medicine Creek, is the center of the Helkau spiritual and ceremonial area. Helkau is located within Ancestral Territory of the Karuk Tribe of California. The area of Helkau and Elk Valley further to the west, are also culturally significant to the Yurok and Hoopa Tribes, and cultural practitioners. Restoration and reclamation of the Siskon Mine has long been a concern and issue with the tribes.

The Site is within Critical Habitat for *Southern Oregon / Northern California Coasts* (SONCC) Evolutionarily Significant Unit (ESU) Coho salmon (*Oncorhynchus kisutch*), which is a listed *Threatened* species under the federal Endangered Species Act (USDA-Forest Service-KNF, 2003e). In addition, Essential Fish Habitat (EFH)[1] for SONNC Coho salmon and Upper Klamath -Trinity River Chinook salmon occurs in Copper Creek, Dillon Creek and the Klamath River. Klamath Mountains Province (KMP) ESU steelhead trout (*O. mykiss)* and Upper Klamath – Trinity Rivers (UKTR) ESU Chinook salmon (*O. tshawytscha*) are both listed *Sensitive* fisheries species for the Pacific Southwest Region of the Forest Service. Both steelhead and Chinook salmon are present in the Klamath River, Dillon Creek and Copper Creek. Suitable habitat for the Northern spotted owl, listed as *Threatened* under the federal Endangered Species Act, does not occur on the Site but does occur within 0.25 miles of the Site. There are no other Threatened, Endangered, Proposed, Forest Service Sensitive, or Survey and Manage Protection Buffer plant or wildlife species, requiring special management at the Site.

The Siskon Mine Site is remotely located and there are no nearby residents. The 14N31 road, which accesses the Site and Copper Creek, is gated almost five miles from the Site. The mine tailings pose a low threat to public health as recreational exposures to the tailings soil are anticipated to be rare.

A streamlined human health risk evaluation was conducted using sampling results from investigations at the Site (USDA-Forest Service, 2003a). The risk evaluation criteria that fits closest to the human exposure scenario for the Site is the BLM Risk Management Criteria for a surveyor (Ford,1996), and the Region 9 Preliminary Remediation Goals for an industrial site worker (U.S. EPA, Region 9, 2002). Comparison of these screening levels with the maximum on-site concentrations of metals indicates that arsenic and iron pose a human health risk (Appendix A, Table 1).

A streamlined ecological risk assessment was conducted as well. Plant cover on the

[1] EFH is defined in Section 3 of the MSA as "those waters and substrates necessary to fish for spawning, breeding, feeding, or growth to maturity."

tailings piles is sparse. Conclusions from visual inspection of the tailings-contaminated area and the screening level risk evaluation for plants that the tailings are phytotoxic to some extent (Appendix A, Table 2). Additional conclusions from the risk evaluation are that the metals in the tailings could pose adverse biological effects to soil organisms (Appendix A, Table 2). The lack of plants and other organic matter in or on the tailings is not indicative of a healthy soil. The wildlife receptor species for which screening levels have been developed that are closest to the animals that are known to use the site are deer mouse and white-tailed deer (Ford, 1996). The tailings are used by both deer and bear as a mineral salt lick (USDA-Forest Service, 2003a). Comparison of screening levels for wildlife indicate that arsenic, cadmium, copper, lead, mercury and zinc in the tailings all exceed the screening criteria (Appendix A, Table 2). In conclusion, the risk evaluation indicates that wildlife such as deer and small mammals such as mice have a potential to experience adverse toxic effects from the tailings. The magnitude of the threat is likely to be at least moderate to high, because some of the animals purposely use the tailings as a mineral lick, and may ingest more than would be expected by incidental ingestion of soil during grazing. The ecological risks posed to stream sediment dwelling organisms was also evaluated (Appendix A, Table 3). In summary, the high levels of arsenic, copper, mercury, cadmium and zinc in the stream sediments downstream of the tailings release not only verify the presence of the release in the aquatic system, but also indicate a potential for an ecological risk to sediment dwelling receptors in Copper Creek.

In summary, the contaminants in the tailings pose a risk to human health and the environment (Table 5). A response action that addresses erosion of tailings soil and delivery to the stream system, and minimizes exposure to the tailings by wildlife and humans on site will reduce the magnitude of threats posed by the tailings.

The USDA Forest Service is exercising its lead agency authority under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and the National Oil and Hazardous Substances Contingency Plan (NCP) to conduct a non-time-critical removal action.

The overall goals of the removal action are to:

- Protect human health, improve riparian function, aquatic and wildlife habitats, attain water quality goals, and maintain beneficial uses in the watershed area.

The objectives of the removal action are to:

1. Eliminate or reduce actual or potential human, plant, and animal, exposures to hazardous substances in the tailings
2. Eliminate or reduce the chronic surface erosion of tailings and contaminants of concern into Copper Creek.
3. Eliminate or reduce the threat of an acute large-volume release of tailings containing hazardous substances into the stream system during a future major storm or flood event.

4. Eliminate or remove the safety hazards and ecological risks posed by the open vat containing tailings, and other metal debris and tailings piles on the mill.
5. Reduce the chronic on-Site sedimentation from mine roads into the mill, former tailings pond area and Copper Creek.

Four alternatives are identified for this removal action.

1. **Alternative 1 - (No Action)** would leave the mill tailings, the tailings pond, mill area, and mine roads in their current condition. The physical conditions at the Site would remain unchanged.
2. **Alternative 2 – Consolidation, Containment, and Capping In Place** would consolidate the tailings, cap them with a layer of clean soil, and contain them with an engineered gabion retaining wall. The front of the gabion wall adjacent to Copper Creek would be protected with a "Reno Mattress" which is a partially buried scour prevention device. Riprap will be placed at the two ends of the gabion wall for additional flood protection at the transition to the natural slopes. Engineered drainage structures would be constructed to collect excess surface runoff, and water from an intermittent spring in the former tailngs pond. Final closure of the tailings would be performed by: (1) fertilizing, seeding, mulching the cap; (2) placement of erosion control matting on top of the seeded cap and, (3) planting of trees and other vegetation on the cap, after the disturbed area has stabilized and grass has been established, in order to establish long-term vegetation. Native soil and rock material comprising the cap would be obtained locally from the Site from: old fill piles on-Site; 1.5 miles of road stormproofing (excess soil removed from road berms), and borrow sites along the mine road.
3. **Alternative 3 – Tailings Removal to an Off-Site Repository Within the Ukonom/Orleans Ranger District, Cap and Revegetate.** Mill tailings would be removed from the Siskon Mine Site and transported to an off-Site mine waste repository, capped with soil and revegetated within the Ukonom/Orleans District. A waste repository of large enough (approximately 4 – 6 acres) to contain approximately 11,500 cubic yards of tailings would be designed and constructed in a suitable site location requiring minimal clearing or and grading. Borrow sites would be developed along existing Forest roads to obtain suitable capping soil. Soil excavated from the borrow sites would be excavated, hauled to the waste repository site, placed on the tailings and compacted. The cap would be fertilized, seeded, mulched and erosion control matting would be placed on top of the seeded cap. Long-term vegetation consisting of trees and other vegetation would be planted on the cap after the site has stabilized. Surface water diversion structures would be designed and constructed as needed around the repository. At the Siskon Mine Site, the hole left from tailings removal would shaped and graded to accept soil as backfill. Native soil and rock material would be placed to backfill the hole left by tailings removal. The clean soil backfill material would be graded to stable slopes, fertilized, seeded and mulched. Erosion control matting would be placed on top of the seeded area of fill. After the disturbed area has stabilized and grass has been

established, trees tolerant for site conditions would be planted to establish long-term vegetation, and reclaim the Site.

4. **Alternative 4 – Removal and Disposal.** This alternative would involve consolidating, excavating and removing approximately 11,500 cubic yards of contaminated tailings from the Site for disposal at a Class I hazardous waste landfill. Small, 10 cubic yard capacity trucks would be loaded with tailings at the Site. The trucks would then transport the material to a nearby transfer site on Forest roads, where the tailings would be transferred to larger 20 cubic yard capacity truck. The trucks would be equipped with a roll-off closed container so that no tailings dust would be emitted during highway transport. The trucks would then transport the material to the Class I landfill at Kettleman Hills, California, a one-way distance of approximately 625 miles. Similar to Alternative 3, the hole left from tailings removal at the Site would be backfilled and reclaimed.

Actions Common to All Alternatives

The following removal and reclamation activities are common to all alternatives. Metal and wood debris at the mill site, including what remains of the two vat leach tanks, will be removed and disposed of off-Site at a appropriate landfill or waste facility. Concrete on the floor of the mill site area will be ripped, broken up and removed. The disturbed areas will be sloped to drain, covered with soil, seeded, mulched and vegetated. The following roadwork would occur:

- routine road maintenance along the 14N31 road access to Copper Creek;
- construction of a temporary vented rock ford with culverts on Copper Creek (allowing fish passage, and designed to handle and pass a 100-year flow);
- repair of one landslide area along the mine road (14N31B) that accesses the mill site;
- construction of a temporary road access from the existing mine road down into the former tailings pond area; and
- stormproofing 1.5 miles of mine road (14N31B) to a hydrologically self-maintaining condition (Maintenance Level 1), so that the risk of causing adverse watershed or water quality impacts is low.

Construction and removal of the temporary road crossing on Copper Creek will be implemented during the dry season when the stream flow is low, near baseflow. The running course of the crossing will be removed seasonally at the close of operations for the year. This crossing will be decommissioned after the monitoring and revegetation phase of the project, when vehicles and heavy equipment are no longer needed to cross the creek. The temporary road to access the tailings will be decommissioned when access for heavy equipment into the former tailings pond area is no longer required.

The removal action will be implemented in phases over two years beginning in 2003, and is projected to be completed in October, 2004, depending on the availability of funding. During the first year, project operations would include all road and stream crossing-related work. The second year would include all work related to the tailings, depending on the alternative finally selected.

The three action alternatives were compared using the critieria of effectiveness, implementability and cost. Alternative 3, is more costly to implement than Alternative 2, and implementation would be more difficult because of evaluation of site suitability, obtaining approval of waste repository sites on the Forest from state and local agencies, and the added risks associated with transport of the hazardous mine tailings waste off-Site on public roads. A suitable site for the waste repository or suitable borrow sources to cap the tailings may not be readily available.

Alternative 4 exceeds the $2 million dollar cap by a large amount and would not be implementable for that reason. Like Alternative 3, implementation would be more difficult because of the large amount of waste handling, constraints on the size of the transport trucks, and the added risks associated with the transport of the hazardous mine tailings off-Site and along many miles of public roads and highways. The large number of qualified drivers, trucks, and containers needed to haul the tailings to the disposal site may be somewhat difficult to obtain locally.

In contrast, Alternative 2 - Consolidation, Containment, and Capping In Place, achieves all the evaluation criteria. The main differences between Alternative 2 and Alternatives 3 and 4 are in lower cost, and greater administrative feasibility of capping and containing the tailings in place. Alternatives 2 and 3 similarly reduce the primary problem of mobility of the tailings. Capping removes the main exposure pathways, but does not reduce toxicity or volume of the tailings. Alternative 4 reduces mobility and toxicity of the tailings, but at very high cost.

Alternative 2 – Consolidation, Containment, and Capping In Place, is the recommended removal action alternative for this Site. It achieves the removal action goal and objectives and is fully protective of human health, the environment, and the community. Implementation would be fully compliant with ARARs provided by state agencies to date, and others drawn from internal and external sources. The alternative fully addresses the primary problem posed by the tailings at the site, mobility and exposure to wildlife, aquatic organisms and plants. The containment and capping of the tailings by engineered structures will ensure both short term and long-term permanence. It is both technically and administratively feasible to implement, and can be completed in a little over one year. At an estimated cost of $0.5 million, it represents a reasonable expenditure within the target cost cap of $2 million.

1.0 INTRODUCTION

This Engineering Evaluation/Cost Analysis (EE/CA) presents findings of an environmental investigation and engineering study conducted for the mill tailings at the former tailings pond, and tailings present at the mill. The purpose of the EE/CA is to provide a vehicle for public involvement, evaluate different alternatives, and recommend a preferred alternative to minimize or eliminate any on-going release or threatened release of hazardous substances into the environment as outlined in 40 CFR 300.425(b)(2)(i)-(viii). This EE/CA is organized into the following sections: (1) Introduction; (2) Site Characterization; (3) Community Involvement; (4) Applicable, Relevant and Appropriate Requirements (ARARs); (5) Identification of Removal Action Goals and Objectives; (6) Removal Action Alternatives (7) Analysis of Alternatives (8) Comparative Analysis of Removal Action Alternatives; (9) Recommended Removal Action Alternative; and (10) References.

Mine tailings associated with the former tailings pond and mill at the Siskon Mine have been found to contain hazardous substances which are being released into the environment, (USDA-Forest Service, 2003a). The Siskon Mine is located in the Dillon Creek Watershed on Ukonom Ranger District of the Klamath National Forest and is approximately 20 miles northwest of the town of Somes Bar, in Siskiyou County, California. Since 1999, the Six Rivers National Forest has administered the Ukonom/Orleans Ranger District.

The “Site” for this analysis encompasses the former mill tailings pond and the mill, which are contaminant sources. Other areas included in the Site are those that are necessary for site access and implementation of the site remedy and include: mine roads; existing flat areas and landings; and borrow sites adjacent to the roads (Figure 3).
The EE/CA is being performed by the Forest Service under its cleanup authorities under the Comprehensive Environmental Response, Compensation and Liability Act, (CERCLA, 42 USC 9604(a)), and Federal Executive Order 12580. This EE/CA has been prepared in accordance with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP, 40 CFR Part 300), and the United States Environmental Protection Agency (EPA) guidance for conducting non-time critical removal actions (U.S. EPA, 1993).

2.0 SITE CHARACTERIZATON

The following is a summary of the characteristics of the Site. For more information, please refer to the Siskon Mine Removal Preliminary Assessment/Site Inspection Report (USDA-Forest Service, 2003a), which is available in the project Administrative File.

2.1 Site Description and Background

2.1.1 Site Location and Access

The Siskon Mine Site is located in the Klamath National Forest approximately 20 miles northwest of the town of Somes Bar, California (Figure 1). The Site is within Copper Creek drainage, which is a tributary to Dillon Creek and the Klamath River (Figure 2). The Site is within Township 14 N, Range 5 E, sections 20, and 29, Humboldt base and meridian (41° 35' 6.6" north latitude and 123° 37' 43.5" west longitude at Copper Creek road crossing) (Figure 3). The former tailings pond and mill occupy an area of approximately 2 acres along Copper Creek, just upstream from the mouth of Medicine Creek. Access to the mine requires vehicle travel on Highway 96 to Forest Service roads 14N69 (Sidewinder Road), 13N35 and 14N31 to the Copper Creek, which is currently a low water ford (Figure 4). The Site includes mine roads that access the mill and continue approximately 1.5 miles to a large rockslide, beyond which the road is impassible by vehicles. An alternate route accessing the Site is from the south on Highway 96 to Forest Service roads 15N01 (the Go Road), 14N21 and the 14N31 to the Copper Creek low water ford. Because of the landslides and narrow spots on the road, (14N31B) , there is no vehicle access on the mine roads on the west side of Copper Creek. The Site can easily be inspected on foot.

2.1.2 Site Description and History

The Siskon Mine is an abandoned gold and silver mine. The mine tailings are the contamination source of concern. Tailings are present in the former tailings pond, and at the mine mill located adjacent to the former tailings pond. There is approximately 11,400 cubic yards (cyds) of tailings in the former tailings pond.

Tailings Along Copper Creek

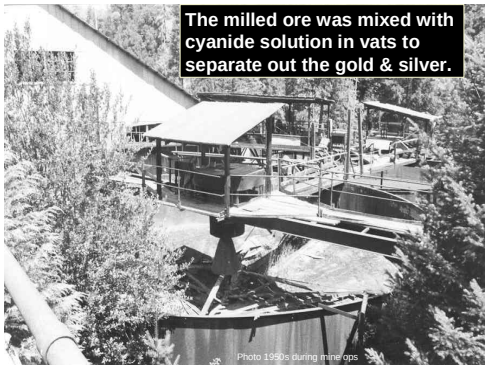
Tailings are present in a remnant ore thickener vat, and in ore dump piles at the mill site. There are approximately 20 cyds of tailings in piles, and 80 cyds yards of tailings in the vat.

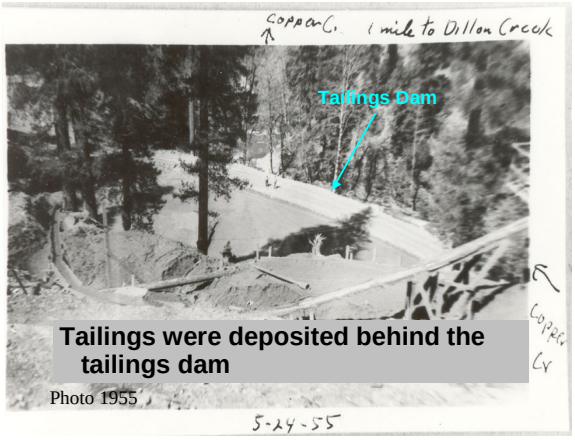
Tailings in Ore Thickener Vat at Mill

Other mine structures and remnant mine relics at the mill include building foundations, wooden stairs, metal and wood debris, metal pipes and roofing, and artifacts associated with ore processing and assay, such as glass fragments and crucibles.

Views of the Mill Site

Mining and exploration for gold and silver began in the early 1900s and was most active from 1951 through 1960. Ultimately six patented claims, 56 unpatented claims, and one unpatented mill site claim were located at Siskon Mine. The unpatented claims were relinquished in 1992 and 1993 and are abandoned. From 1951 through 1960, ore was removed from three open pits and trucked 2.5 miles to the mill located adjacent to Copper Creek. Ore milling and disposal of mine tailings first began in 1953. Ore was milled and gold and silver were concentrated using a cyanide slime processing plant[2].





Processed tailings were deposited in the tailings pond. A photograph from May 24, 1955, indicated that an earthen dam was constructed to impound the tailings, and Copper Creek was diverted around the dam. One written account of the mining operation indicates that at least from 1957 to 1960, after milling operations ceased in late November, a hole was punched into the tailings dam releasing tailings accumulated over the year's operations (Smith, 1993). A California Department of Fish and Game (CDFG) memorandum from February 15, 1958, describes an event in the fall of 1957,

[2] Finely ground ore was placed into leaching tanks to which cyanide, lime, and water were added. The slurry was agitated, and processed through a series of leaching tanks, concentrating the gold. Zinc dust was added to precipitate out the gold and silver, amalgamating the metal. The amalgam was then retorted in crucibles with borax to separate the zinc out from the gold and silver. The melted gold and silver were poured into ingots and then transported to the smelter in Tacoma, Washington where the gold and silver were further refined.

during which the Siskon Mine tailings were released from the tailings impoundment, causing discoloration of the Klamath River (CDFG, 1958). When active mining operations ceased in 1960, maintenance activities were discontinued, resulting in the failure of impoundment berms and erosion of the remaining tailings into Copper Creek. After 1960 no other mining or milling occurred at the site. The 1964 flood washed away the tailings dam and much of the tailings at the edge of the impoundment. In 1976, the mine mill buildings were demolished and equipment was salvaged. The activities that took place at the Siskon Mine from 1960 to 1992 consisted of limited sampling and exploration on the patented lands. None of these activities were at, or on the mine tailings.

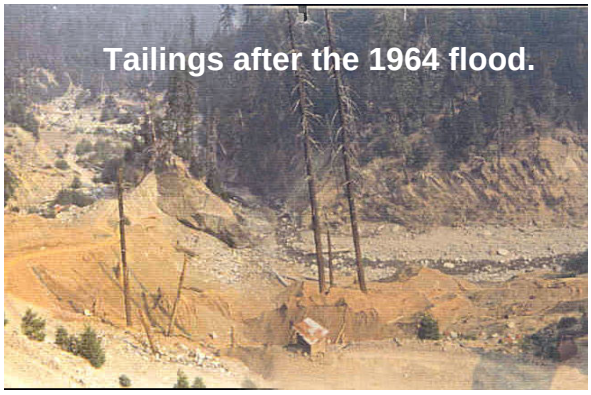


FIGURE 1
LOCATION MAP
SISKON MINE
ORLEANS/UKONOM RANGER DISTRICT
SIX RIVERS NATIONAL FOREST

Figure 2. Siskon Mine Vicinity Map

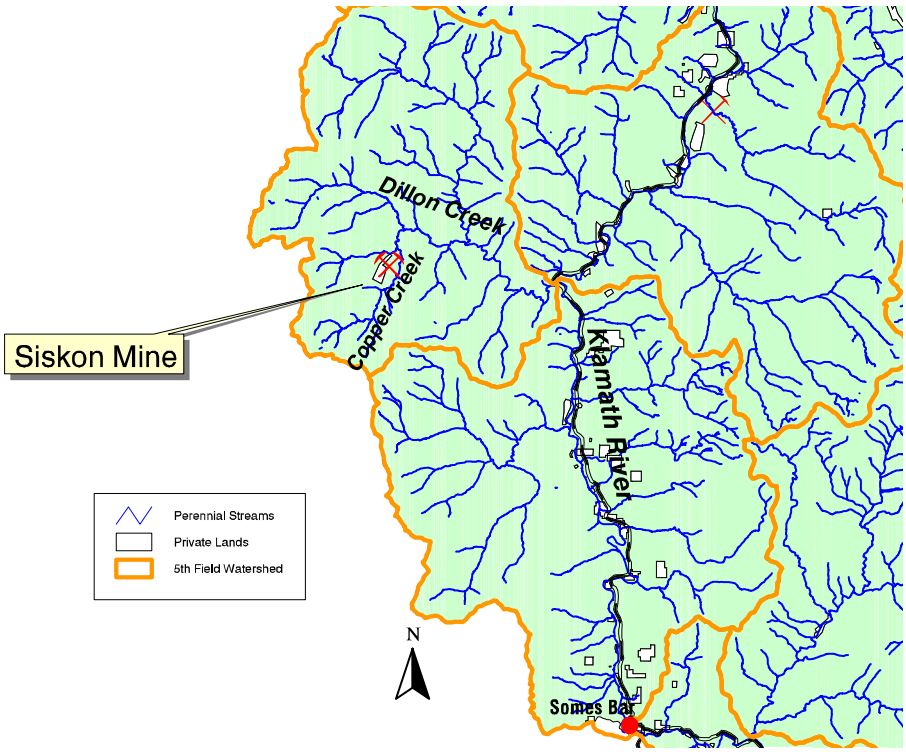
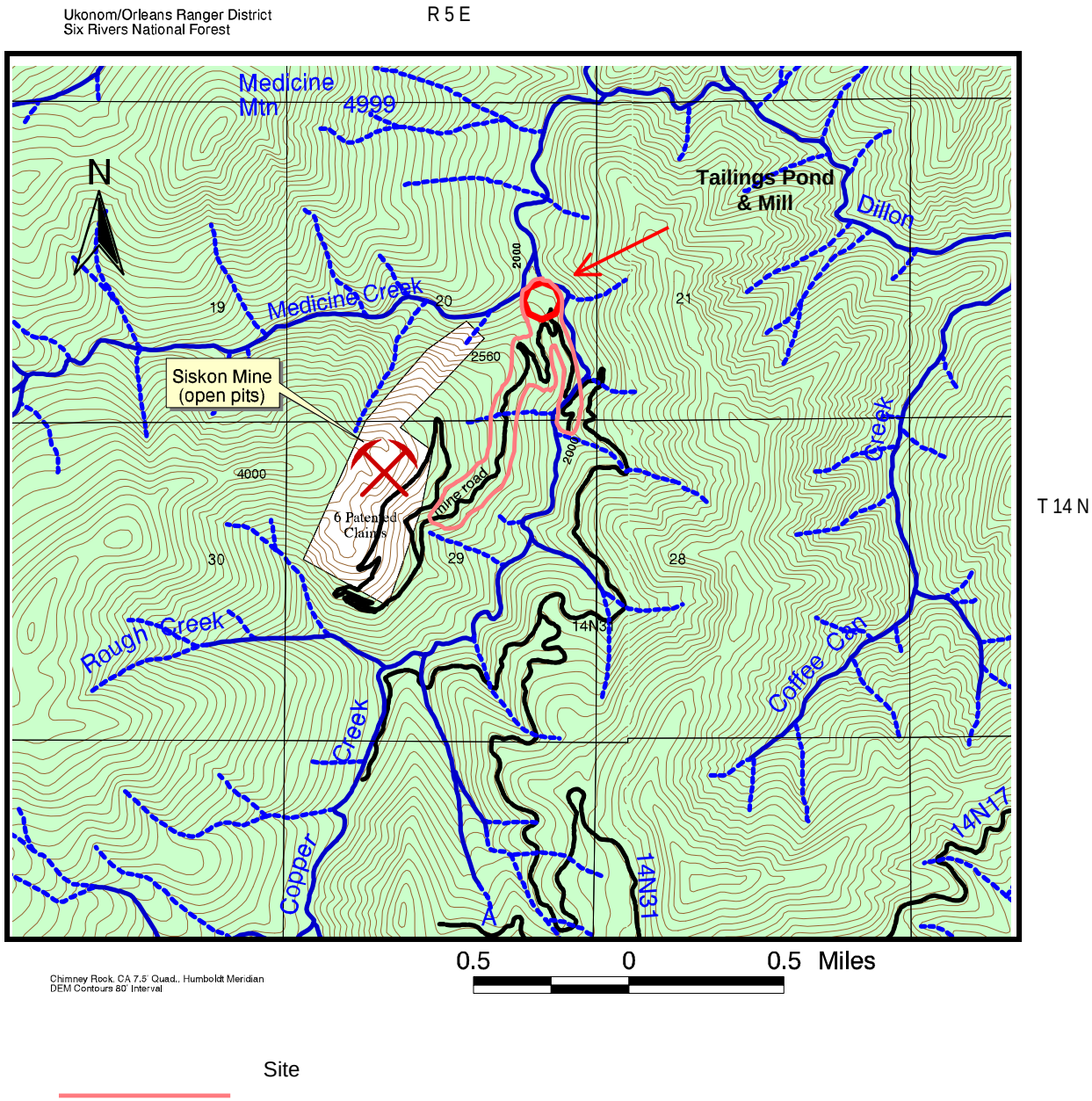
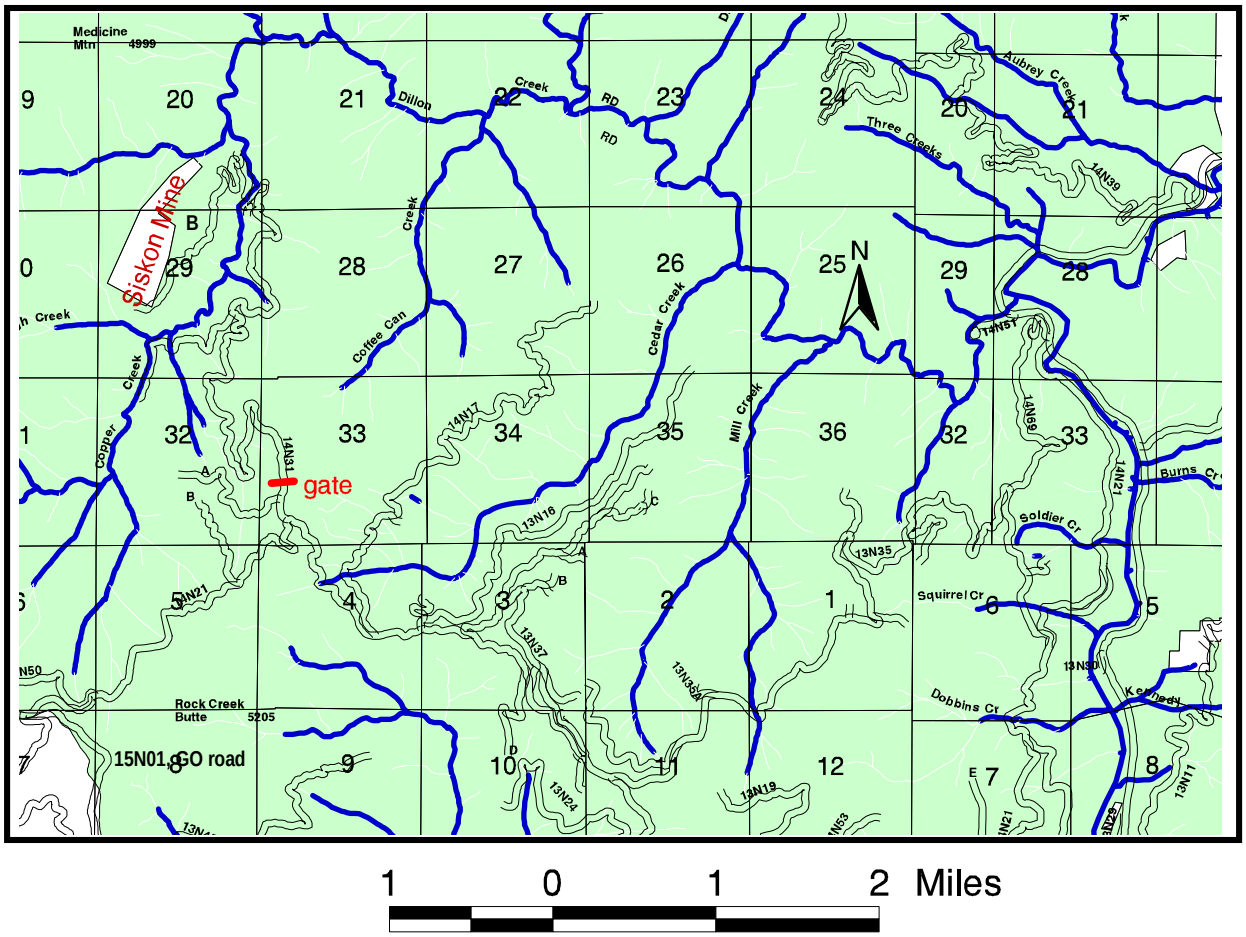


Figure 3. Siskon Mine Site Map



Site

Figure 4. Siskon Site Road Access



2.1.3 Site Setting, Climate, Hydrology, Geology, and Soils

The Siskon Mine Site (Figures 1 and 2) is located within the Dillon Creek watershed,(46,857 acres) which has elevations ranging from approximately 1,000 feet to 5,200 feet above mean sea level (AMSL). The mill area is at approximately 2,000 feet AMSL. The Site is located on the eastern side of a ridge bounded by Copper, Medicine, and Rough Creeks and is located on National Forest System lands administered by the Six Rivers National Forest. The slope steepness at the Site ranges from flat and gentle to steep, greater than 65% slopes.

The Site is located in the central Klamath Mountains. In this area, summers are hot and dry and winters are cool and wet. Summer temperatures range from 55 to 90 degrees Fahrenheit (^{o}F). Winter temperatures average between 40 and 50°F. According to precipitation maps developed by the USGS, annual precipitation at the Siskon Mine area is approximately 80 – 90 inches per year (Rantz,1969). Approximately 90% of the precipitation falls from October through May. The normal average precipitation at Orleans, CA, located along the Klamath River approximately 20 air miles from the Site, is 55.8 inches a year.

Medicine and Rough Creeks are tributaries of Copper Creek, a watershed of 8,040 acres. Copper Creek empties into Dillon Creek approximately one (1.0) mile from the point of release of tailings (Figure 2). Dillon Creek flows into the Klamath River approximately eight (8.0) miles downstream from its confluence with Copper Creek (Figure 2). The average annual flow rates of streams 15 miles downstream of the Site are as follows: Copper Creek, 90 cubic feet per second (cfs); Dillon Creek, 300 cfs; and the Klamath River, 3,700 cfs (Rantz 1968 and United States Geological Survey [USGS] 1982). The estimated 2 year, 10 year, 25 year and 100 year flood flow of Copper Creek at the low water crossing is 607 cfs; 1581 cfs; 2261 cfs; and 3866 cfs, respectively. The flow calculations were made using the U.S. Geological Survey Method, and assumed 85 inches of rain per year.

Because no groundwater wells exist within a 4-mile radius of the Site, the depth to the regional groundwater zone is unknown. Groundwater is thought to be in perched zones at the bedrock contact, because a spring and riparian vegetation are present in the former tailings pond area (USDA-Forest Service, 2003a; 2002c; URS Consultants 1995). The spring in tailings pond area is thought to emerge at the contact between ultramafic bedrock (serpentinite) and overlying soils (alluvium capped by mill tailings).

The Siskon Mine ore deposit can be characterized as a disseminated epithermal[3] massive sulfide deposit, with pyrite as the dominant sulfide mineral. Mineralization occurs within a structurally complex zone consisting of fault-bounded blocks of rocks from both the Western Jurassic and Western Paleozoic and Triassic belts of the

[3] The Siskon Mine gold deposit most closely resembles an epithermal high sulfidation ore deposit that has formed in island arc tectonic environment associated with subduction zones. The ore deposits form at shallow depth, less than 1 kilometer and are hosted mainly by volcanic rocks.

Klamath Mountains geological province (USDA-Forest Service, 2003a). Bedrock underlying the Site includes serpentinite, greenstone or metavolcanics (greenish metamorphosed mafic rock), and hornblende diorite (magnesium- and iron-rich intrusive igneous rock). Soils at the Site include stream channel alluvial materials and soils derived from serpentinite, metavolcanics, and the hornblende diorite. Geomorphic terranes of the Site include several large active landslides, gentle to steep mountain slopes, and steep inner gorges through which the larger creeks flow (Medicine Creek and Copper Creek). The landform at the mill and tailings pond appears to be upper terrace of Copper Creek.

2.1.4 Surrounding Land Use and Communities

Siskon Mine is remotely located and there are no nearby residents. Except for the parcel of private land in Sections 20 and 29, the land surrounding the mine area is National Forest System Lands. There are no residences, schools, day care centers or work places within 200 feet of the site. In fact, the nearest residents and school is located approximately 16 air miles southeast in the community of Somes Bar. The nearest developed recreational site is the Dillon Creek Campground which is located approximately 5 air miles from the Site. The groundwater underlying the Site is not being used as drinking water and there are no groundwater or drinking water wells within a 4-mile radius of the Site. The surface water of Copper and Dillon Creek are not used as domestic water sources.

The mine tailings pose a low threat to public health as recreational exposures to the tailings soil are anticipated to be rare (USDA-Forest Service, 2003a). Recreational visitors (i.e. hikers, hunters, recreational miners, mushroom gatherers, fishing enthusiasts) may occasionally visit or camp near the Site, along the east side of Copper Creek approximately 1700 feet (0.25 miles) from the mill and tailings pond area. Other visitors to the Site include Native Americans visiting the area to gather traditional materials or for spiritual reasons. Recreational visitors can enter the area on foot or by vehicle if the gate on the 14N31 road is unlocked or open. The 14N31 road was gated in 1996, and the road is closed year-round. The hike from the gate to the Site is almost 5 miles. There may be periods of time when the gate is left open. There is a chance that a recreational visitor might visit the Site and wander into the areas where the tailings are present, and could come into direct contact with tailings in the former tailings pond and mill area. Little evidence of visitation (trash, bottles, cans) has been observed in the 7 years that the Forest Service has regularly visited the Site. Contractors to the Forest Service such as timber sale or road maintenance workers may occasionally conduct activities along the 14N31 road or at the Copper Creek low water crossing. Routine Site visits are carried out annually by Forest Service employees who access the Site for 1 to 5 days a year. Forest Service personnel likely visit the Site more frequently than recreational users.

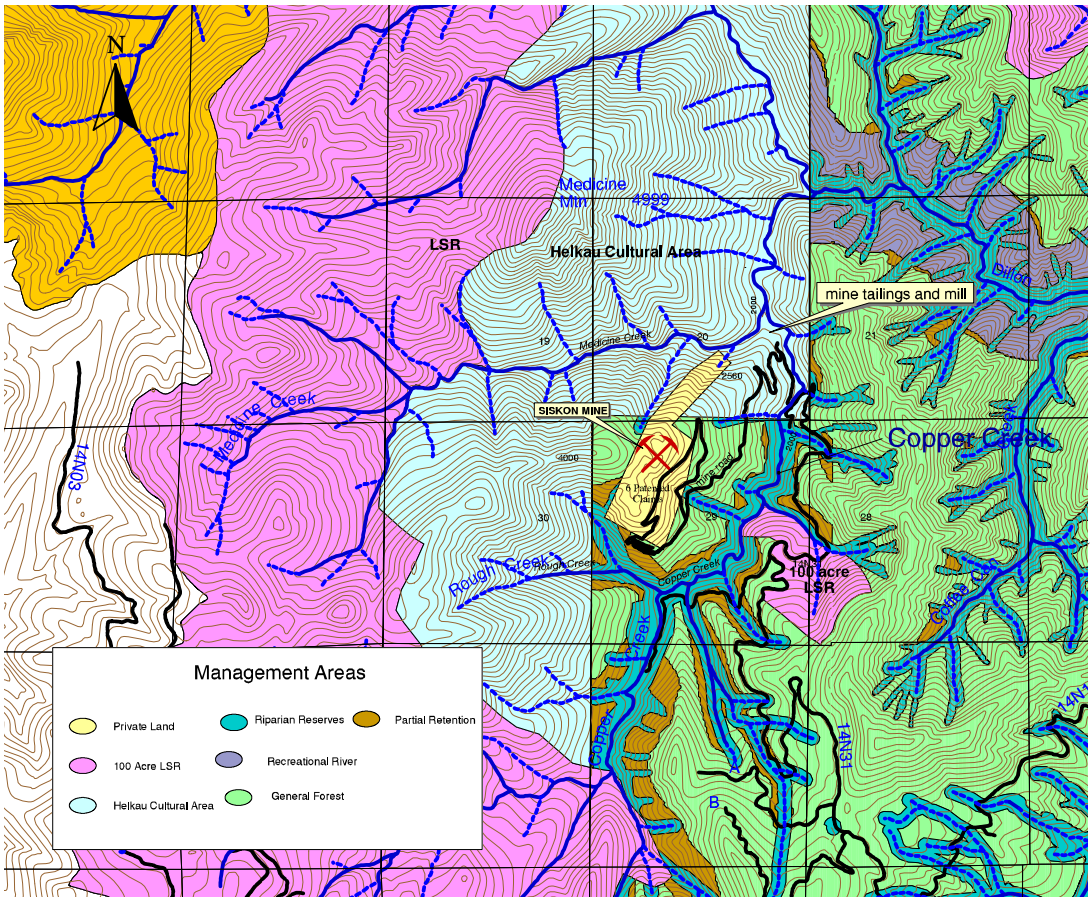
2.1.5 Heritage Resources

The part of Siskon Mine on Forest Service managed lands has been recorded as three distinct historical archeological sites. Archeological resource documentation has taken place to update the site records in 1999 and in 2002-2003 (USDA-Forest Service, 2003b). It has been recommended that Siskon Mine is not eligible to the National Register of Historic Places (NRHP).

Parts of the Siskon Mine and the Site are located within the Helkau Cultural Area, which was determined to be eligible to the NRHP 1981 (Figure 5). Medicine Mountain, which located north of Medicine Creek, is the center of the Helkau spiritual and ceremonial area. Helkau is located within Ancestral Territory of the Karuk Tribe of California. The area of Helkau and Elk Valley further to the west, are also culturally significant to the Yurok and Hoopa Tribes, and cultural practitioners. Restoration and reclamation of the Siskon Mine has long been a concern and issue with the tribes.

Figure 5. Siskon Mine Land Management Areas Map

Ukonom.Orleans Ranger District
Six Rivers National Forest



Chimney Rock CA 7.5' Quad.
Humboldt Meridian
DEM Contours, 80' interval
Scale: 1: 40,000

0.5 0 0.5 1 Miles

2.1.6 Threatened, Endangered, and Sensitive Species

Copper Creek, Dillon Creek and the Klamath River contain Critical Habitat (CH)[4] for *Southern Oregon / Northern California Coasts* (SONCC) Evolutionarily Significant Unit (ESU) Coho salmon (*Oncorhynchus kisutch*), which is a listed *Threatened* species under the federal Endangered Species Act (USDA-Forest Service-KNF, 2003e). CH for Coho salmon is present at the Site, and upstream and downstream from the Site, as Copper Creek is within the known range of steelhead trout. CH includes all waterways, substrate, and adjacent riparian zones within the ESU (Federal Register, 1999 , V. 64, No. 86, May 5, 1999, p. 24049 – 44062). Aside from a short reach just above the confluence with the Klamath River, Dillon Creek is not within the known range of Coho salmon. Fish population surveys in the Dillon Creek watershed have identified Coho salmon (adults and juvenile fish) only in the lower mainstem of Dillon Creek, over five miles downstream from the Site. In addition, Essential Fish Habitat (EFH)[5] for SONNC Coho salmon and Upper Klamath -Trinity River Chinook salmon occurs in Copper Creek, Dillon Creek and the Klamath River. EFH provisions as defined by the Magnuson Stevenson Act, (16 U.S.C. 1801 *et seq*; 50 CFR 600.92(j)) require heightened consideration of fish habitat in all resource management decisions.

Suitable habitat for the Northern spotted owl, listed as *Threatened* under the federal Endangered Species Act, does not occur on the Site but does occur within 0.25 miles of the Site. Suitable habitat is found along the lower portions of Forest Road 14N31 on the eastern side Copper Creek (USDA-Forest Service-KNF, 2001). A historical Northern spotted owl activity center (100-acre Late Successional Reserve) occurs to the southeast of the Site (Figure 5). This activity center was occupied prior to the Dillon Wildfire of 1994, but was burned over by the fire. Protocol surveys for the Northern spotted owl have been conducted in 2000, and are planned in 2003 prior to project implementation. To date, no nesting spotted owls have been found within 0.25 miles of the Site.

There is no suitable nesting habitat for the marbled murrelet listed as *Threatened* under the ESA, within 0.25 miles of the Site. There is no known use of the area by bald eagles.

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[4] When specific Coho salmon habitat use information is lacking for a stream, a conservative estimate of SONCC Coho distribution in streams can be provided by using the current Klamath National Forest (KNF) "*known or suspected steelhead habitat*" geographic information system (GIS) data layer. Survey data are more complete for steelhead than for Coho. Use of the KNF "*known or suspected steelhead habitat*" GIS data layer overestimates SONCC Coho salmon CH, but is a useful approach for conservatively assessing affects to SONCC Coho salmon and CH.

[5] EFH is defined in Section 3 of the MSA as "those waters and substrates necessary to fish for spawning, breeding, feeding, or growth to maturity."

There are no *Threatened* or *Endangered* plant species at the site. (USDA-Forest Service-KNF 2002c; 2000c).

There are no Forest Service Sensitive wildlife or plant species at the Site (USDA-Forest Service-KNF2002c; 2000c; 2001).

Klamath Mountains Province (KMP) ESU steelhead trout (*O. mykiss)* and Upper Klamath – Trinity Rivers (UKTR) ESU Chinook salmon (*O. tshawytscha*) are both listed *Sensitive* fisheries species for the Pacific Southwest Region of the Forest Service. Forest Service *Sensitive* species are those having viability concerns as evidenced by recent downward trends in population numbers, densities and habitat quality or quantity. Similar to the analyses for TES species, activities affecting Sensitive species are evaluated for their potential of adverse impacts that could result in a trend towards Federal listing (USDA-Forest Service-KNF, 2003e).

KMP steelhead utlilize the upper 2.5 miles of Copper Creek which includes the reach of the Site, and 1.5 miles upstream from the Site. Steelhead spawning habitat exists both upstream and downstream from the Site. KMP steelhead utilizes the mainstem of Dillon Creek, often extending up into second-order tributaries. UKTR Chinook salmon spawn and rear in the lower two miles of Dillon Creek, nearly six miles downstream from the Site (USDA-Forest Service-KNF, 2003e).

In summary, Coho salmon is a *Threatened* species which has Critical Habitat at the Site. The *Threatened* Northern spotted owl has suitable habitat within ¼ mile of the Site, and surveys are conducted annually to determine whether a nesting pair is present. The only Forest Service Sensitive species at the Site is summer steelhead.

2.1.7 Sensitive Ecosystems

The Klamath River, approximately 8 miles downstream of the Site, is classified as a Recreational Wild and Scenic River under the National Wild and Scenic River System. Dillon Creek, less than one mile downstream from the Site, is recommended as a Recreational River (Figure 5) to be included in the Wild and Scenic River System (USDA-Forest Service, Klamath National forest Land and Resource Management Plan, 1995). The outstandingly remarkable values of Dillon Creek are cultural, fisheries, geology, water quality, scenery and vegetation. The corridor boundary of the main stem Dillon Creek extends approximately 0.5 miles on either side of the river.

The Siskon Mine is within the Dillon Creek Watershed which is a designated Tier 1 Key Watershed under the Record of Decision (ROD) for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl, 1994, which amended existing forest plans (USDA&USDI, 1994). Tier 1 Key Watersheds are crucial refugia for at-risk fish species and that currently provide high quality water.

Terrestrial environments considered by the Forest Service as sensitive occur at the Site

at the former tailings pond, mill site area and along the mine road accessing the mill. These areas are within the Riparian Reserve Management Area (Figure 5), which are reserves allocated for maintenance and restoration of riparian ecosystems. Riparian ecosystems at the Site include aquatic ecosystems, the stream channel, and adjacent terrestrial areas that extend 340 feet measured from either edge of Copper Creek (equivalent to a buffer zone of 680 feet in width), which buffers the stream.

Water quality and aquatic habitats in the Dillon Creek watershed is considered to be in good to excellent condition. However, the Klamath River (CalWater Watershed # 10512050) into which Dillon Creek drains, is a Federal Clean Water Act 303d listed *impaired* waterbody for nutrients, organic enrichment/low dissolved oxygen and temperature. Sediment is also being monitored and evaluated for future listing as a pollutant/stressor.

Port-Orford-cedar (POC) trees are present on-Site in spring and seep areas. They have been noted along the mine road (14N31B) where springs intercept the road and ditchline, and a number of young trees (less than 25 years old) are growing in the middle of the tailings pond where an intermittent spring emerges. There is no POC root diseased trees or infections at the Site or along the 14N31 road leading to the Site.

A small patch of spotted knapweed has recently been located in the Siskon Mine area, along the 14N31 road in the vicinity of the Copper Creek low water ford. This noxious weed site is currently being evaluated and assessed.

2.2 Previous Removal Actions

In September of 1999, 819 cyanide drums were treated and removed from the Site as a non-time critical removal action (USDA – Forest Service, 1999a, 1999b, 1999c). A contract completion report documenting the removal action was prepared (AC Industrial Services, 1999).

2.3 History of Investigations at the Site

Two separate field investigations of the site were undertaken to assess conditions at the site. In 1994, the Forest Service completed a preliminary assessment (PA), which documented known and suspected contaminant sources at the site: mill tailings, empty cyanide drums with cyanide residue, and acidic drainage from the Scott Tunnel (USDA,-Forest Service, 1994). The second study in 1996-2002, documented existing site information, investigated site conditions, sampled and tested potential contaminant sources and pathways at the site, assessed the threats posed to human health and the environment, and determined the need for response actions at the site (USDA-Forest Service, 2003a).

The 1994 PA was submitted to Region IX of the United States Environmental Protection Agency (EPA). The EPA tasked URS Consultants, Inc., to conduct a review of the

Federal Facility PA documentation for Siskon Mine. URS Consultants prepared a review report in 1995 (URS Consultants, 1995), and a formal letter from the EPA to the Forest Service accompanied the report in 1997 (U.S. EPA, 1997).

2.4 Source, Nature and Extent of Contamination

The tailings are the source of contaminants released into the environment. This has been confirmed from field observations, sampling and testing. The information presented in the following sections on the source, nature and extent of contamination is summarized from the Removal Preliminary Assessment/Site Inspection Report (USDA-Forest Service, 2003a), which is incorporated by reference and is available in the project Administrative File for the Site.

2.4.1 Analytical Data, Results and Conclusions

The tailings contaminant source is characterized below in Table 1.

Table 1. Characteristics of the Mill Tailings Contaminant Source

	Mill Tailings		
Approximate Volume, Area	Mill Tailing @ Former Tailings Pond Mill Tailings, Cyanide Leach Vat at the Mill Mill Tailings, Piles and Spill Over at the Mill	11,400 cyds; 1.3 acres 80 cyds; 3,000 sq. ft. 20 cyds; 1,500 sq. ft.	
Hazardous Substance Concentrations, Min-Max, mg/kg, dry weight	Arsenic Cadmium Copper Total Cyanide WAD Cyanide Iron Lead Mercury Molybdenum Selenium Silver Zinc	56 - 1200 5.3 - 42 210 – 3900 0.99 – 17.8 0.57 – 0.86 35,000 – 320,000 3.1 – 310 0.1 – 16 6 - 170 2.4 – 41 1.0 - 12 30 - 540	
Acid Base Account	5.3 to 17.72 Tons $CaCO_3$/ 1000 Tons		
Total Sulfur **Pyritic Sulfur**	0.11 – 0.15% <0.01 – 0.02		
Leaching Potential, (Cal-WET, mg/L)	Arsenic Copper Lead Zinc	 0.094 – 0.51 0.53 - 3.6 	
Unified Soil Classification System	ML – reddish brown sandy silt with clay		
Atterberg Limits	PL = 14%; LL = 21%, PI = 7		
Density, AASHTO T-99	128.8 pcf at 14.3% moisture content		
Specific Gravity	2.7		

mg/kg = milligram per kilogram
mg/L = milligram per liter
sq. ft. = square feet
cyds = cubic yards
pcf = pounds per cubic foot

The tailings are a fine grained reddish brown soil, typical of final process tailings slimes after milling and leaching out the gold and silver. Most of the tailings are piled in the former tailings pond (~11,400 cyds) and another 100 cyds is present in a relict cyanide leach vat at the mill, and in piles at the mill. The tailings have high concentrations of heavy metals, characteristic of similar epithermal massive gold ore deposits and mine wastes in the central Klamath Mountains. Though total cyanide is present in the tailings, the majority of the cyanide is bound up with iron or other metals and is considered effectively immobile. Leaching tests performed on the tailings, (Cal-WET), indicate that arsenic, copper, lead and zinc showed a very low leaching potential, well below California Soluble Threshold Limit Concentrations (California Code of Regulations (CCR) Title 22, § 66.261.24(a)(2)(A). Acid Base Accounting tests run on the tailings showed that the total sulfur content is low (< 0.20%), pyritic sulfur is very low (< 0.02%) and neutralizing potential far exceeds acid generating potential. Based on these results, the tailings should not generate acid drainage. No acidic leachates have ever been observed coming from the tailings.

The contaminants of concern associated with the tailings are the following heavy metals: arsenic, cadmium, copper, iron, lead, mercury, molybdenum, selenium, silver, zinc. The metals are characteristic of the tailings as their high concentrations exceed background (uncontaminated) levels of metals of soils from 7 to 640 times (Table 2).

Table 2. Metal Contamination in Tailings and Exceedance Over Background Soils
(mg/kg, dry weight)

Metal Found in Tailings	Maximum On-Site Concentration in Tailings	Sample ID	Exceedance Over Background
Arsenic	1200	*006A*	92X
Cadmium	42	*006A,C100*	7X
Copper	3900	*006A*	26X
Iron	320,000	*C100*	8X
Lead	310	*002A*	525X
Mercury	16	*F100*	640X
Molybdenum	200	*C100*	32X
Selenium	41	*C100*	123X
Silver	12	*006A*	10X
Zinc	540	*C100*	15X

Table modified after Table 16, Siskon Mine Removal PA/SI Report, 2003

The Siskon Mine tailings material contains elevated concentrations of arsenic and copper at levels which exceed the values used by the State of California to classify a material as a toxic hazardous waste (California Code of Regulations (CCR) Title 22, § 66.261.24(a)(2)(A). The exceedance of the Total Threshold Limit Concentration limits also classify the tailings as a hazardous mine waste as they are above the “Persistent and Bioaccumulative Toxic Substances” hazardous waste characteristic (CCR, Title 22,

Chapter 11, Division 4.5, § 66261.24). The samples that exceed the TTLCs are shown in Table 3 below.

Table 3. Levels of Arsenic and Copper in Siskon Mine Tailings Exceeding California TTLCs

Sample ID	Arsenic (mg/kg)*	Copper (mg/kg)*
006A	972	3159
AA100	556.8	
C100	714	2688
F100, F100 dup	697, 533.2	
TTLC	**500**	**2500**

* wet weight

Table modified after Table 4 , Siskon Mine Removal PA/SIU Report, 2003

2.4.2. Nature and Extent of Contaminant Releases to the Environment

Ongoing and potential releases of contaminated tailings into the environment that were considered in the Removal PA/SI (USDA- Forest Service, 2003a) and that are considered in this EE/CA include:

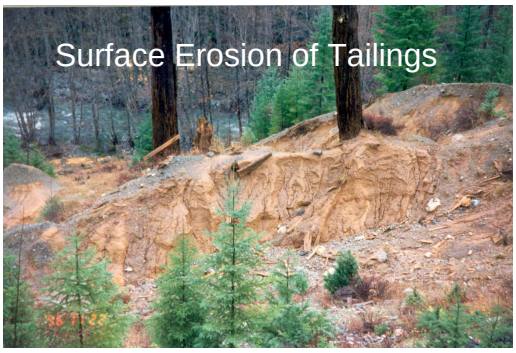
1. **Surface Water Pathway:**
   a. chronic erosion of the mill tailings sediment into Copper Creek
   b. threatened mass sediment releases into Copper Creek, Dillon Creek and the Klamath River
2. **Soil and Air Pathway**
   a. exposure to contamination in the tailings soils though absorbtion[6], ingestion, and skin contact, and inhalation of contaminants in airborne dust.

The groundwater pathway was considered an insignificant pathway at the Site due to the lack of targets and the limited groundwater sources at the Site. This section describes the extent of ongoing and potential contamination of surface water sources downstream of the Site by the tailings. The nature and extent of contamination associated with tailings soils on-site has been described in the previous section, *2.4.1, Analytical Data, Results and Conclusions*.

Sediment from the mill tailings in the former mill tailings pond discharges directly into Copper Creek during the rainy season (November-March) and during large rain storms at other times of the year. Mill tailings have been observed directly eroding into Copper Creek, and the stream bed in the downstream of the tailings discharge point is discolored with the fine-grained reddish tailings sediment. Surface erosion estimates made within the subwatershed of the mill and tailings pond indicates that annually, 17 cubic yards of sediment is mobilized of which 10 cubic yards

[6] Absorption or uptake of heavy metals by plants

per year are delivered into Copper Creek (USDA-Forest Service, 2002b). This equates to about one 10 yard dump truck of sediment being deposited into the stream system every year from the tailings pond area. This is a chronic hazardous substance release into a surface water target. Another 500 cubic yards of mine tailings mixed with channel alluvium sediment is proximal to the Copper Creek stream channel within the estimated 100 year flood zone. This tailings sediment poses a potential large volume release into the stream system in a major flood.



Evidence for sedimentation and transport of tailings in Copper Creek downstream of the discharge point was obtained from sediment sampling conducted in 1996 (USDA-Forest Service, 2003a). Table 4 shows the levels of contamination noted in Copper Creek downstream of the tailings discharge point.

Table 4. Metals Concentrations in Sediment in Copper Creek

	Sample Sites			
Metal Concentration (mg/kg, dry weight)	**CC-1 (upstream background)**	**CC-4 (downstream, nearest point of tailings discharge)**	**CC-5 (downstream)**	**CC-6 (downstream)**
Copper	39	830	42	69
Arsenic	2.9	240	3.7	9.8
Zinc	46	180	52	60
Molybdenum	6.2	40	6.2	6.4
Lead	0.62	28	0.62	0.64
Cadmium	4.3	14	5.2	6
Selenium	0.8	10	2.1	2.8
Mercury	0.025	2.2	0.025	0.079
Silver	1.2	1.5	1.2	1.3
Iron	30,000	86,000	35,000	40,000
Distance Along Copper Creek from CC-1 (feet)	0	8,130	8,460	9,660

The sample location downstream of the tailings discharge point (CC-4) has the highest concentrations of the ten characteristic metals associated with the tailings observed in any of the sediment samples collected from Copper Creek. Approximately 330 feet downstream, most of the metals are approaching background concentrations observed in sample CC-1. However, the ten metals are still evident in the stream sediment at the furthest downstream sample site, 1530 feet (> ¼ mile) downstream of the tailings discharge point. The metal contamination in Copper Creek is shown graphically in Figures 6 and 7 below.

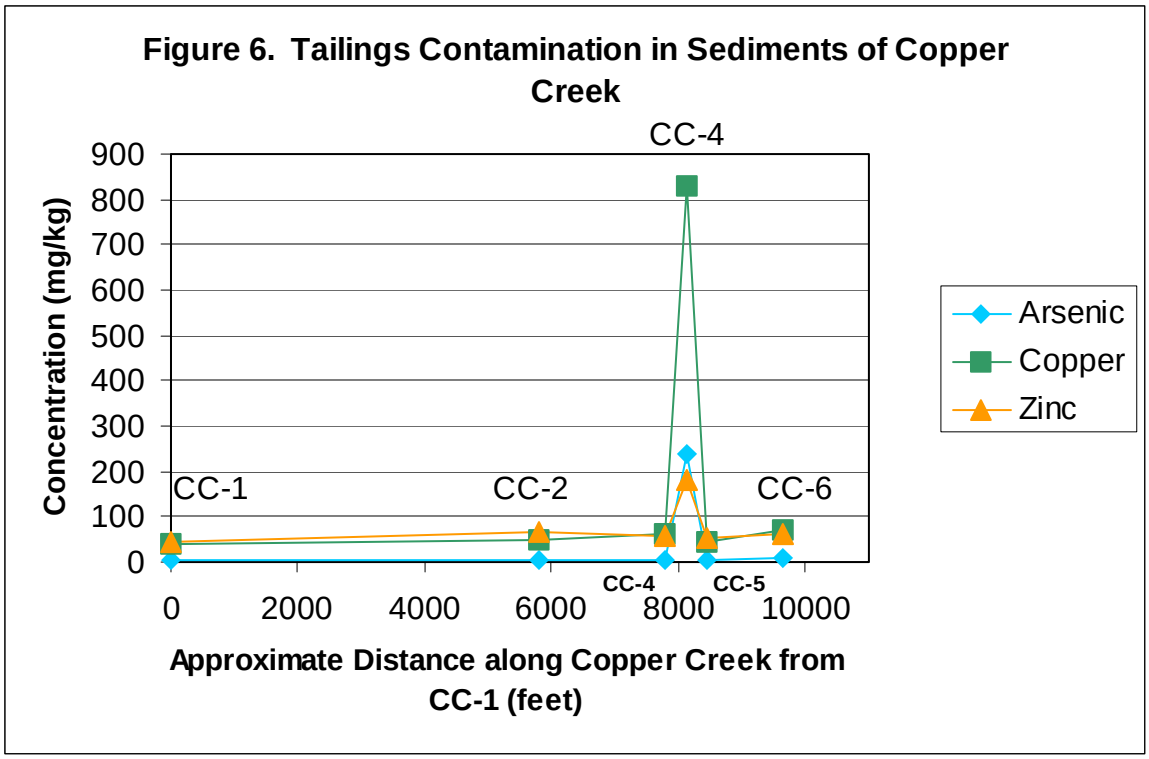


Figure 6. Tailings Contamination in Sediments of Copper Creek
Concentration (mg/kg)
900
800
700
600
500
400
300
200
100
0
CC-4
CC-1
CC-2
CC-6
CC-4
CC-5
0
2000
4000
6000
8000
10000
Approximate Distance along Copper Creek from CC-1 (feet)
Arsenic
Copper
Zinc

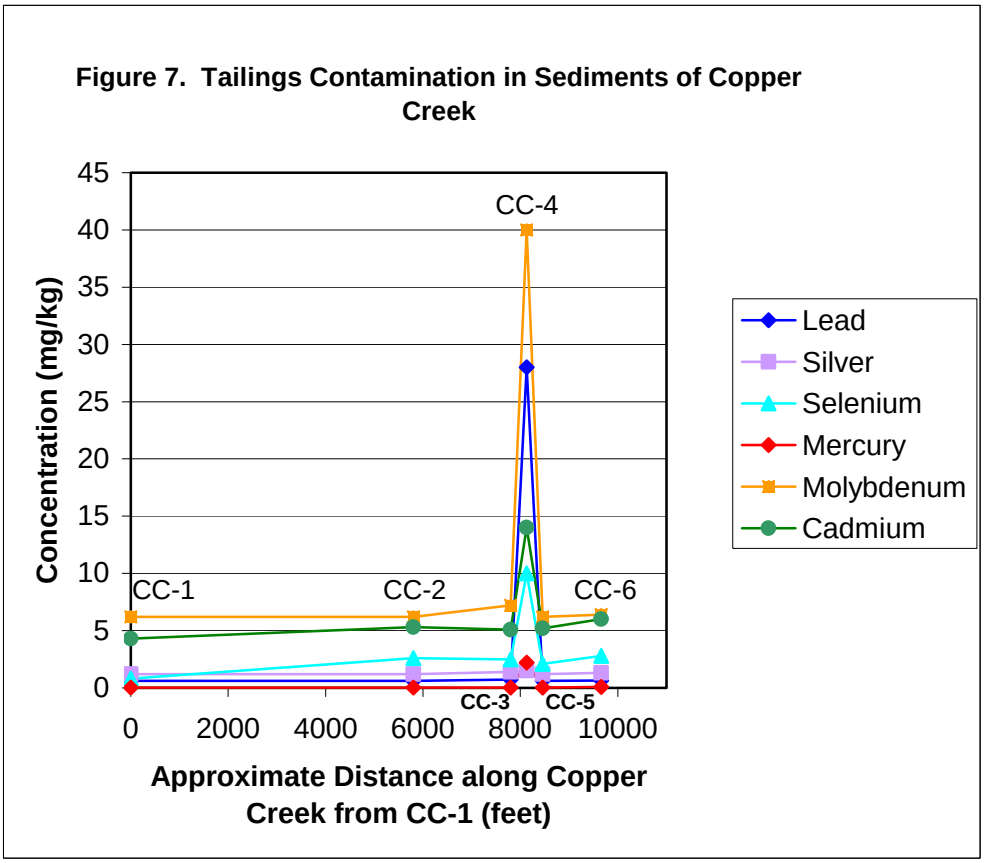


Figure 7. Tailings Contamination in Sediments of Copper Creek
Concentration (mg/kg)
45
40
35
30
25
20
15
10
5
0
CC-4
CC-1
CC-2
CC-6
CC-3
CC-5
0
2000
4000
6000
8000
10000
Approximate Distance along Copper Creek from CC-1 (feet)
Lead
Silver
Selenium
Mercury
Molybdenum
Cadmium

2.5 Streamlined Risk Evaluation

Both human health risk and ecological risk from contaminated tailings at the Site are functions of exposure to contaminants found in the tailings. Various risk management criteria and screening level benchmarks for contaminants in soil and stream sediment are commonly used to assess the risk to humans, terrestrial wildlife, plants, soil organisms, and aquatic organisms. Screening benchmarks and risk management criteria are used to identify contaminants of potential concern in soils and stream sediments. They are not clean up standards or levels. They are simply an indicator of risk, and can be used to demonstrate the need for a response activity, such as a Removal action, at a given site.

The following criteria and screening benchmarks are used to evaluate the risk at the Site. A set of risk management criteria (RMC) developed by the Bureau of Land Management for chemicals of concern at abandoned mining sites are used to evaluate risks to human health and wildlife receptors (Ford, 1996; USDI-Bureau of Land Management, 1999). Preliminary Remediation Goals developed by Region 9 of the EPA are used to evaluate risk to human health from exposure to contaminants at industrial sites (U.S. EPA, Region 9, 2002). Screening benchmarks presented by the National Oceanographic and Atmospheric Administration (NOAA) to evaluate inorganic contaminants in freshwater stream sediments, are used to evaluate risks to aquatic organisms from tailings eroding into Copper Creek (NOAA, 1999). Soil screening level guidance developed by the EPA, and scientists working for the U.S. Department of Energy, are used to assess risk to plants, soil invertebrates, and soil microorganisms from contaminants in the tailings soil (U.S. EPA, 2000; Efroymyson, Will and Suter, 1997; and Efroymyson, Will, Suter, and Wooten, 1997). Data on the levels of contaminants used in this streamlined risk assessment comes from the Removal PA/SI report (USDA-Forest Service, 2003a). The Removal PA/SI report also has analyses and discussions of the screening level risk evaluation which are summarized here.

As described in the Removal PA/SI (USDA-Forest Service, 2003a) the targets of contamination are:

- hunters, hikers, Forest service workers, and industrial site workers conducting activities on tailings-contaminated areas
- terrestrial plants, wildlife and soil organisms exposed to tailings-contaminated soil and
- fisheries and aquatic organisms in Copper Creek exposed to tailings-contaminated sediments.

2.5.1 Human Health Risk Evaluation

A reasonable human health exposure scenario can be developed, considering the factors such as site remoteness, access, and recreational use. The individuals likely to be exposed to the Siskon Mine tailings piles are people hunting or hiking, Forest Service employees conducting site surveys and field studies in the area, and industrial site workers conducting site clean-up activities using heavy equipment. The routes of

exposure for these individuals consist of: dermal (skin) absorption of metals contamination from the tailings; inhalation of dust during activities on or near the tailings; and incidental ingestion of contaminated soil. These exposures would be generally low and of short duration for hunters, hikers, or Forest Service workers. Industrial site workers would be subject to higher and longer duration exposures during heavy equipment use at the Site. Since 1999, the road to the mill and tailings pond area is impassible, and there has never been any known or observed all terrain vehicle (ATV) use at the mill or tailings pond area. The area of tailings contamination is not a desirable camping location; the nearest dispersed camping location is on the east side of Copper Creek approximately 1700 feet (0.25 mile) from the mill and tailings pond area.

The risk evaluation criteria that fits closest to the human exposure scenario described above is the BLM RMC for a surveyor (Ford,1996), and the Region 9 PRGs for an industrial site worker (U.S EPA, Region 9, 2002). Comparison of these screening levels with the maximum on-site concentrations of metals indicates that arsenic and iron pose a human health risk (Appendix A, Table 1). The BLM RMC for arsenic is 100 mg/l and the PRG for arsenic and iron is 260 mg/l, (non-cancer endpoint) and 100,000 mg/l respectively. Arsenic in the tailings ranges from 56 to 1200 mg/l, and iron ranges from 35,000 to 320,000 mg/l (Table 1). Nine out of 11 samples of tailings exceed the screening levels for arsenic and iron. Arsenic is also a known human carcinogen. The PRG for the cancer endpoint of arsenic is very low, 1.6 mg/l (Appendix A, Table 1). All tailings samples exceed this level. It is concluded from evaluation of the screening level criteria that arsenic and iron in the tailings present a human health risk with typical exposures during industrial and surveying type work, and for recreationists hiking or hunting in tailings-contaminated areas. The magnitude of threat to recreationists is anticipated to be much lower than that for workers as the actual incidences of recreationists hiking or hunting at the site of tailings contamination is anticipated to be very low. This is because of the remoteness of the Site, and the gate on the road accessing the site (USDA-Forest Service, 2003a). The magnitude of the threat to workers is most significant for workers using heavy equipment at the tailings piles, which has never occurred (USDA-Forest Service, 2003a). Tailings dust exposures would be a concern during future response actions using heavy equipment.

2.5.2 Ecological Risk Evaluation

Assessing ecological risk involves consideration of a variety of factors in addition to the level of metals contamination in the tailings soils. The common factors used include uptake or ingestion rates, body weights and size, and effects attributed to the uptake of contaminants in soil. Plant and soil organisms toxicity are directly measured through testing. Evaluation of plant toxicity to soil contaminations considers mainly reductions in growth and yield from uptake of metals in the soil or mineral solutions (Efroymyson, Will, Suter, and Wooten, 1997). Effects to soil organisms and soil macroinvertebrates consider reductions in growth, reproduction or activity level (Efroymyson, Will and Suter, 1997). Toxicity to wildlife is not directly tested, but rather is calculated from toxicity reference values representing daily dose of the metals for each wildlife receptor that will

not result in adverse chronic toxic effect (Ford, 1996). For all the screening levels for plants, soil organisms, and wildlife, contamination above the threshold indicates the potential for adverse biological effects.

Plant cover on the tailings piles is sparse. A stand of young trees associated with riparian vegetation is growing in the center of the tailings pond where a small spring emerges. Plant growth seems to be affected by differences in slope steepness, erosion rates, and proximity to surface water, with more plants growing in areas not covered by tailings, and in areas of lower slope gradients. Comparison of screening level benchmarks for plants (Efroymyson, Will and Suter, 1997) to the maximum concentrations of metals in the tailings indicates that arsenic, cadmium, copper, lead, mercury, molybdenum, selenium, silver, and zinc are in excess of the screening levels (Appendix A, Table 2). For an example of the magnitude of the exceedance, the screening level for arsenic is 37 mg/kg and the maximum tailings concentration in the soil is 1200 mg/kg. For copper, the screening level is 100 mg/kg, as compared to a maximum tailings soil concentration of 3200 mg/kg, and a background soil concentration of 150 mg/kg. The exceedances range from < 1 to 100 times the screening level. It is concluded from visual inspection of the tailings contaminated area and the screening level risk evaluation that the tailings are phytotoxic (poisionous to plants) to some extent.

Little information is known about the presence, species composition, diversity, or types of soil organisms and macroinvertebrates that inhabit the tailings piles.
Comparison of the various screening levels for these soil organisms indicates that arsenic, copper, iron, and zinc in the tailings exceed screening levels (Appendix A, Table 2). The iron concentrations in the tailings are very high, having a maximum result 320,000 mg/kg, (or 3.2% of the major element composition by total weight) which compares to a screening level of 200 mg/kg. Arsenic was 12 times greater than its screening level, and copper was >63 times its screening level. Conclusions from the risk evaluation are that the metals in the tailings could pose adverse biological effects to soil organisms. The lack of plants and other organic matter in or on the tailings is not indicative of a healthy soil.

The wildlife receptor species, for which screening levels have been developed, that are closest to the animals that are known to use the site are deer mouse and white-tailed deer (Ford, 1996). Both deer and bear use the tailings as a mineral salt lick (USDA-Forest Service, 2003a). Both animals have been seen in the tailings pond area, and there is ample evidence of deliberate tailings ingestion by these animals in the form of tongue grooves, hoof marks and claw gouges on the tailings piles. Bear and deer scat is also colored red-orange from the tailings. Other screening levels used are the median wildlife criteria that consist of an average of the screening values for a group of 12 different birds, wildlife and livestock (USDI-BLM, 1999). Comparison of these screening levels for wildlife indicate that arsenic, cadmium, copper, lead, mercury and zinc in the tailings all exceed the screening criteria (Appendix A, Table 2). Using the median wildlife values for simplicity, cadmium and copper are at high risk to wildlife (14 and 28 times the benchmark) and arsenic, mercury and zinc are at moderate risk levels

(> 1 to 4 times the benchmark). In conclusion, the risk evaluation indicates that wildlife such as deer and small mammals such as mice have a potential to experience adverse toxic effects from the tailings. The magnitude of the threat is likely to be at least moderate to high, because some of the animals purposely use the tailings as a mineral lick, and may ingest more than would be expected by incidental ingestion of soil during grazing. Overall, the lack of good vegetative cover on the tailings provides poor habitat for most wildlife species.

The risks posed to stream sediment dwelling organisms were evaluated using Screening Quick Reference Tables developed by NOAA. (NOAA,1999). Benchmarks for metals in freshwater sediments were compared with the concentrations found in the sediment of Copper Creek. This was done in order to evaluate the off-site risk from contaminants in the tailings eroding into the creek. The screening values should be used along with background levels to estimate what contaminants are potentially concerns to aquatic habitats. Screening with Threshold Effects Levels (TELs) is a conservative approach. Levels below the thresholds provide a high degree of confidence that the contaminant poses little potential threat. Freshwater TELs are based on benthic community metrics and toxicity test results. The TELs represent the concentration below which adverse effects are expected to occur only rarely.

Arsenic, mercury and selenium exceeded background levels by more than three times in samples CC4-SD and CC6-SD; additionally, the metals cadmium, copper, lead, molybdenum and zinc in sample CC4-SD also exceeded background by more than 3 times (Appendix A, Table 3). The metals in CC-4 are significantly greater than that found in the background sediment; for example, the exceedances for arsenic, copper, mercury and selenium are > 120, >21, >88, >12, times background concentrations. Sample CC4-SD, which is the closest sample downstream of the tailings release, greatly exceeded the screening level for arsenic, copper, mercury, cadmium and zinc (Appendix A, Table 3); exceedances are >40, >23, >12, >23, and >1 respectively. Note that the levels of cadmium and copper exceeded the benchmark in all samples (Appendix A, Table 3). In summary, the high levels of arsenic, copper, mercury, cadmium and zinc in the stream sediments downstream of the tailings release not only verify the presence of the release in the aquatic system, but indicate a potential for a ecological risk to sediment dwelling receptors in Copper Creek.

2.5.3 Risk Evaluation Summary

In summary, the contaminants in the tailings pose a risk to human health and the environment (Table 5). A response action that addresses erosion of tailings soil and delivery to the stream system, and minimizes exposure to the tailings by wildlife and humans on site will reduce the magnitude of threats posed by the tailings. Covering the tailings with a suitable soil medium to promote vegetative growth will also reduce tailings erosion rates and promote a more healthy soil.

Table 5. Streamlined Risk Evaluation
(fields containing icons exceed screening benchmarks)

Contaminant of Concern	Surveyor	Industrial Site Worker	Plants	Soil Invertebrates and Microorganisms	White-tailed Deer	Deer Mouse	Sediment Dwelling Aquatic Organisms
Arsenic	☹	☹	🌲	SOIL	🦌	🐀	🐟
Cadmium			🌲		🦌		🐟
Copper			🌲	SOIL	🦌	🐀	🐟
WAD Cyanide							
Iron		☹		SOIL			
Lead			🌲		🦌	🐀	
Mercury			🌲		🦌	🐀	🐟
Molybdenum			🌲				
Selenium			🌲				
Silver			🌲				
Zinc			🌲	SOIL	🦌	🐀	🐟

See Appendix A for tables showing comparisons of metals concentrations in tailings soil and stream sediment to the various screening level benchmarks.

3.0 COMMUNITY INVOLVEMENT

Community relations activities are a required during the planning phase of removal actions under the NCP, 40 CFR 300.415(m), and 300.820. The two forms of public participation for all removal actions are:

1. Community relations activities designed to integrate the information needs of the community into the communications approach or community relations plan for the site.
2. Administrative record activities, which are designed to chronicle the basis for the response selection and serve as a vehicle for public participation in the removal action.

3.1 Schedule of Proposed Actions

Community involvement actions began with listing of the CERCLA project in the Klamath National Forest Schedule of Proposed Actions (SOPA) for all four quarters (Winter Spring, Summer and Fall) from 2000 to the present. The project was listed in the Six Rivers National Forest SOPA beginning in the Fall of 2002. The SOPA is posted on each Forest's internet site. The Karuk and Yurok Tribes each receive a copy of the SOPA every quarter.

3.2 Public Mailings

In January of 2003, a letter providing information and seeking public comment was mailed to approximately 17 individuals and groups. This included state agencies, county offices, businesses, interest groups and individuals. A total of five responses to this initial mailing were received.

The federally-recognized tribes, (Karuk, Yurok and Hoopa), and interested cultural practitioners received a copy of the community involvement plan.

In March and April, 2003, The Siskon Mine Removal Preliminary Assessment/Site Inspection Report was mailed out to approximately 17 agencies, individuals and groups that had requested it.

3.3 Internet Site

In early February, 2003, information about the Siskon Mine CERCLA Removal Action project was posted on the Klamath Forest public internet site. The Community Involvement Plan was placed on the site along with the letter mailed to interested parties, a powerpoint presentation describing the Site and problems posed by the Site, and a fact sheet on the CERCLA removal action process. The Internet site has been updated monthly. The last update in April 2003, consisted of a summary of the Removal PA/SI report (USDA-Forest Service, 2003a).

3.4 Meetings with Native American Groups, Agencies and Others

The Project On-Scene Coordinator presented information on the project, clean up options, and a proposed project schedule at the October 18, 2002, Karuk Tribe - Forest Service monthly project coordination meeting meeting. Formal letters informing local tribes about the proposed action and the project schedule were sent in November 2002, to the tribal chairs of the Karuk, Hoopa, and Yurok Tribes. The Klamath and Six Rivers Forest Supervisors discussed the project at the Karuk Tribe Summit Meeting on November 26, 2002. A field trip to Siskon Mine Site was held on November 18, 2002 with the tribal chair as well as other members of the Karuk Tribe. On January 24, 2003, a presentation was made to the Yurok Tribe Cultural Committee representatives. Klamath National Forest tribal relations, heritage resources and engineering staff presented handouts and lead discussions on the mine Site, environmental problems, cultural concerns and the CERCLA Removal Action. Government to Government consultation is on-going as part of the compliance with the following Federal Laws and Regulations: the National Historic Preservation Act as amended, (NHPA); American Indian Religious Freedom Act (AIRFA); Executive Order 13007 (Integrity of Sacred Sites); Executive Order 13175 (Consultation and Coordination with Indian Tribal Governments); and the 1994 Presidential Memorandum regarding Government-to-Government relations with Native American Tribal Governments. Consultation with tribes and practitioners is on-going.

Information has been exchanged in a variety of formats (meetings, correspondence, phone conversations and e-mail) with various state and local agency representatives from October 2002 to the present. Agencies contacted include the North Coast Regional Water Quality Control Board, California Department of Fish and Game, Siskiyou County Department of Health and Environmental Services, Siskiyou County Air Pollution District, California EPA, Department of Toxic Substances Control, the Department of Conservation Abandoned Mine Lands Unit, and the State Historic Preservation Office. A field trip to the Siskon Mine Site was held on April 22, 2003 with representatives from the North Coast Regional Water Quality Control Board and California Fish and Game.

3.5 30-Day Comment Period on the EE/CA

The NCP, 40 CFR 300.415 (m), requires a 30 day public notice and comment period at the time when the EE/CA is placed in the Administrative Record File. The EE/CA describes the recommended removal action response for the Site. At that time, the Administrative Record File for the Site is made available for public inspection at the Orleans Ranger District and the Klamath National Forest Supervisors Office. The 30-day comment period may be extended a minimum of 15 days if requested by the public. During the public comment period, a public meeting on the removal action will be held in Orleans, California. After the public comment period is over, the Responsible Official making the decision will consider comments received during the comment period. Responses to comments will be appended to the Removal Action Memorandum, which is the decision document.

3.6 Summary of Public Issues

In general, the Tribes, agencies, and groups interested in the Siskon Mine CERCLA Removal Action project agree that pollutants from the Siskon Mine tailings are a detriment to the water quality and fisheries of the Dillon Creek watershed. The Tribes additionally believe that the contamination associated with the Site is an infringement on the spiritual characteristics of the Helkau Cultural Area. The public generally supports the Forest Service in its efforts to remedy the situation.

All comments received on the project up to the date of signing of the Removal Action Memorandum are compiled in the Administrative Record File. Of the many comments and concerns received from the public to date, the only significant issue relevant to remedy alternative development has been the following:

1. There is a dispute that an on-Site removal action remedy (e.g. containment and capping) will only be a short-term, band-aid solution that will require further response actions or remediation in 10 to 20 years. Alternatives that consider complete removal of the contaminated tailings to an off-Site repository on the Forest or to a hazardous waste landfill need to be considered. Only these alternatives provide a long-term solution.

In response to this issue, alternatives that consider development of an off-site repository, and off-Site removal to a hazardous waste landfill are analyzed in the EE/CA.

4.0 IDENTIFICATION OF APPLICABLE, RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)

ARARs were introduced in the 1985 NCP and codified in the Superfund Amendments and Reauthorization Act of 1986. ARARs apply to on-Site actions, and for all actions off-Site, compliance is only necessary with applicable requirements. ARARs are important to help to determine remedy selection and implementation, and influence clean up goals and criteria. For removal actions, ARARs apply to the extent practicable, given the circumstances of the situation, and whether the problem is an emergency or non-time-critical.

4.1 Request for ARARS

Lists of applicable, relevant and appropriate requirements (ARARs) were obtained from state regulatory agencies in 1998. The regulatory agencies that were contacted include: California Regional Water Quality Control Board, North Coast Region; California Department of Fish and Game; California Department of Toxic Substances Control; and the California Air Resources Board. Responses were obtained from the North Coast Regional Water Quality Control Board, the California Department of Fish and Game and the California Department of Toxic Substances Control. The ARARs for the Site are summarized here; the requests for ARARs and responses from the agencies are contained in the Site Administrative Record File.

4.2 Definitions and Use of ARARs

ARARs are defined as standards or requirements that are found to be either "applicable" or "relevant and appropriate" to the conditions and circumstances found at a CERCLA Site under consideration for a removal action. A requirement may be “applicable” or “relevant and appropriate,” but not both.

> **Applicable Requirements**. Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal or State environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. "Applicability" implies that the removal action or the circumstances at the site satisfy all of the jurisdictional prerequisites of a requirement. An applicable federal requirement is an ARAR. An applicable state requirement is an ARAR, only if it is more stringent than federal ARARs.
>
> **Relevant and Appropriate Requirements**. Relevant and appropriate requirements are those cleanup standards, standards of control, and other

substantive environmental protection requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, removal action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site.

To constitute an ARAR, a requirement must be substantive, (not procedural or administrative). Therefore, only the substantive provisions of requirements identified as ARARs are considered. Permits are considered to be procedural or administrative requirements. Provisions of generally relevant federal and state statutes and regulations that were determined to be procedural or non-environmental, including permit requirements are not considered to be ARARs.

In addition to ARARs, agencies may, as appropriate, identify other advisories, criteria, or guidance to be considered for the particular removal action. The “to be considered” category, as defined in 40 CFR 300.400(g)(3), consists of advisories, criteria, or guidance that were developed by EPA, other federal agencies or states that, while non-promulgated, may be useful in developing CERCLA response actions. For example the EPA Region 9 PRGs, and the BLM Risk Management Criteria discussed in the previous section on Streamlined Risk Evaluation, are to be considered in determining the need for an action at this Site.

4.3 Identification of ARARs

This subsection identifies ARARs that may be applicable or relevant and appropriate to a removal action at the Site. ARARs were compiled and evaluated from Forest Service Guidance for CERCLA Removal Actions, EPA guidance documents, and from ARARs obtained from California State agencies for the Siskon Mine Site.

ARARs are divided into action-specific, contaminant-specific, and location-specific requirements.

Action-specific ARARs are usually technology- or activity-based requirements, or are limitations on actions taken with respect to hazardous substances. A particular removal activity will trigger an action-specific ARAR. Unlike chemical- and location-specific ARARs, action-specific ARARs do not, in themselves, determine the removal alternative. Rather, action-specific ARARs indicate how the selected remedy must be achieved.

Contaminant-specific ARARs govern the release of materials possessing certain chemical or physical characteristics or containing specific chemical compounds into the environment. Contaminant-specific ARARs generally set human or environment risk-based criteria and protocols which, when applied to site-specific conditions, result in the establishment of numerical action values. These values establish the acceptable amount or concentrations of a chemical

that may be found in, or discharged to the ambient environment.

Location-specific ARARs relate to the geographic or physical position of the site, rather than to the nature of the contaminants. These ARARs place restrictions on the concentration of hazardous substances or on the conduct of the removal actions response activities due to their location in the environment.

A summary of ARARs received and compiled to date is presented in Table 6 below.

Table 6. ARARs for the Siskon Mine Site				
Source	**Standard, Requirement, Criterion or Limitation**	**Description**	**ARARs, or To Be Considered**	**Comments**
ACTION-SPECIFIC				
California Hazardous Waste Control Law and Hazardous Waste Disposal Regulations	Title 22, CCR 66262.1 *et seq*	Requirements for hazardous waste management, including manifesting, record-keeping, storage, and packaging procedures for hazardous waste.	Applicable	
California Occupational Health and Safety Act	Title 8 CCR Division 1, Chapter 3.2.	Safety requirements applicable for all phases of Site removal actions including hazardous waste handling.	Applicable	
California Occupational Health and Safety Act	Title 8 CCR Division 1, Chapter 4, Subchapter 7, Group 16, sec. 5192, Hazardous Waste Operations and Emergency Response.	Regulations equivalent to the Federal HAZWOPER standard, 29 CFR secs. 1910.120, 1926.65.	Applicable	
RCRA Part 263, Standards Applicable to Transporters of Hazardous Waste	40 CFR 263.10-31.	These regulations are applicable for hazardous waste transported off-site.	Applicable	
Hazardous Materials Transportation Act	49 CFR 107, Parts 171-179; 383, 391-397	Transportation requirements.	Applicable	
Special Treatment, Storage, and Disposal Units, Mine Waste Management Discharges of Hazardous Waste to Land	Title 27, CCR 20005 *et seq*. Title 23, CCR, 2510 et seq.	Title 27: Regulations defining mining waste, closure requirements, and monitoring and post-closure maintenance regulations. Title 23: Regulations pertaining to water quality aspects of waste discharge to land.	Applicable	

Special Treatment, Storage, and Disposal Units, Mine Waste Management Discharges of Hazardous Waste to Land	Title 27, CCR, Section 20090(d), Title 23, CCR, Section 2511 (d).	Action taken by public agencies to clean up unauthorized releases are exempt from Title 27/Title 23 except that wastes removed from immediate place of release and discharged to land must be managed in accordance with classification (Title 27, CCR, Section 20200/ Title 23, CCR, Section 2520) and siting requirements of Title 27 or Title 23 and wastes contained or left in place must comply with Title 27 or Title 23 to the extent feasible.	Applicable	Applies to remediation and monitoring of sites.
	Title 27, CCR, Section 20410, Title 23, CCR, Section 2550.6.	Requires monitoring for compliance with remedial action objectives for three years from the date of achieving cleanup standards.	Applicable	
	Title 27, CCR, Section 20415, Title 23, CCR, Section 2550.7.	Requires general soil, surface water, and ground water monitoring.	Applicable	
	Title 27, CCR, Section 20430, Title 23, CCR, Section 2550.10.	Requires implementation of corrective action measures that ensure that cleanup levels are achieved throughout the zone affected by the release by removing the waste constituents or treating them in place. Source control may be required. Also requires monitoring to determine the effectiveness of the corrective actions.	Applicable	
	Title 27, CCR, Section 21090.	Requires a final cover constructed in accordance with specific prescriptive standards, to be maintained as long as wastes pose a threat to water quality.	Applicable Relevant & Appropriate	Applies to non-mining wastes contained or left in place at the end of remedial actions that could affect water quality. Includes closure of landfills and other areas where wastes have been discharged to land. Relevant and appropriate for closed & abandoned mining wastes which have been discharged to land and water quality is threatened.
Porter Cologne Water Quality Control Act	California Water Code Section 13243.	The Regional Water Quality Control Board may specify certain conditions or areas where discharge of waste will not be permitted.	Applicable	Applies to all remedial/removal action

California Fish and Game Code	Division 6, Fish, Chapter 2, Section 5650-5651.	Prohibits any substance or material that is deleterious to fish, plant life or bird life from being deposited in or put in a place where it can pass into the waters of the state. When a source of chronic pollution exists, the department shall report that condition to the appropriate regional water quality control board and will cooperate with them in the correction and abatement of the pollution.	Applicable	
	Division 9, Section 12015	Expeditious cleanup is the primary interest of the people of the State of California to protect the people and the environment. Parties responsible for pollution are required to cleanup the pollution or pay costs of removal by the department.	Applicable	
	Division 13, Section 1600-1603	General plans describing the nature of a project to change the bed, channel, or bank of any river, stream or lake must be submitted to the department for review and comment.	Applicable	
	Division 3, Section 2014.	Prevention of willful or negligent destruction of birds, mammals, fish, reptiles, or amphibia.	Applicable	
	Division 4, Section 3005.	Unlawful to take birds or mammals with any net, pond, cage, trap, etc. For ongoing mining operations a mitigation plan shall be approved by the department.	Applicable	
	California Fish and Game Code, Division 2, Section 1015.	The department shall be provided an opportunity to ensure that a project proposal will protect salmon and steelhead resources from damage resulting from the project.	Applicable	
Asbestos Toxic Control Measure for Construction, Grading, Quarrying and Surface Mining, California Code of Regulations	California Code of Regulations, Title 17, Section 93105.	Requires notification of road construction and maintenance in ultramafic rock, and outlines dust abatement measures for road construction, grading and quarrying in ultramafic rock.	Relevant and Appropriate	

CHEMICAL-SPECIFIC				
Porter Cologne Water Quality Control Act, California Water Code Section 13000 et seq.	Water Quality Control Plan for the North Coast Region, 1994, with amendments.	Establishes water quality objectives and designates the beneficial uses for waters within the North Coast Region, and streams of the Middle Klamath River Hydrologic Area.	Applicable	Specific applicable portions of the Basin Plan include beneficial uses of affected water bodies and water quality objectives to protect those uses. Any activity, including, but not limited to, the discharge of contaminated soils or waters or in-situ treatment or containment of contaminated soils or waters, must not result in actual water quality exceeding water quality objectives.
	State Water Resources Control Board Resolution No. 68-16. ("Anti-degradation Policy")	Provides for the maintenance and protection of existing high quality waters of the state, and any activity which produces a waste discharge will meet waste discharge requirements to ensure that pollution will not occur and that existing high quality waters will be maintained.	Applicable	Applies to discharges of waste to waters, including discharges to soil that may affect surface or ground waters. In-situ cleanup levels for contaminated ground waters must be set at background level, unless allowing continued degradation is consistent with the maximum benefit of the people of the state. If degradation of waters is allowed, or allowed to remain, the discharge must meet best practical treatment or control standards, and result in the highest water quality possible that is consistent with the maximum benefit to the people of the state. In no case may water quality objectives be exceeded.
	State Water Resources Control Board Resolution No. 92-49 (As amended April 21, 1994) .	Establishes requirements for investigation and cleanup and abatement of discharges of waste. Among other requirements, dischargers must clean up and abate the effects of discharges in a manner that promotes the attainment of either background water quality, or the best water quality that is reasonable if background water quality cannot be restored.	Applicable	Applies to all removal/remedial actions.

Porter Cologne Water Quality Control Act, California Water Code Section 13000 et seq.	State Water Resources Control Board Resolution No. 88-63 ("Sources of Drinking Water Policy").	Specifies that, with certain exceptions, all ground and surface waters must have the beneficial use of municipal or domestic water supply.	Applicable	Applies in determining beneficial uses for waters that may be affected by discharges of waste.
	Special Treatment, Storage, and Disposal Units, Mine Waste Management, Title 27, CCR, Section 20400, Title 23, CCR, Section 2550.4.	Concentration limits must be established for groundwater, surface water, and the unsaturated zone. Must be based on background, equal to background, or for corrective actions, may be greater than background, not to exceed the lower of the applicable water quality objective or the concentration technologically or economically achievable.	Applicable	Applies in setting cleanup levels for all discharges of waste to land.
Special Treatment, Storage, and Disposal Units, Mine Waste Management Discharges of Hazardous Waste to Land	Title 27, CCR, Section 20425, Title, 23, CCR, Section 2550.9.	Requires an assessment of the nature and extent of the release, including a determination of the spatial distribution and concentration of each constituent.	Applicable	Applies to areas at which monitoring results show statistically significant evidence of a release.
Staff Report of the RWQCB, Central Valley Region, August 2000, with Updates 2000-2002.	"A Compilation of Water Quality Goals"	Provides guidance on selecting numerical values to implement narrative water quality objectives contained in the Basin Plan.	To Be Considered	Performance Standard. To be considered in selecting appropriate numerical values to implement the Basin Plan for setting cleanup levels and discharge limits. The numerical values contained in the staff report may be ARAR's, or Performance Standards, depending on the source of the values.
Environmental Protection Agency, Region 9	"Region 9 Preliminary Remediation Goals, 2002"	Preliminary cleanup goals for contaminants in soil, air and tap water.	To be Considered	PRGs should always be considered in conjunction with ARAR-based goals (e.g. MCLs and Basin Plan Objectives), ecological benchmarks and "background" conditions before establishing a final cleanup level for a particular site.

LOCATION-SPECIFIC				
National Historic Preservation Act, 1966 as amended	16 U.S.C. 470 *et seq,*	Requires federal agencies to take into account the effect of any federal undertaking on any prehistoric or historic district, site, building, structure or object that is included or may be eligible for inclusion in the National Register of Historic Places.	Applicable	
American Indian Religious Freedom Act	42 U.S.C. Sec. 1996.	Protects and preserves religious freedoms of Native Americans including access to religious sites and consultation with tribal leadership concerning human burial sites that federal project might disturb.	Applicable	
Archeological and Historic Preservation Act	16 U.S.C. 469-469C, 40 CFR 6.301	Establishes procedures to preserve historical and archeological data that might be destroyed through alteration of terrain as a result of a federal undertaking.	Applicable	
Federal Memorandum Government-Government Relations with Native America Tribal Governments, April 29, 1994.		Outlines agency responsibilities to consult with Native American Tribal governments in a government-to-government relationship.	Relevant and Appropriate	
Executive Order No. 13007: Indian Sacred Sites, May 24, 1996.		Directs Federal agencies responsible for the management of Federal lands to accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners and avoid adversely affecting the physical integrity of such sacred sites.	Relevant and Appropriate	
Executive Order 13175 Consultation and Coordination with Indian Tribal Governments, November 6, 2000.		Reaffirms the U.S. Governments responsibility for continued collaboration and consultation with Tribal Governments …. To strengthen the U.S. government-to-government relationships with Indian tribes.	Relevant and Appropriate	

Endangered Species Act	16 USC 1531 *et seq*.	Requires assessment and protection of threatened or endangered species by prohibiting activities and that would have an adverse effect or cause jeopardy to the species.	Applicable	
Wild and Scenic Rivers Act	16 U.S.C. Sec. 1271 *et seq*.	Preserves and protects in a free-flowing condition of certain select rivers that possess outstandingly remarkable scenic, recreation, geologic, fish and wildlife, historic, cultural or other similar outstandingly remarkable values.	Applicable	
Federal Noxious Weed Act	7 U.S.C. 2801 *et seq*.	Requires efforts to avoid the introduction and spread of identified noxious weeds.	Applicable	
Phytophthora ramorum; Quarantine and Regulations,	U.S. Department of Agriculture, 7 CFR Part 301, Federal Register Vol. 67, No 31, February 14, 2002.	Quarantines 10 counties in California and one county in Oregon because of the presence of *Phytophthora ramorum* which causes sudden oak death.	Applicable	

5.0 IDENTIFICATION OF REMOVAL ACTION GOALS AND OBJECTIVES

5.1 Statutory Limits on Removal Actions

Section 300.415 (b) (4) of 40 CFR allows at least six months lead time before cleanup must begin on a non-time-critical removal action if the lead agency (the USDA-Forest Service) deems such action is appropriate to the site conditions. In general, the removal action tries to adhere to the same restriction placed on CERCLA fund-financed removal actions. These restrictions are not to exceed $2 million for the action and to complete the removal action within 12 months from initiation of on-site activity. While the limit to not exceed $2 million, and to complete the action within 12 months, is specific to actions by the EPA, Forest Service-funded removal actions try to adhere to the same restriction.

5.2 Determination of Removal Action Scope, Goals and Objectives

Assessment of the Site indicates that hazardous substances (arsenic, cadmium, copper, lead, mercury, molybdenum, selenium, silver, and zinc) are present in mill tailings at the Site, and are being released into the environment. The high levels of hazardous substances in the tailings, and their lack of containment and cover, pose threats of exposure to human and ecological receptors at the Site and off-Site.

The threats posed by the Site, and justifying the necessity of a removal action according to 40 CFR 300. 415 (b)(2) (i -viii) have been described in the Removal PA/SI Report (USDA-Forest Service, 2003a). They are briefly summarized here. The primary threat is from high levels of metal contaminants in the surface soil (mine tailings) that are migrating (eroding) off-Site into Copper Creek, causing contamination of a sensitive ecosystem. Additional threats exist which include: presence of contaminants in tailings in an open cyanide leach vat; exposure of terrestrial plants, animals, and aquatic organisms to contamination in the tailings; weather conditions that may cause large volumes of hazardous substances in the tailings to be released into the stream system; threat of wildfire which could increase on-Site erosion and contaminant migration; and human health risks from exposure to dust containing arsenic and iron during work activities at the site.

The scope of this removal action at the Siskon Mine Site is to address the threats posed by "… contaminants in other bulk storage containers that may pose threat of release" "high levels of contaminants in soils largely at or near the surface which may migrate" and as defined under section 40 CFR 300.415 (b) (2) (iii and iv). Elimination of these threats can be achieved by stabilizing or removing the mine tailings, controlling on-Site erosion, and eliminating off-Site migration of the tailings.

This is expected to be the final removal action at the site; cyanide drums were removed 1999 as part of non-time critical CERCLA removal action. It is unlikely that the Siskon

Mine Site would quality for the National Priority List (NPL), and require remedial action. While there is clear need to address the metals contamination in the tailings, the Site is too distant from population centers, the contamination is not threatening domestic or municipal water supplies, or causing fish kills that could qualify the Site for the NPL and remedial action. The tailings present in the former tailings pond, in a vat at the mill site, and covering parts of the ground at the mill site, are the only currently identified operational units needing to be addressed under CERCLA.

The overall goals of the removal action are to:

- Protect human health, improve riparian function, aquatic and wildlife habitats, attain water quality objectives, and maintain beneficial uses in the watershed area.

The objectives of the removal action are to:

1. Eliminate or reduce actual or potential human, plant, and animal, exposures to hazardous substances in the tailings
2. Eliminate or reduce the chronic surface erosion of tailings and contaminants of concern into Copper Creek.
3. Eliminate or reduce the threat of an acute large-volume release of tailings containing hazardous substances into the stream system during a future major storm or flood event.
4. Eliminate or remove the safety hazards and ecological risks posed by the open vat containing tailings, and other metal debris and tailings piles on the mill.
5. Reduce the chronic on-Site sedimentation from mine roads into the mill, former tailings pond area and Copper Creek.

5.3 Determination of Removal Schedule

The Siskon Mine Site is generally not accessible from November to March most years. Initiation of the removal action and on-Site activities are expected to occur between established operating periods of June 1 to October 15. If nesting Northern spotted owls are discovered within 0.25 mile of the Site, the operating period will begin July10. At present, no nesting owls in the project vicinity have been found. Because of the extensive amount of road construction and road maintenance necessary to access the site, it is anticipated that the removal action will require two summer seasons to accomplish. Site work would be completed over a period of approximately 14 months. The removal action is anticipated to begin in August, 2003 and be completed in October, 2004. Monitoring, operations and maintenance activities at the Site would continue for at least three additional years, to 2007.

6.0 IDENTIFICATION OF REMOVAL ACTION ALTERNATIVES

6.1 Initial Screening of Removal Action Options

A range of options was considered as removal action responses applicable under the NCP, 40 CFR 300.415 (d) (1-9). The goal of the screening process is to identify options that will enhance the protection of human health and the environment at the Site and downstream of the Site, and that will achieve the removal action goals and objectives outlined in Section 4.2.

Under CERCLA and the NCP, eight[7] types of Removal Actions are generally appropriate for the situations encountered with hazardous substances at remote abandoned mine sites. Each was evaluated for applicability to the Site conditions and were screened as follows:

1. **Fences or other security/site controls to prevent access to a release.** Institutional controls, such as fencing, gating and posting warnings at the Site was screened from further consideration because this remedy would not stop ongoing erosion of the tailings into Copper Creek or remove the threat of a large volume release of tailings from a large flood; nor would it limit exposures to the tailings by some smaller forms of wildlife or aquatic organisms. The Forest Road, 14N31, which accesses the Site is gated year-round which provides a small measure of institutional control to the public from the hazards posed by the Site.

2. **Drainage controls where needed to reduce migration of hazardous substances or contaminants.** This option is applicable and was retained for further evaluation.

3. **Stabilization of berms, dikes, lagoons, etc., to maintain structural integrity.** Stabilization of existing berms, dikes and impoundments is not applicable to the Site conditions and was screened from further consideration. The former tailings pond is uncontained. The old impoundment dam was breached when mine operations ended in 1960 and has eroded into Copper Creek since then.

4. **Capping of contaminated soils or sludges to reduce migration of contaminants.** This option is applicable and was retained for further evaluation.

5. **Using chemicals or other materials to retard the spread of the release or to mitigate its effects.** The use of chemicals or other materials such as lime addition, or crushed limestone to mitigate the effects of the release was also found to not be applicable to the site, as the tailings are not acid-generating, and no leachates are being released into the environment. The metals in the tailings have been found to be relatively immobile and have a low potential to become

[7] The ninth category of Removal Action, provision of alternative water supply, (40 CFR 300.415(d) (9) does not apply to the conditions and release pathways of the Site.

soluble in water. This option was screened out.

6. **Excavation, consolidation, or removal of highly contaminated soils to reduce the spread of or contact with contamination.** This option is applicable and was screened for further evaluation.

7. **Removal of drums, barrels, tanks (e.g. open vat leach tank) that contain hazardous substances that where it will reduce the likelihood of exposure to humans or animals.** Tailings are present in a large open vat leach tank at the mill. This option is applicable and was screened for further evaluation.

8. **Containment, treatment, disposal, or incineration of hazardous materials to reduce the likelihood of exposure.** Containment and disposal of the tailings is applicable and was retained for further evaluation. Treatment processes such as Solidification/Stabilization, (S/S) are those that change the physical characteristics of the contaminated soils to reduce their mobility by creating a physical barrier to leaching. S/S technology is usually applied by mixing contaminated soils or tailings with a physical binding agent (e.g. cement) to form a crystalline, glassy or polymeric framework around the particles of waste. These technologies are complicated to evaluate for soils and tailings having several different metal contaminants. The implementation cost is also high. This type of treatment generally reduces migration of soluble contaminants into groundwater; however, this is not a problem posed by the site. S/S treatment would not reduce the potential for erosion or releases of tailings during floods, and since it does not reduce the contaminant concentrations at the surface, it would not limit exposures to humans or wildlife. In addition, S/S is difficult to implement with large volumes of tailings that are already situated in waste piles, as is the case at the Siskon Mine Site. The tailings would have to be excavated, mixed or amended with a binding agent and replaced back on the Site. For these reasons, soil contaminant treatment technologies such as S/S were screened from further consideration. Incineration of the tailings would require removal of the tailings from the Site, transport to a facility, and incineration. This option was screened from consideration due to the high volumes of material containing hazardous substances, the high costs of transport to a facility, most of which are outside of California, and the high costs of incineration.

In summary, various components of options 2, 4, 6, 7, and 8 were retained for consideration in removal action alternative development. Actions consisting of drainage control, capping, excavation, consolidation, containment, off-site removal, and off-site disposal, can be combined in a range of alternatives that meet the goals and objectives for addressing contaminant issues with the tailings at the former tailings pond, in piles at the mill, and in the open vat leach tank at the mill.

6.2 Description of Potential Removal Action Options

Management or treatment of the tailings includes options that can be conducted on-Site, or off-Site. Some of the tailings treatment options require little movement or handling of the tailings; other options require extensive movement or handling of the tailings. Some

of the options are ineffective on their own, but meet more response action objectives in combination with other options. The following options that have passed through the initial screening above are examined further in how they could be implemented at the Site, and in how they meet response action goals and objectives for the Site:

- Consolidation
- Containment
- Capping
- Drainage Control
- Excavation and Removal
- Disposal

Consolidation: The tailings present in the vat leach tank and in piles at the mill would be consolidated with the other tailings in the former tailings pond area. This would eliminate the hazards posed by the tailings in the tank, and would reduce the area of contamination and sites of contamination. Consolidation could include regrading tailings piles to lower slope gradients to reduce the potential for erosion. Tailings could be consolidated and left on site, or removed to an off-site location in a repository or to a hazardous waste disposal site. By itself, consolidation and regrading on-site would not reduce human or wildlife exposures to the tailings, nor would it appreciably change erosion of the tailings or the potential for tailings to be released in a large flood. Consolidation alone, also would not promote vegetation and restoration of the site as the tailings appear to be somewhat toxic to shallow rooted plants. It would not address concerns with the safety hazards associated with the metal debris at the mill or erosion from mine roads on to the mill. This option is retained to be combined with other options.

Containment: This option includes engineered containment structures such as riprap, a gabion wall buttress, or rigid block retaining walls which would contain and shield the tailings from erosion during flood events, and would limit tailings migration off-site into the creek. Of the various containment options, a gabion wall buttress was screened as the preferred containment structure, over riprap and other rigid retaining walls (USDA-Forest Service-KNF, 2003c). By itself, containment of the tailings would limit delivery of tailings to the stream channel but would not reduce tailings erosion. It would not reduce human or wildlife exposures to the tailings in the former tailings pond or at the mill, nor would it address safety hazards associated with the metal debris at the mill or erosion from mine roads on to the mill. This option is retained to be combined with other options.

Capping: Capping involves placing a cover over the tailings to limit the potential for human and ecological exposure to the contaminants in the tailings. There are various types of caps which include: clean, permeable soil cover; impermeable clay cover; and various synthetic and geocomposite liners placed as a barrier between the tailings and the cap. Because of the immobility of the contaminants at the site, the large volume of the tailings present, the large area of the site, and the presence of suitable on-site borrow areas, onsite capping with clean soil was screened as the preferred cap type

(USDA-Forest Service-KNF, 2003c). Groundwater is not a significant transport mechanism of contaminants in the tailings or exposure pathway at the site; therefore a barrier such as a synthetic or geocomposite liner is not necessary to limit metals contaminant migration in the tailings. Further, deep rooted vegetation such as conifers, alders, maple trees, or other brushy riparian vegetation could not be planted on site to restore the riparian function, if a liner was present. They could not grow roots through the liner. Although capping would not reduce the toxicity or volume of contamination, it would reduce its mobility by making the contamination inaccessible to surface water erosion and storm water flow. Capping in combination with drainage controls, would disperse concentrated runoff on the cap and limit erosion of the cap. Vegetation of the cap would reduce erosion and allow the Site to be restored to a more natural riparian function. Capping with soil in combination with consolidation, grading and containment of the tailings appears to meet most of the objectives of limiting exposures, controlling erosion, flood protection, and restoration.

Drainage Control: Drainage control includes surface trenches and channels, and constructed stream diversions to control surface water, route it away from contamination sites, dissipate the energy of water, and to isolate surface water from wastes such as the tailings. On-site drainage controls considered include shallow rock-lined surface trenches to capture concentrated runoff from the steeper slopes above the former tailings pond, and a rock–lined channel to capture water from the shallow intermittent spring that emerges in the middle of the tailings (USDA-Forest Service-KNF, 2003c). The drainage control structures are constructed of riprap so that surface runoff will not cut down through the cap, and use geotextiles as liners so that fines from the tailings or the cap will not migrate into the drainage structure. Re-routing or diverting Copper Creek away from the tailings was screened from further consideration because the current channel is confined by bedrock and there is no place to redirect the large stream away from the tailings. By itself, drainage control will not reduce human or wildlife exposures to the tailings, nor would it appreciably change erosion of the tailings or the potential for tailings to be released in a large flood. It would not address concerns with the safety hazards associated with the metal debris at the mill or erosion from mine roads on to the mill. On-site drainage control in combination with consolidation, grading, containment and capping, would however, meet these objectives.

Excavation and Removal: Excavation and removal of mine tailings is potentially an effective means of achieving the objectives and goals for the Site. The excavated material could be deposited in a suitable waste repository on-Site or at an off-Site location. The tailings at the waste repository would need to be graded, layered and capped with suitable fill soil, and revegetated. Excavation and removal of tailings from the Site would also require that the hole left by the tailings removal from the former tailings pond be filled in with clean soil, and disturbed areas would need to be graded to a final slope and revegetated. This would necessitate development of additional soil borrow site areas to cap the tailings at the repository, and fill in the hole at the Site. Development of an off-Site repository for the tailings would require transport and haul of the hazardous mine tailings to the repository and would impact an area on the Forest not presently impacted by mining disturbance or metal-bearing contaminants.

Permitting, logistical and legal requirements of a new off-Site repository for the tailings would be greater, increasing costs. Costs would depend on how far away the off-Site repository was from the Siskon Mine Site. Excavating and removing the mine tailings to an on-Site repository was screened from further consideration because there are no large, (2 – 4 acres) flat, stable, and relatively cleared areas on-Site that could be used to develop a tailings repository. Excavating and removing the mine tailings to an off-Site tailings repository was retained for further consideration because it could meet the goals and objectives, and is an option that the public wants considered as an alternative.

Disposal: Disposal entails most of the activities described above in excavation and removal, but would dispose of the mine tailings at a Class I Hazardous Waste Landfill. This would require a very long haul and transport distance of the tailings to Kettleman City, California, the nearest landfill disposal site which would accept contaminated soils containing lead, as well as other metals at high concentrations. This option is very costly due to the transport distance, volume of tailings waste, and other factors. Disposal of the mine tailings at a hazardous waste landfill would not require development of a tailings waste repository off-Site on the Forest. Disposal was retained for further consideration as a viable option, partly in response to issues raised by the public.

A summary of the results of screening of management and removal options for the tailings at Siskon Mine is presented in Table 7.

Table 7. Results of Screening Removal Action Options at Siskon Mine Site

Category	Technology Type	Results of Screening Process
No Action	None	Retained for Further Analysis
Institutional Controls	Fences, gates, warning signs	Eliminated
Tailings Treatment On-Site	Lime addition/amendment	Eliminated
	Solidification/Stabilization	Eliminated
Tailings Management On-Site	Stabilization of berms, dikes, lagoons etc. to maintain structural integrity	Eliminated
	Consolidation of tailings at the mill and former tailings pond	Retained for Further Analysis in Combination with Other Options
	Containment – gabion wall buttress	Retained for Further Analysis in Combination with Other Options
	Containment – riprap, or rigid retaining wall	Eliminated
	Capping – clean soil	Retained for Further Analysis in Combination with Other Options
	Capping – clay, synthetic or geocomposite liners	Eliminated
	Drainage Control – channel diversion/rerouting	Eliminated
	Drainage Control – surface rock-lined trenches, and channels	Retained for Further Analysis in Combination with Other Options
Tailings Excavation & Removal	On-Site Tailings Repository	Eliminated
	Off-Site Tailings Repository	Retained for Further Analysis
Tailings Disposal	Incineration	Eliminated
	Excavation and Removal to a Class I Hazardous Waste Landfill	Retained for Further Analysis

6.3 Identification of Alternatives

6.3.1 *Alternative 1 – No Action*

This alternative is required. Under this alternative the tailings would remain on Site in their current condition. The physical conditions of the Site, such as erosion from the mine road would remain unchanged. This alternative provides comparison between the current situation and the results of the proposed response actions.

6.3.2 *Alternative 2 – Consolidation, Containment, and Capping In Place.*

This alternative is expected to meet the removal action goals and objectives for the Siskon Mine Site. This alternative is the recommended alternative.

Alternative Description
Mill tailings materials would be consolidated, contained, and closed in-place at the Siskon Mine Site. Tailings will be pulled back upslope from where they are deposited in the 100 year flood plain near the Copper Creek stream channel and consolidated with the other tailings piles within the former tailings pond area, encompassing an area approximately 1.3 acres. Tailings in the vat leach tank at the mill, and in piles and spillover at the mill would also be combined with the rest of the tailings. The consolidated tailings and soil cap would be retained by an engineered gabion retaining wall. The gabion wall is designed to withstand the estimated 100-year flood without undercutting, overtopping, or sustaining any other serious damage. Riparian vegetation directly adjacent to the stream channel will be retained and protected from disturbance to the maximum extent practicable in order to construct the gabion wall. The gabion wall footing will be constructed at an elevation sufficiently below channel grade to provide for a high degree of slope stability and protection from flooding and channel scour. The front of the gabion wall (adjacent to the stream) will be protected with a "Reno Mattress" (partially buried scour prevention device). Riprap will be placed at the two ends of the gabion wall for additional flood protection at the transition to the natural slopes. Final closure of the tailings would be performed by: (1) grading and compacting the tailings; (2) capping the graded tailings with clean fill (uncontaminated soils); (3) fertilizing, seeding, mulching the cap; (4) placement of erosion control matting on top of the seeded cap and, (5) planting of trees and other vegetation on the cap, after the disturbed area has stabilized and grass has been established, in order to establish long-term vegetation. Specified rock material from a source off of the Forest will be hauled to the Site for filling the gabion baskets and riprap. A minimum of two feet of capping material will be placed on the tailings. Native soil and rock material comprising the cap would be obtained locally from the Site from: old fill piles on-Site; 1.5 miles of road stormproofing (excess soil removed from road berms), and borrow sites along the mine road. It is estimated that 4500 – 5000 cubic yards of soil/rock material will be used to cap the estimated 11,500 cubic yards of tailings. All soil borrow sites shall be sloped and graded to ensure proper drainage, seeded and mulched at the close of the season of use.

An engineered drainage structure (rock-lined surface trench drain) will be constructed along contour at the base of steeper uncontaminated slopes along the outside edge of the tailings cap. The drainage structure will collect excess surface runoff, slow it down and allow it to infiltrate into the subsurface soils. Within the area of capped tailings, another rock-lined drainage channel will be constructed to capture water flowing from the intermittent spring. This drainage structure will be constructed so that captured spring water and surface runoff from the cap will be isolated from the tailings using geotextile, fill and riprap.

See Section 6.3.5 for removal and reclamation activities, project timing and schedule, and resource protection measures for this alternative.

6.3.3 *Alternative 3 – Tailings Removal to an Off-Site Repository Within the Ukonom/Orleans Ranger District, Cap and Revegetate*

Alternative Description

Mill tailings would be removed from the Siskon Mine Site and transported to an off-Site mine waste repository, capped with soil and revegetated within the Ukonom/Orleans District. A waste repository of large enough (approximately 4 – 6 acres) to contain approximately 11,500 cubic yards of tailings would be designed and constructed in a suitable[8] site location requiring minimal clearing or and grading. The foundation of the site would be prepared to accept tailings. Tailings from the former tailings pond, tailings in the vat leach tank at the mill, and in piles and spillover at the mill would consolidated, hauled to the waste repository site, layer placed and compacted. Small, 10 cubic yard capacity trucks would be loaded with tailings at the Site, and the truck beds would be covered with tarpaulins. The truck would then transport the material to the waste repository site on Forest roads. Borrow sites would be developed along existing Forest roads to obtain suitable capping soil. Soil excavated from the borrow sites would be excavated, hauled to the waste repository site, placed on the tailings and compacted. The cap would be fertilized, seeded, mulched and erosion control matting would be placed on top of the seeded cap. Long-term vegetation consisting of conifer trees would be planted on the cap after the site has stabilized. Surface water diversion structures would be designed and constructed as needed around the repository.

At the Siskon Mine Site, the hole left from tailings removal would be shaped and graded to accept soil as backfill. Native soil and rock material comprising the backfill would be obtained locally from the Site from: old fill piles on-Site; 1.5 miles of road stormproofing (excess soil removed from road berms), and borrow sites along the mine road (14N31B). Rocked surface water drainages and diversion structures would be constructed as needed to control surface runoff on the backfilled area. The clean soil backfill material would be graded to stable slopes, fertilized, seeded and mulched. Erosion control matting would be placed on top of the seeded area of fill. After the

[8] Suitable repository sites in this alternative would have fewer resource concerns than the existing Site (e.g. not within sites eligible for the National Register of Historic Places, outside of Riparian, Geologically Unstable, and Late Successional Reserves, outside of Critical or Suitable Habitat for threatened and endangered species, etc.).

disturbed area has stabilized and grass has been established, trees tolerant for site conditions would be planted to establish long-term vegetation.

The first season of project operations would include all road and stream crossing-related work. The second year of the project would include all work related to repository site design and construction, consolidations and removal of the tailings from the Siskon Mine Site, borrow site development, placement of tailings, capping, and initial revegetation of the tailings at the repository site. Work the second season would additionally include all borrow site development, backfill, drainage control, and revegetation at the former tailings pond site where the tailings were removed. Project monitoring, and establishment of long-term vegetation would occur following completion of the removal action for a minimum of three years, during 2004-2007.

6.3.4 *Alternative 4 – Removal and Disposal*

Alternative Description

This alternative would involve consolidating, excavating and removing approximately 11,500 cubic yards of contaminated tailings from the Site for disposal at a Class I hazardous waste landfill. Small, 10 cubic yard capacity trucks would be loaded with tailings at the Site, and the truck beds would be covered with tarpaulins. The trucks would then transport the material to a nearby transfer site on Forest roads, where the tailings would be transferred to larger 20 cubic yard capacity trucks. The trucks would be equipped with a roll-off closed container so that no tailings dust would be emitted during highway transport. The trucks would then transport the material to the Class I landfill at Kettleman Hills, California, a one-way distance of approximately 625 miles. Trucks would drive approximately 25 miles on Forest roads to Highway 96, and then travel 100 miles on Highway 96 through the small communities of Happy Camp, Seiad Valley, Hamburg, Horse Creek, and Klamath River to Interstate 5. From Interstate 5, trucks would travel another 500 miles to Kettleman City, passing through major cities of Redding, and Sacramento. An estimated 575 round-trips would be needed to complete removal and disposal of the contaminated tailings. Trucks would need to be washed three times each round-trip, and each round trip including transferring, offloading and washing would take nearly three days.

Similarly to Alternative 3, the hole left from tailings removal at the Siskon Mine Site would require shaping and grading to accept soil as backfill. Native soil and rock material comprising the backfill would be obtained locally from the Site from: old fill piles on-Site; 1.5 miles of road stormproofing (excess soil removed from road berms), and borrow sites along the mine road (14N31B). Rocked surface water drainages and diversion structures would be constructed as needed to control surface runoff on the backfilled area. The clean soil backfill material would be graded to stable slopes, fertilized, seeded and mulched. Erosion control matting would be placed on top of the seeded area of fill. After the disturbed area has stabilized and grass has been established, trees tolerant for site conditions would be planted to establish long-term vegetation.

The first season of project operations would include all road and stream crossing-related work. The second year of the project would include all work related to tailings consolidation, excavation and removal to a disposal site. It is estimated that truck transport of the tailings to the Kettleman Hills would take nearly 5 months, loading 12 large trucks daily. Additional work the second season includes all borrow site development, backfill, drainage control, and revegetation at the former tailings pond site where the tailings were removed. Project monitoring, and establishment of long-term vegetation would occur following completion of the removal action for a minimum of three years, during 2004-2007.

6.3.5 *Actions Common to Alternatives 2, 3 and 4*

Alternatives 2, 3, and 4 are consistent with management direction found in the Klamath Forest Land and Resource Management Plan (USDA-Forest Service, KNF, 1995), Standards and Guidelines (USDA-Forest Service, KNF, 1995), and the Aquatic Conservation Strategy (USDA & USDI, April 1994).

Removal and Reclamation Activities

Metal and wood debris at the mill site, including what remains of the two vat leach tanks, will be removed and disposed of off-Site at a appropriate landfill or waste facility. Concrete on the floor of the mill site area will be ripped, broken up and removed. The disturbed areas will be sloped to drain, covered with soil, seeded, mulched and revegetated. None of the vertical concrete walls that are presently standing will be disturbed. Concrete removed from the mill area may be used for drainage control structures and riprap.

The following roadwork would occur:

- routine road maintenance along the 14N31 road access to Copper Creek;
- construction of a temporary vented rock ford with culverts on Copper Creek (allowing fish passage, and designed to handle and pass a 100-year flow);
- repair of one landslide area along the mine road (14N31B) that accesses the mill site;
- construction of a temporary road access from the existing mine road down into the former tailings pond area; and
- stormproofing 1.5 miles of mine road (14N31B) to a hydrologically self-maintaining condition (Maintenance Level 1), so that the risk of causing adverse watershed or water quality impacts is low.

Construction and removal of the temporary road crossing on Copper Creek will be implemented during the dry season when the stream flow is low, near baseflow. The running course of the crossing will be removed seasonally at the close of operations for the year. This crossing will be decommissioned after the monitoring and revegetation phase of the project, when vehicles and heavy equipment are no longer needed to cross the creek. Stormproofing will involve removing road berms and out-sloping, and installation of critical dips in the road to prevent water diversion. A new temporary road will be constructed through the lower part of the mill to allow heavy equipment to access the former tailings pond area. The location is in an area of past mine-related disturbance. The temporary road will be decommissioned when access for heavy

equipment into the former tailings pond area is no longer required.

Natural drainage patterns will be restored on slopes outside of the mill and former tailings pond area to eliminate or decrease erosion and gullying on steep erosive slopes, particularly in places where control of drainage is crucial to the success of the project.

Project implementation would require the use of hand tools and heavy equipment including excavators, loaders, graders, bulldozers, dump trucks, water tenders, pickup trucks, and off-highway vehicles (OHVs). Track mounted equipment would be used to construct the gabion wall, excavate and grade the tailings, and cap the tailings. Dump trucks would dump fill material down into the mill tailings pond where it can be handled by the track-mounted equipment.

Project Timing and Schedule

The removal action will be implemented in phases over two years beginning in 2003, and is projected to be completed in October, 2004, depending on funding availability. During the first year, project operations would include all road and stream crossing-related work. The second year would include all work related to the tailings, depending on the alternative. Project monitoring, and establishment of long-term vegetation would occur following completion of the removal action for a minimum of three years, during 2004-2007. Removal action implementation would be seasonal and would occur within the aquatic limited operating period (LOP) between June 1 and October 15 each year. The aquatic operating period may be extended with fisheries biologist determination and approval, depending on weather forecast, magnitude and duration of the work, and location of work. If nesting Northern Spotted owls are found within 0.25 miles of the Site, removal action operations involving noise disturbance will be restricted until July 10th of that year.

Resource Protection Measures

Resource protection measures and Best Management Practices have been incorporated into the project design, and are to be incorporated into contract specifications for project implementation. Resource protection measures not already mentioned in the alternative description and project schedule are summarized here and can be found in the Project Design Standards and Best Management Practices Report, (USDA-Forest Service-KNF, 2003f) which is incorporated by reference, and available in the Administrative Record File.

- Best Management Practices applicable to the project will be implemented. These measures have been certified by the State Water Quality Board and approved by the EPA to maintain water quality and protecting beneficial uses. These practices have been routinely applied in timber sales, road construction and watershed restoration projects on the Klamath National Forest.

- Klamath National Forest Wet Weather Operations (WWO) Guidelines will be used to determine appropriate operations during periods of wet

weather. The project will be implemented during the dry season from June 1 to October 14. WWO Guidelines include ceasing project operations before weather and soil conditions deteriorate to a condition that continuing with project implementation would cause adverse effects. Forecast periods will also be of a suitable length to allow completion or winterization of the task undertaken before precipitation events occur. When precipitation is forecast, the project Inspectory/COR/CO will be on site to insure that winterization procedures are implemented in a timely fashion and to initiate shutdown operations. Operations will not resume until suitable weather, soil and forecast conditions exist. The Inspector/COR/CO and/or project earth scientist will examine field conditions to determine when the soil and/or road has dried out enough to enable operations to resume without adverse affects to soil and water resources.

- An Erosion Control Plan is required to be submitted by the contractor(s) implementing the project. The plan must be approved and agreed to by the Forest Service prior to initiation of construction activities (BMP2.2).

- All contractors operating at the Site are responsible for preparation and implementation of a Hazardous Spill Contingency and Countermeasures Plans as specified in the contract, and shall be prepared to contain, control and cleanup any accidental spills onto the land or water bodies on the Forest.

- All refueling, lubricating, and servicing of vehicles and equipment will take place at designated staging or servicing areas (BMP 2.12).

- All disturbed sites are to be seeded and mulched (Certified Noxious Weed Free) prior to winter weather.

- Unsuitable soil and rock material will be placed in stable, non-floodplain sites, and then seeded and mulched to limit erosion. Timber slash will be placed in designated landings along Forest system roads. Suitable landslide, road fill and timber slash may be used to restore natural or near-natural contours, as approved by the geotechnical engineer or other qualified personnel.

- Minimize disturbance of existing vegetation within the road clearing limits, at stream crossings, and approved borrow and waste repository sites to maintain and improve hydrologic functions.

- All vehicles, transport trucks and other large equipment shall comply with cleaning of equipment specifications to prevent the introduction and spread of noxious weeds, Port -Orford -Cedar Root Disease, Sudden Oak Death etc. Vehicles and equipment shall be inspected and approved for entry by the Forest Service. Cleaning and washing sites shall be inspected and approved by the Forest Service.

- All operators and equipment on-Site shall comply with the Fire Plan specifications and requirements.

- Fine sediment generated and transported from work sites, along roads used for haul of materials or tailings, including roads in ultramafic rock, will be minimized by implementing dust abatement measures (BMP2.23).

- Water drafting sites will be developed following guidelines set forth by the National Marine Fisheries Service (August, 2001), and following BMP 2.21.

- Public access to the Site will be restricted during operations at the Site.

- Tribal Governments and practitioners will be notified routinely of the projected schedule of work at the Site (e.g. haul road being used, and work being performed), and when changes occur. This action will be tracked by the project On-Scene Coordinator.

- Elk Valley or the adjacent high-country areas in Helkau will not be used by the contractors for project-related camping or parking of equipment.

- The Go-Road will be signed between Orleans and Rock Creek Butte, during periods when haul trucks for the project are using the road.

Monitoring

Best Management Practices Implementation and Effectiveness monitoring will be conducted according to established Forest and Region procedures. Project monitoring during implementation will include water and air quality monitoring and assessment. Post project monitoring will include erosion and vegetation photo point monitoring, noxious weed monitoring, and stream sediment sampling and testing. Post project monitoring will occur annually for 3 to 5 years, and after big storm events when the Site is accessible.

7.0 ANALYSIS OF ALTERNATIVES

7.1 Introduction

The criteria which are used to analyze Removal Action Alternatives in an EE/CA are suggested and described in *Guidance on Conduction Non-Time Critical Removal Actions Under CERCLA* (EPA, 1993). The three general criteria are effectiveness, implementability and cost. The specific components of each criteria consist of the following:

Effectiveness Evaluation
- Ability to Achieve Removal Action Goals, Objectives & Overall Protectiveness of Human Health and the Environment
- Reduction of Toxicity, Mobility or Volume
- Short and Long Term Effectiveness & Permanence
- Compliance with ARARs

Implementability Evaluation
- Technical and Administrative Feasibility
- Availability of Materials and Sources
- State Acceptance
- Community Acceptance

Cost Analysis
- Capital Cost
- Outyear Operations, Maintenance, Revegetation, and Monitoring Costs

The four alternatives, which were described in Section 6.3, are analyzed below for their effectiveness, implementability and cost.

7.2 Alternative 1 – No Action

7.2.1 Effectiveness

The No Action alternative does not meet the removal action objectives and goals, as the threat of exposure to the metal contaminants in the tailings by humans, plants and animals remains unchanged, and tailings will still migrate off-Site into the stream system. There is no reduction in toxicity, mobility or volume of contaminated tailings. The threatened release of a large volume of metal-laden tailings during a large storm or flood event would remain, and the pollution caused by this release would violate North Coast Basin Water Quality objectives. This alternative is not protective of public health or the environment.

Most of the action-specific and all of the location-specific ARARs would not apply to Alternative 1 because no action would be undertaken at the Site. As an abandoned mine with wastes discharging to land and waters of the state, the Site is not in compliance with Title 27, CCR, Section 21090, requiring a final cover on mine wastes posing a threat to water quality. The Site is not in compliance with the California Fish

and Game Code, Division 6, Chapter 2, Section 5650-5651 which prohibits substances deleterious to fish from being in a place where it can pass into waters of the state. Alternative 1 is not in compliance with any of the chemical-specific ARARs, chiefly the Porter-Cologne Water Quality Control Act. The chronic and threatened acute discharge of tailings into Copper Creek is not in compliance with North Coast Basin Plan objectives for settleable material, and during a significant storm or flood event, objectives for sediment and turbidity would not be met, as the tailings discharge adversely affects beneficial uses of the streams. The chronic and potential acute discharge of the tailings may not be in compliance with objective of toxicity; however, sampling and analyses to verify toxic effects on aquatic life have not been conducted. The Basin Plan encourages source control of hazardous substances. If No Action was taken to control the tailings release, it is likely that the Forest would receive a Cleanup and Abatement Order for the discharge at the site by the California Regional Water Quality Control Board, North Coast Region.

7.2.2 Implementability

Not applicable

7.2.3 Cost

There would be no costs with this alternative, as no removal action response would occur. If a Cleanup and Abatement Order were issued, costs would be incurred responding to that, and the CERCLA and NCP processes for a response action would need to be re-initiated.

7.3 Alternative 2 - Consolidation, Containment, and Capping In Place

7.3.1 Effectiveness

Alternative 2 achieves the overall goal and objectives of the removal action by eliminating the potential for soil contact exposure to the tailings by humans, wildlife, and aquatic organisms, and prevents migration of the tailings off-Site into the stream system. Capping the tailings would also prevent release of metal-laden dust into the air, and would allow the Site to be vegetated with shallow and deep-rooted plants. The tailings would be contained by an engineered gabion retaining wall and riprap, thereby removing the threat of a large-volume release during a flood. While there is no reduction of toxicity or volume of the tailings, surface erosion of the tailings is eliminated, by capping and vegetating the cap. Containment and capping the tailings addresses the primary problem at the site, erosion of the tailings into the stream system. The retaining wall will provide permanent, long-term structural containment of the tailings. The cap would be vegetated with grass to provide cover for the short term, and trees would be planted at a later time to promote long-term vegetation and cover. Routine monitoring of the Site would ensure that vegetation is providing adequate ground cover, and drainage control and tailings containment structures are performing as intended. This alternative would be fully protective of public health and the environment.

Many of the action-specific ARARs would apply to Alternative 2. The California Occupational Health and Safety Act Title 8 CCR would apply, as would Special Treatment, Storage, and disposal Units, Mine Waste Management, Title 27 CCR. As the tailings would be contained and left in place, Title 27 would be complied with to the extent feasible. The characteristics of the mine tailings meet the criteria of a Class B mining waste. A liner, clay cap, and leachate collection system is not necessary at the Site, because leachate is not anticipated to form or escape from the capped waste pile, and there is very little groundwater underlying the area (USDA-Forest Service- KNF, 2003c). The Alternative would comply with California Fish and Game Codes by preventing migration of tailings into waters of the state. The Department of Fish and Game will be provided opportunity to comment on the EE/CA, and review engineering plans for project implementation. No wildlife will be willfully taken or trapped. Engineering controls such as dust abatement, adherence to a Site Health and Safety Plan, and use of personal protective equipment would ensure worker protection during implementation.

Alternative 2 would comply with water quality objectives of the North Coast Basin Plan by containing and capping the tailings, thereby reducing stream sedimentation and turbidity. The current water quality of Copper Creek, which complies with Basin Plan objectives and ambient water quality criteria, will be maintained. Alternative 2 would not directly achieve EPA Region 9 PRGs, and other risk management screening benchmarks for arsenic, cadmium, copper, iron, lead, mercury, molybdenum, selenium, silver and zinc, but capping of the tailings would prevent direct exposure to the elevated metals concentrations.

All of the location-specific ARARs are applicable or relevant and appropriate to Alternative 2, and would be met. Biological assessments and evaluations have been performed by Forest Service specialists for fisheries, wildlife, and botany (USDA-Forest Service-KNF 2003d; 2003e; 2002c; 2002d; 2001; 2000a; and 2000c). There are no Federally listed Threatened, Endangered or Proposed plant species or Region 5 Sensitive plant species, populations or habitat known to occur within the project area. To date, though there is suitable habitat within one-quarter mile of the Site, no nesting Northern spotted owls have been found, and Alternative 2 would have **No Effect** on the Northern Spotted Owl. If nesting Northern spotted owls are found during annual protocol surveys conducted in 2003 and 2004 within one quarter mile of the project site, operations producing noise at the Site will be restricted until after July 9. If nesting owls are found, the determination is **May Affect, Not Likely to Adversely Affect** the Northern spotted owl. Alternative 2 will have **No Effect** to Northern spotted owl Critical Habitat, marbled murrelets, marbled murrelet Critical Habitat or bald eagles. Alternative 2 **May Affect, but is not Likely to Adversely Affect SONCC** Coho salmon. Implementation of Alternative 2 is likely to result in beneficial effects to SONCC Coho salmon in the long term. Alternative 2 is **Not Likely to Adversely Affect** SONCC Coho salmon Critical Habitat. Alternative 2 may affect individuals, and may have beneficial effects to their habitat but is not likely to result in a trend towards Federal listing or loss of viability of KMP steelhead trout or UKTR Chinook salmon. Terrestrial plant and animal Survey and Manage evaluations have been conducted and there are no known

sites or habitat present. Effects of Alternative 2 on Management Indicator Species have been evaluated. Alternative 2 may have short term adverse effects on KMP steelhead and rainbow trout (River and Stream species) associated with construction and removal of the temporary crossing of Copper Creek. There will be no loss of habitat to River and Stream species association. Short-term direct or indirect effects to River and Stream species from sedimentation associated with the stream crossing construction are expected to be minor, localized, and of limited duration. The alternative will have beneficial long-term effects to River and Stream species from reductions in surface erosion of the tailings, and the elimination of the threat of a large volume release of the tailings. Alternative 2 will remove five snags standing within the 1.3 acres of tailings piles, thereby removing a small fraction of the available snag habitat for the woodpecker and sapsucker species of the Snag Association. The direct and indirect effects from the loss of habitat are small as there appear to be adequate snags available on the landscape in other areas of the Site and outside of the Site.

The Site has been evaluated and recorded as a historical archeological site. The Siskon Mine has been recommended to be Not Eligible as a property for the National Register of Historic Places, and Alternative 2 has been recommended to have no adverse effect on the remaining features, or mining debris present on the Site (USDA-Forest Service-KNF 2003b). The mine road, mill and tailings piles are within the Helkau Cultural Area which was determined Eligible to the National Register of Historic Places in 1981. Implementation of Alternative 2 may potentially create an adverse effect to the eligible property, in addition to noise disturbance for Native American practitioners using Medicine Mountain and certain high country areas during the summer months. Government-to-Government coordination and consultation is ongoing in compliance with the National Historic Preservation Act as amended, (NHPA); implementing regulations of 36 CFR 800; American Indian Religious Freedom Act (AIRFA); Executive Order 13007 (Sacred Sites); Executive Order 13175 (Consultation and Coordination with Indian Tribal Governments); and the 1994 Presidential Memorandum regarding Government-to-Government relations with Native American Tribal Governments.

Alternative 2 has been evaluated for compliance with the Wild and Scenic Rivers Act, and the proposed river classification of Dillon Creek as a free flowing recreational river and the outstandingly remarkable values within the river corridor and immediate vicinities would not be unreasonably diminished (USDA-Forest Service-KNF, 2000b). Wild and Scenic River values will be enhanced by Alternative 2 in the long term.

Alternative 2 will comply with the Federal Noxious Weed Act through use of Certified Noxious Weed Free seed and mulch, and by implementation of vehicle inspection and equipment cleaning provisions in all contracts and other associated work at the Site. Though there is no POC infestation in the project area, implementation of the project during the dry season of the year, June-October, will reduce the potential for spread of POC disease. Contract provisions for vehicle equipment inspection and cleaning prior to work being conducted on the Forest roads will reduce the likelihood that noxious weeds or POC disease will be introduced by the project. The Ukonom/Orleans Ranger District is currently evaluating the existing noxious weed patch found in the project area,

and the weeds are planned to be pulled out by hand, prior to a response action at the Site. Vehicles entering the Forest from counties quarantined because of the presence of *Phytophthora ramorum* will be inspected in compliance with USDA requirements. Post-project monitoring will include monitoring for any new noxious weed infestations in the project area.

7.3.2 Implementability

Alternative 2 is feasible both administratively, and technically, and is generally easy to implement, as it employs common construction methods and techniques. The containment by an engineered gabion retaining wall and riprap, and capping with clean soil called for in Alternative 2 is a technique with demonstrated long-term performance. It is technically feasible at this location due accessibility for the needed heavy equipment, and the availability of nearby soil borrow areas with sufficient quantities of material along the mine road (14N31B). The design of the cap incorporates drainage control structures and erosion control methods that are known to be effective and are commonly used. The engineered gabion retaining wall and "Reno Mattress" have both been designed for the Site to maintain slope and foundation stability and be protected from effects of flooding (USDA-Forest Service-KNF, 2003c). Operationally, the road construction work, and work at the mill and former tailings pond area will be limited to the summer season, when the roads are open, after the snow has melted and the creek flows have peaked. Operations will shut down during periods of wet weather and before the onset of fall rains. Alternative 2 will be implemented over two summer seasons to ensure that there is sufficient time to complete all project activities, and that all erosion control measures are in place and effective. Qualified contractors, equipment, and materials are available to perform this work. There are no permit issues associated with this alternative. Based on past field trips with representatives from the California Department of Fish and Game, and the North Coast Regional Water Quality Control Board, and the Karuk Tribe, and comments from the public Alternative 2 is generally accepted with few reservations. Some members of the public would like tailings completely removed from the Site.

7.3.3 Cost

The capital costs of consolidation of the tailings, containment and capping them in place, including the road work to access mill and tailings, borrow source development and road stormproofing are low when compared to the other alternatives analyzed in this EE/CA with the exception of Alternative 1, No Action. The capital cost of Alternative 2 is approximately $0.5 million dollars. Outyear costs for monitoring, maintenance, and revegetation are approximately $25,000 annually for three years.

7.4 Alternative 3 - Tailings Removal to an Off-Site Repository Within the Ukonom/Orleans Ranger District, Cap and Revegetate

7.4.1 Effectiveness

Consolidation of the mine tailings, and removal to a designed mine waste repository on the Ukonom/Orleans Ranger District would fully meet the goal and objectives of the

removal action at the Site. The potential for soil contact exposure to the tailings by humans, wildlife and aquatic organisms would be eliminated, and the tailings would be removed from a sensitive location in the Riparian Reserve. Capping the tailings at an off-Site waste repository would prevent release of metal-laden dust in the air, and would allow the repository location to be vegetated with shallow and deep-rooted plants. While there is no reduction of toxicity or volume of the tailings by moving them, surface erosion and mobility of the tailings is eliminated, by capping and vegetating the cap at the repository site. Additionally, the existing mill and former tailings pond area of the Site would be reclaimed and restored. Routine monitoring of the waste repository would ensure that vegetation is providing adequate ground cover, and drainage control and tailings containment structures are performing as intended. A waste repository at a suitable location would have both short-term and long-term permanence. Additional monitoring would be necessary at the former tailings pond and mill at the Siskon Mine Site to ensure that reclamation is successful. Dust abatement during transport of tailings to the waste repository site, and adherence to a Site Health and Safety Plan would limit impacts to workers, the community and the environment. This alternative would be fully protective of public health and the environment.

All of the action-specific ARARs would be applicable to Alternative 3. In comparison to Alternative 2, there would be additional ARARs to be met for handling and transport of hazardous waste. In addition to requirements of Title 27, because the mine waste would be removed from its current location, the requirements of Title 23, Discharge of Hazardous Waste to Land, would potentially be applicable. Similar to Alternative 2, all of the remaining action-specific ARARs would be met.

Alternative 3 would comply with the water quality objectives of the North Coast Basin Plan by containing and capping the tailings at the waste repository site. The current water quality of Copper Creek, which complies with Basin Plan objectives and ambient water quality criteria, would be maintained. Similar to Alternative 2, off-Site disposal would not directly achieve EPA Region 9 PRGs, and other risk management screening benchmarks for the various metal contaminants of concern, but capping of the tailings would prevent direct exposure to the elevated metals concentrations.

Similar to Alternative 2, all of the location-specific ARARs pertaining to heritage resources, tribal relations, endangered species, wild and scenic rivers, noxious weeds, and sudden oak death would be applicable and met at both the Siskon Mine Site and the off-Site repository location. The determination of effects would be the same as Alternative 2 for actions conducted to remove the tailings and reclaim the Site. There would be additional noise disturbance and potential disruption to wildlife during transport of tailings and construction of the waste repository. The off-Site waste repository selected would be a site with minimal resource concerns as compared to the existing Site.

7.4.2 Implementability

Alternative 3 though feasible, would be more difficult to implement because of the difficulties involved in finding a suitable site, designing and constructing the site, and

obtaining approval of the waste repository by State and local agencies. Off-site disposal would require evaluation and site-specific investigations of 4 to 6 acre sites suitable for land disposal of mine waste materials. This would increase the cost over Alternative 2. Construction of an off-Site waste repository would disturb an area not presently impacted by mine waste. Suitable sites selected for evaluation, however, would be areas that have already been disturbed, such as flat, stable ground that has been burned or clear cut in the recent past, in order to reduce other resource impacts. Investigation, legal requirements, permitting, and logistical considerations would require additional time as compared to on-Site disposal, and would increase costs. Off-Site disposal would require transport of hazardous mine tailings on public Forest Roads, and possibly a State highway. This would greatly increase costs, and would have the risks of loss of life in traffic accidents, and release of hazardous substances to the land or waterways in the event of a traffic accident. Using 10 cubic yard dump trucks, it would require 1,150 round trips to remove the tailings from the Site. The time needed and costs of hauling the large volume of tailings to an off-Site location would be much greater than for Alternative 2.

Design and construction of a waste repository for mine tailings is technically feasible, and would have adequate short-term and long-term performance. Implementation of Alternative 3 would require two summer seasons. The second season would include removal of the tailings, transport to the waste repository, construction of the repository, borrow source development, capping, and reclamation of the mill and former tailings pond area at the Siskon Mine Site. This alternative would be more difficult to implement because of the significant amount of construction activities required at two locations. Excavation and relocation of 11,500 cubic yards of mine tailing is a task of great magnitude. Development of a waste repository would require additional approvals with regulatory agencies, and road improvements, making the alternative more difficult to implement. Alternative 3 would necessitate hauling a large volume of tailings on steep, narrow and winding Forest roads, which would increase risks to worker and public safety, and the environment. Qualified contractors, equipment, and materials are available to perform this work. There may be permitting issues and approvals needed for the development of an off-Site repository. This alternative was retained for evaluation because some members of the public want to see the tailings completely removed from their location. There may be significant community concerns with transport of the tailings to an off-Site location, depending on where the waste repository is located. The level of acceptance of this alternative by State and local agencies is unknown.

7.4.3 Cost

The capital cost of tailings removal to an off-Site repository, and reclamation of the mill and former tailings pond Site at Siskon Mine, including all road work and borrow source development is higher than Alternative 2 and No Action, but significantly lower than Alternative 4. The capital cost of Alternative 3 is approximately 1.0 million dollars. The cost is double the cost of Alternative 2. Outyear costs for monitoring, operations, revegetation and maintenance of the waste repository, and the reclamation at Siskon Mine are approximately $50,000 annually for three years.

7.5 Alternative 4 – Removal and Disposal

7.5.1 Effectiveness

Alternative 4 achieves the goal and objectives for the removal action at the Site. Removal and disposal of the tailings at a hazardous waste landfill eliminates the potential for soil contact exposure to the tailings by humans, wildlife and aquatic organisms. The tailings would be removed from a sensitive location in the Riparian Reserve. Tailings removal would prevent erosion and migration of the tailings into Copper Creek and the air. This would achieve both short-term and long-term permanence because the tailings would be treated and disposed of at a landfill. While there is no reduction of toxicity or volume of the tailings by moving them, surface erosion and mobility of the tailings is eliminated by their treatment and disposal at a fully contained and monitored waste facility. This alternative would include reclamation and restoration of the mill and former tailings pond Site after removal of the tailings. Monitoring would be necessary at the former tailings pond and mill at Siskon Mine to ensure that reclamation is successful. Dust abatement during transport of tailings to the waste repository site, and adherence to a Site Health and Safety Plan would limit impacts to workers, the community and the environment. This alternative is fully protective of public health, and the environment.

Some of the action-specific ARARs would apply for this alternative, chiefly the requirements relating to handling and transport of hazardous waste, and health and safety. As the tailings would be removed from the Site, some of the requirements of Title 27 and 23 relating to capping and mine waste management would not be applicable. Requirements of the California Fish and Game Code and the Asbestos Toxic Control Measure would apply for road construction and other activities at the Site.

Alternative 4 would comply with the water quality objectives of the North Coast Basin Plan by removing the tailings to a TSD facility. The current water quality of Copper Creek, which complies with Basin Plan objectives and ambient water quality criteria, would be maintained. Removal of the tailings to a TSD facility would achieve EPA Region 9 PRGs, and other risk management screening benchmarks for the various metal contaminants of concern.

Similar to Alternative 2, all location-specific ARARs would apply and be met. The determinations of effects would be the same as for Alternative 2. There would be additional noise disturbance and potential disruption to wildlife during transport through the Forest and during transfer of the tailings to larger trucks.

7.5.2 Implementability

Alternative 4, though feasible, would be more difficult to implement than Alternative 2 but easier than Alternative 3, because no waste repository site on the Forest would need to be developed. A Class I Hazardous Waste Landfill is an approved Treatment, Storage and Disposal (TSD) facility. Removal of the tailings to a TSD facility is a

feasible technique with proven long-term performance and permanence. The nearest TSD facility that would take the tailings is the landfill at Kettleman Hills, operated by Chemical Waste Management. A disadvantage of disposal of hazardous waste at a TSD facility is that there could be future liability costs.

Implementation of Alternative 4 would require two summer seasons to implement. The second season would include all tailings consolidation, excavation, transport to the TSD facility, and Site reclamation. Similar to Alternative 3, excavation and transport of 11,500 cubic yards of tailings is a task of great magnitude. This alternative would require a large number of dedicated transport trucks to haul tailings to the transfer site and then all the way to Kettleman Hills. The condition and grade of the 14N31 road limits the size of truck that can carry tailings to the transfer location as only 10 cubic yard trucks can travel on the road. Alternative 4 would necessitate hauling a large volume of tailings on steep, narrow and winding Forest roads, which would increase risks to worker and public safety, and the environment. Disposal at a TSD would require transport of hazardous mine tailings on public Forest Roads, State and Federal highways. This would greatly increase costs, and would have the risks of loss of life in traffic accidents, and release of hazardous substances to the land or waterways in the event of a traffic accident. Using 10 cubic yard dump trucks, it would require 1,150 round trips to remove the tailings from the Site to a transfer location on the Forest. Using larger 20 cubic yard trucks, it would require 525 round trips from the transfer location to the TSD facility. The amount of handling of the tailings, and truck washing to mitigate dust, disease and invasive species would greatly increase the time required and costs for implementation. The time needed and costs of hauling the large volume of tailings to a TSD would be much greater than for Alternative 2 or Alternative 3.

Qualified contractors, equipment, and materials are available to perform this work. It may be difficult to obtain enough qualified drivers and the types of trucks and containers needed to transport the tailings to Kettleman Hills. This alternative was retained for evaluation because some members of the public want to see the tailings completely removed from their present location. There may be significant community concerns with transport of the tailings to Kettleman Hills. The level of acceptance of this alternative by State and local agencies is unknown.

7.5.3 Cost

The capital cost of tailings disposal to a Class I hazardous waste landfill at Kettleman Hills, and reclamation of the mill and former tailings pond Site at Siskon Mine including all road work and borrow source development to fill in the hole left by the tailings, is significantly higher than all other alternatives. The capital cost of Alternative 4 is approximately 4 million dollars. This cost is four times greater than Alternative 3 and eight times greater than Alternative 2. Outyear costs for monitoring, operation, and maintenance of the reclamation at Siskon Mine are approximately $20,000 for three years.

8.0 COMPARITIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES

Alternative 1, No Action is included for comparison to the action alternatives of Alternative 2 – Consolidation, Containment, and Capping In Place, Alternative 3 – Tailings Removal to an Off-Site Repository Within the Ukonom/Orleans Ranger District Cap and Revegetate; and Alternative 4 – Removal and Disposal. The No Action alternative represents the current conditions that have resulted in the need for a removal action at the Siskon Mine Tailings and Mill Site. Table 8 illustrates the basic differences between the four alternatives. The dark shaded boxes represent criteria that are not met and the lightly shaded boxes represent criteria that would be difficult to implement. Table 9 shows a cost comparison between the four alternatives analyzed.

Alternative 3, is more costly to implement than Alternative 2, and implementation would be more difficult because of evaluation of site suitability, obtaining approval of waste repository sites on the Forest from state and local agencies, and the added risks associated with transport of the hazardous mine tailings waste off-Site on public roads. A suitable site for the waste repository or suitable borrow sources to cap the tailings may not be readily available.

Alternative 4 exceeds the $2 million dollar cap by a large amount and would not be implementable for that reason. Like Alternative 3, implementation would be more difficult because of the large amount of waste handling, constraints on the size of the transport trucks, and the added risks associated with the transport of the hazardous mine tailings off-Site and along many miles of public roads and highways. The large number of qualified drivers, trucks, and containers needed to haul the tailings to the disposal site may be somewhat difficult to obtain locally.

In contrast, Alternative 2 - Consolidation, Containment, and Capping In Place, achieves all the evaluation criteria. The main differences between Alternative 2 and Alternatives 3 and 4 are in lower cost, and greater administrative feasibility of capping and containing the tailings in place. Alternatives 2 and 3 similarly reduce the primary problem of mobility of the tailings. Capping removes the main exposure pathways, but does not reduce toxicity or volume of the tailings. Alternative 4 reduces mobility and toxicity of the tailings, but at very high cost.

State and Community Acceptance of Alternatives 2, 3, and 4 will be determined from the comments received during the public comment period for the EE/CA. Written and verbal comments to date from representatives from State agencies indicate that Alternative 2 is generally accepted.

Table 8. Comparison of Alternatives				
Criteria	**Alternative 1 No Action**	**Alternative 2 Consolidation, Containment, and Capping In Place**	**Alternative 3 Tailings Removal to an Off-Site Repository Within the Ukonom/Orleans Ranger District, Cap and Revegate**	**Alternative 4 Removal and Disposal**
Ability to Achieve Removal Action Goals and Objectives	Unable to Achieve	Achieves	Achieves	Achieves
Reduction of Toxicity, Mobility or Volume	No Reduction	Mobility is Reduced; No Reduction in Toxicity or Volume; Contaminant Pathway is Removed	Mobility is Reduced; No Reduction in Toxicity or Volume; Contaminant Pathway is Removed	Mobility and Toxicity is Reduced; No Reduction in Volume; Contaminant Pathway is Removed
Short and Long Term Effectiveness and Permanence	Not Applicable	Adequate	Adequate	Adequate
Overall Protectiveness of Human Health and the Environment	Not Protective	Protective	Protective	Protective
Compliance with ARARs	Out of Compliance	Complies	Complies	Complies
Technical Feasibility	Not Applicable	Feasible	Feasible	Feasible
Administrative Feasibility	Not Applicable	Feasible	Difficult to Implement Due to Evaluation of Site Suitability, and Approvals; Increased Risks of Waste Transport	Difficult to Implement Due to Amount of Waste Handling, Cleaning, and Constraints on Size of Transport Trucks; Increased Risks of Waste Transport; Exceeds $2.0 million cap
Availability of Materials and Sources	Not Applicable	Readily Available	Suitable Sites and Borrow Sources May Not be Readily Available	Qualified Drivers, Suitable Trucks and Containers May Not be Locally Available, or In the Quantities Desired
State Acceptance	Unacceptable	Likely to be Fully Accepted	To Be Determined	To Be Determined
Community Acceptance	Unacceptable	To Be Determined	To Be Determined	To Be Determined
Capital Cost	$0	$0.5 million	$1.0 million	$4.0 million
Outyear Operations, Maintenance, Revegetation, and Monitoring Costs	$0	$25,000	$50,000	$50,000

Table 9. Cost Comparison of Alternatives

Item Description	Alternative 1, No Action	Alternative 2, Consolidation, Containment, and Capping In Place	Alternative 3, Tailings Removal to an Off-Site Repository within the Ukonom/Orleans Ranger District	Alternative 4, Removal and Disposal
Mine Road 14N31B Construction & Improvement	-0-	$70,000	$70,000	$70,000
Tailings Access Road	-0-	$15,000	$30,000	$30,000
Tailings Containment Gabion Wall	-0-	$200,000	-0-	-0-
Tailings Pond Cap, Borrow Site Development, Drainage, Vegetation & Erosion Control	-0-	$150,000	$40,000	$40,000
Repository Site Investigation for Groundwater and Stability	-0-	-0-	$80,000	-0-
Repository Site Preparation	-0-	-0-	$10,000	-0-
Haul Road Maintenance	-0-	-0-	$10,000	$10,000
Haul Road Dust Abatement	-0-	-0-	$20,000	$20,000
Load Tailings into 10 cyd Dump Trucks			$30,000	$30,000
Haul to Waste Repository	-0-	-0-	$100,000	$2,665,000
Landfill Disposal Cost	-0-	-0-	-0-	$600,000
Truck Washing	-0-	-0-	$150,000	$250,000
Repository Grading and Drainage Control	-0-	-0-	$90,000	-0-
Repository Borrow Site Development	-0-	-0-	$80,000	-0-
Repository Cap Vegetation & Erosion Control	-0-	-0-	$10,000	-0-
Site Safety, Health & Monitoring	-0-	$10,000	$20,000	$20,000
Erosion Control Plan	-0-	$5,000	$10,000	$5,000
Sub Total	***-0-***	***$450,000***	***$750,000***	***$3,740,000***
Health & Safety Factor	-0-	$5,000	$10,000	$45,000
Contingency Factor	-0-	$115,000	$190,000	**$374,000**
CAPITAL COST TOTAL		**$570,000**	**$950,000**	**$4,160,000**
Outyear Monitoring, Operations, Maintenance	-0-	$25,000	$50,000	$20,000

Notes: All costs include mobilization, overhead and profit.

9.0 RECOMMENDED REMOVAL ACTION ALTERNATIVE

The preceding analysis of each alternative and the comparison among them is the basis for determining the recommended alternative. The three action alternative represent the best possible courses of action available to recommend for the Siskon Mine Tailings and Mill Site.

Alternative 2 – Consolidation, Containment, and Capping In Place, is the recommended removal action alternative for this Site. The principle reasons why it is the recommended alternative is because it is easier to implement, and costs less than the other two alternatives. It achieves the removal action goals and objectives and is fully protective of human health, the environment, and the community. Implementation would be fully compliant with ARARs provided by state agencies to date, and others drawn from internal and external sources. The alternative fully addresses the primary problem posed by the tailings at the site, mobility and exposure to wildlife, aquatic organisms and plants. The containment and capping of the tailings by engineered structures will ensure both short term and long-term permanence. It is both technically and administratively feasible to implement, and can be completed in a little over one year. At an estimated cost of $0.5 million, it represents a reasonable expenditure within the target cost cap of $2 million.

10.0 REFERENCES

A.C. Industrial Services Corp., November 4, 1999, *Siskon Mine Sodium Cyanide Container Removal Reports,* 15 pages.

California State Water Resources Control Board, February 4, 2003, Resolution No. 2003 – 0009, *Approval of the 2002 Federal Clean Water Act Section 303(d) list of Water Quality Limited Segments*.

California Regional Water Quality Control Board, August 2000. *A Compilation of Water Quality Goals,* 179 pp.

California Regional Water Quality Control Board, 20 November 2001. *Water Quality Goals Update*, 10 pp.

California Regional Water Quality Control Board, 26 July 2001. *Water Quality Goals Update*, 5 pp.

California Regional Water Quality Control Board, 8 February 2001. *Water Quality Goals Update,* 10 pp.

California Department of Fish and Game, 1999, memo from Donald B. Koch, Regional Manager to Polly Haessig describing ARARs for Siskon Mine.

California Department of Fish and Game, 1971, memo from R. U. Hanson to Elton Bailey, Inspection of Siskon Mine, 2 pp.

California Department of Fish and Game, 1958, memo from Millard Coots to Chester Woodhull, regarding Siskon Mine.

Efroymson, R. A., Will, M. E., Suter II, G. W. and A. C. Wooten, 1997, *Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision.* http://www.esd.ornl.gov/programs/ecorisk/tm85r3.pdf

Efroymson, R. A., Will, M. E., and G. W. Suter II, 1997, Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision. http://www.esd.ornl.gov/programs/ecorisk/tm126r21.pdf

Federal Register, 1999 , V. 64, No. 86, May 5, 1999, p. 24049 – 44062).

Ford, Karl L., December 1996, technical Note 390 (revised) *Risk Management Criteria for Metals at BLM Mining Sites*. 24 p.

National Oceanographic and Atmospheric Administration, (NOAA), 1999, *SQuiRT Screening Reference Tables.* http://response.restoration.noaa.gov/cpr/sediment/squirt/squirt.pdf

North Coast Regional Water Quality Control Board, 1993, with amendments, 1994-1996, *Water Quality Control Plan for the North Coast Region*.

Rantz, S.E., 1969, *Mean Annual Precipitation in the California Region*, USGS.

_____, 1968, *Average Annual Precipitation and Runoff in North Coastal California*, USGS.

Smith, Lauren, 1993, Mining - Siskon Mine, IN: Davies, Gilbert, W. and Frank, Florice M, eds, *Memories from the Land of the Siskiyou, Past Lives and Times in Siskiyou County*,

History Inc. Books, Hat Creek, CA.

United States Department of Agriculture and United States Department of Interior, (USDA & USDI) (April, 1994). *Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl, and Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl.*

United States Department of Agriculture (USDA) , Forest Service, Klamath National Forest, 2003a, *Removal Preliminary Assessment/Site Inspection Report, Siskon Mine,* 116 p.

_____, 2003b*, Archeological Reconnaissance Report, Siskon Mine CERCLA Removal Action and Reclamation Project.*

_____, 2003c*, Geotechnical Engineering Design Overview of the Siskon Mine CERCLA Removal Action and Reclamation Project, 20 p.*

_____, 2003d*, Management Indicator Species Assessment, Siskon Mine Reclamation Project,* 13p.

_____, 2003e*, Biological Assessment and Biological Evaluation for Threatened, Endangered, Proposed and Sensitive Fish Species That May Be Affected by the Siskon Mine Removal Action and Reclamation Project*, 63p.

_____, 2003f, *Project Design Standards and Best Management Practices, Siskon Mine CERCLA Removal Action and Reclamation Project*, 12p.

_____, 2002a, *Tailings Volume At Siskon Mine*. 2 pages.

_____, 2002b, *Surface Erosion Rates of the Tailings and Mill at Siskon Mine*, 5 pages.

_____, 2002c, *Supplemental Input*, *Biological Assessment/Evaluation (BA/BE) for Sensitive, Threatened, and Endangered Plant Species, Siskon Mine Reclamation Project,* 1 p.

_____*, 2002d, Supplemental Input, Survey and Manage and Protection Buffer Wildlife Species,* 1p.

_____, 2001, *Biological Assessment, Threatened, Endangered and Proposed Wildlife Species, Siskon Mine Restoration Project,* 8p.

_____, 2000a*, Survey and Manage Vascular Plant and Bryophyte Surveys, Siskon Mine Reclamation Project,* 3p.

_____, 2000b, *Scenery and Wild and Scenic Rivers Evaluation, Siskon Mine Reclamation Project*, 5 p.

_____, 2000c, *Biological Assessment/Evaluation (BA/BE) for Sensitive, Threatened, and Endangered Plant Species, Siskon Mine Reclamation Project*, 10 p.

_____, 1999a , *Federal Facility Removal Preliminary Assessment/Site Inspection, Siskon Mine Cyanide Drum Removal*, 36 pages.

_____, 1999b, *Engineering Evaluation/Cost Analysis for the Siskon Mine Cyanide Drum Removal*, 50 pages.

_____, 1999c, *Removal Action Memorandum for the Siskon Mine Cyanide Drum Removal,* 14 p.

_____, 1999d, Survey and Manage Species Survey Report, Siskon Mine Rehabilitation Project, 2p.

_____, September 15, 1998, *Letter to Mr. John Hannum, North Coast Water Quality Control Board, Requesting ARARs for the Siskon Mine*, 4 pages plus test results, maps and photographs.

_____, August 19, 1996a, *Field Notes on the trip to the Bill's Mine Area*, 4 pages.

_____, 1996b, *Dillon Fire Recovery Environmental Assessment,* Happy Camp and Ukonom Ranger Districts, Klamath National Forest, Pacific Southwest Region.

_____, 1995, *Klamath National Forest Land and Resource Management Plan* and *Record of Decision.*

_____, July 1994, *Preliminary Assessment Report*, Siskon Mine, Klamath National Forest, Pacific Southwest Region 5, Polly Haessig, Project Coordinator; Ed Rose, Project Manager.

_____, 1994, *Dillon Creek Watershed Analysis*.

_____, 1993, *Abandoned/Inactive Mine Inventory Form*, Klamath National Forest.

USDI, Bureau of Land Management, (BLM) 1999, Information Bulletin No. RS-99-004, *Interim Revision of Wildlife Risk Management Criteria*, Technical Note 390.

United States Environmental Protection Agency (EPA), and California Department of Health Services, November, 2002, *Maximum Contaminant Levels and Regulations Dates for Drinking Water Contaminants* http://www.dhs.cahwnet.gov/ps/ddwem/chemicals/MCL/EPAandDHS.pdf

U.S. Environmental Protection Agency (EPA), July 2002, *National Recommended Water Quality Criteria:* 2002, EPA-822-R-02-047 http://www.epa.gov/waterscience/pc/revcom.pdf

_____, July 2000, *Draft Ecological Soil Screening Level Guidance*. http://www.epa.gov/superfund/programs/risk/ecorisk/guidance.pdf

_____, August 14, 1997. *Siskon Mine Preliminary Assessment*, Letter from Betsy Curnow, EPA Region IX, Chief States Planning and Assessment Office to Dave McCauley, Regional Environmental Engineer. 2 p.

_____, 1994, *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*. Office of Emergency and Remedial Response, EPA 540/R-94/013, Washington, D.C.

_____, 1993, *Guidance on Conducting Non-Time Critical Removal Actions Under CERCLA*, EPA/540-R-93-057, 57 p.

_____, 1992 *Guidance for Performing Site Inspections Under CERCLA, Interim Final,* EPA/540-R-92-021, Office of Emergency and Remedial Response.

U.S. EPA Region 9, 2002, *Preliminary Remediation Goals, 2002*. http://www.epa.gov/region09/waste/sfund/prg/index.htm

URS Consultants, April 21, 1995, *Federal Facility Preliminary Assessment Review*, Siskon Mine.

APPENDIX A - Screening Level Risk Evaluation Tables

Table 1: Screening Level Risk Evaluation, Comparison of Tailings/Soil Contaminants of Concern to Human Health Screening Criteria

Table 2: Screening Level Risk Evaluation, Comparison of Tailings/Soil Contaminants of Concern to Soil Screening Levels for Plants, Soil Organisms , & Wildlife.

Table 3: Screening Level Risk Evaluation, Comparison of Contaminants of Concern in Copper Creek Sediments to Freshwater Sediment Screening Levels.

TABLE 1

SCREENING LEVEL RISK EVALUATION

COMPARISON OF TAILINGS/SOIL CONTAMINANTS OF CONCERN TO HUMAN HEALTH SCREENING LEVELS

FOR OUTDOOR WORKERS AND A SURVEYOR

SISKON MINE SITE

SIX RIVERS NATIONAL FOREST, CALIFORNIA

(mg/kg dry weight)

Table modified after Table 17 of the Removal PA/SI, (USDA-Forest Service, 2003a)

Contaminant of Concern	Maximum Onsite Concentration In Tailings Soil	*Sample ID*	Maximum Background Concentration	*Sample ID*	Exceedance Over Background	BLM MINE SITE CRITERIA SURVEYOR [a]	EPA PRGs OUTDOOR INDUSTRIAL SITE WORKER [b]	Exceeds Background	Exceeds One or Both Screening Levels?	Exceedance Over Screening Level
Arsenic	1,200J	*006A*	13J	*BKN*	92X	100	260 nc, 1.6 ca	**Yes**	**Yes**	***4 to 12 X, nc 750 X, ca***
Cadmium	42 J	*006A, C100*	5.6 J	*BKN*	7X	800	450 nc	**Yes**	**No**	---
Copper	3,900	*006A*	150	*BKN*	26X	590,000	41,000 nc	**Yes**	**No**	---
WAD Cyanide	0.86	*T3*	0.62U	*BKS1*	1X	No Screening Level	12,000 nc [c]	**Yes**	**No**	---
Total Cyanide	20	*G150*	0.62U	*BKS1*	32X	No Screening Level	No Screening Level	**Yes**	---	---
Iron	320,000	*C100*	37000	*BKS3*	8X	No Screening Level	100,000 max	**Yes**	**Yes**	*3.2 X*
Lead	310	*002A*	0.59U	*BKS2*	525X	2,000	750 nc	**Yes**	**No**	---
Mercury	16	*F100*	0.025U	*BKS1*	640X	480	310 nc	**Yes**	**No**	---
Molybdenum	200	*C100*	6.2U	*BKS1*	32X	No Screening Level	5100 nc	**Yes**	**No**	---
Selenium	41J	*C100*	3J	*BKN*	123X	8,000	5,100 nc	**Yes**	**No**	---
Silver	12	*006A*	1.2U	*BKS1, BKS2*	10X	8,000	5,100 nc	**Yes**	**No**	---
Zinc	540J	*C100*	36J	*BKN, BKW*	15X	480,000	100,000 nc	**Yes**	**No**	---

Notes:

mg/kg = milligrams per kilogram.
WAD = weak acid disassociable
nc = non-cancer endpoint
ca = cancer PRG
ca* = cancer endpoint where nc < 100 X ca
max = ceiling limit
a Ford, Karl L, 1996, Risk Management Criteria for Metals at BLM Mining Sites, USDI, Bureau of Land Mangement, National Applied Resource Sciences Center, Denver, CO.
b U. S. EPA Region 9, 2002, Prelminary Remediation Goals. http://www.epa.gov/region09/waste/sfund/prg/index.htm
c = value is for free cyanide

U - The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

J - The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.

UJ = The analyte was not detected above the reported sample quantitation limit, however, the reported quantitation limit is approximate due to exceedance in QC criteria.

TABLE 2

SCREENING LEVEL RISK EVALUATION
COMPARISON OF TAILINGS/SOIL CONTAMINANTS OF CONCERN TO SOIL SCREENING LEVELS
FOR PLANTS, SOIL ORGANISMS, & WILDLIFE
SISKON MINE SITE
SIX RIVERS NATIONAL FOREST, CALIFORNIA
(mg/kg dry weight)
Table modified after Table 16 of the Removal PA/SI, (USDA-Forest Service, 2003a).

Contaminant of Concern	Maximum Onsite Concentration In Tailings Soil	*Sample ID*	Maximum Background Concentration	Exceedance Over Background	*Sample ID*	Plants Screening Level (P)	Soil Invertebrate & Microorganisms Screening Level (I)	White-tailed Deer (D)	Deer Mouse (M)	Median Wildlife Criteria for Metals in Mine Soils (W)	Exceeds Background	Exceeds Screening Level? P, I, D, M, W
Arsenic	1200J	*006A*	13J	92X	*BKN*	37 [a]	100 [b]	319 [e]	230 [e]	275 [d]	**Yes**	**Yes P, I, D, M, W**
Cadmium	42	*006A, C100*	5.6 J	7X	*BKN*	29 [a]	110 [a]	3 [e]	7 [e]	3 [d]	**Yes**	**Yes P, D, M, W**
Copper	3900	*006A*	150	26X	*BKN*	pending [a] 100 [b]	61 [a]	128 [e]	640 [e]	136 [d]	**Yes**	**Yes P, I,, D, M, W**
WAD Cyanide	0.86	*T3*	0.62U	1X	*BKS1*	No Screening Level	No Screening Level	No Screening Level	No Screening Level	No Screening Level	**Yes**	--
Total Cyanide	20	*G150*	0.62U	32X	*BKS1*	No Screening Level	No Screening Level	No Screening Level	No Screening Level	No Screening Level	**Yes**	--
Iron	320000	*C100*	37000	8X	*BKS3*	No Screening Level	200 [c]	No Screening Level	No Screening Level	No Screening Level	**Yes**	**Yes I**
Lead	310	*002A*	0.59U	525X	*BKS2*	50 [b]	900 [c]	124 [e]	142 [e]	125 [d]	**Yes**	**Yes P, D, M, W**
Mercury	16	*F100*	0.025U	640X	*BKS1*	0.3 [b]	30 [c]	11 [e]	2 [e]	8 [d]	**Yes**	**Yes P,D, M, W**
Molybdenum	200	*C100*	6.2U	32X	*BKS1*	2 [b]	200 [c]	No Screening Level	No Screening Level	No Screening Level	**Yes**	**Yes P**
Selenium	41J	*C100*	3J	123X	*BKN*	1 [b]	100 [c]	No Screening Level	No Screening Level	No Screening Level	**Yes**	**Yes P**
Silver	12	*006A*	1.2U	10X	*BKS1, BKS2*	2 [b]	50 [c]	No Screening Level	No Screening Level	No Screening Level	**Yes**	**Yes P**
Zinc	540J	*C100*	36J	15X	*BKN, BKW*	190 [a]	120 [a]	267 [e]	419 [e]	307 [d]	**Yes**	**Yes P, I, D, M, W**

Notes:
mg/kg = milligrams per kilogram.
[a] USEPA July 10, 2000, Draft Ecological Soil Screening Level Guidance [Eco-SSL]
[b] Efroymson, Will, Suter, and Wooten, 1997, Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision
[c] Efroymson, Will and Suter, Toxicological Benchmarks for Contaminant of Potential concern for Effects on Soil and Litter Invertebrates and Hetertrophic Process: 1997 Revision. Screening value shown is for soil microorganisms and microbioal processes.
[d] USDI, Bureau of Land Management, 1999, Info. Bulletin No. RS-99-004, Interim Revision of Wildlife Risk Management Criteria, Technical Note 390
[e] Ford, Karl, L, 1996, Risk Management Criteria for Metals at BLM Mining sites, USDI- Bureau of Land Management

U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit
J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.
UJ = The analyte was not detected above the reported sample quantitation limit, however, the reported quantitation limit is approximate due to exceedance in QC criteria.

TABLE 3

SCREENING LEVEL RISK EVALUATION

COMPARISON OF CONTAMINANTS OF CONCERN IN COPPER CREEK SEDIMENTS TO FRESHWATER SEDIMENT SCREENING LEVELS

SISKON MINE SITE

SIX RIVERS NATIONAL FOREST, CALIFORNIA
(mg/kg) dry weight
Table modified after Table 6 of the Removal Action PA/SI, (USDA-Forest Service, 2003a).

Analyte	TTLC	SQRT-TEL (a)	CC1-SD, (background)	CC2-SD	CC3-SD	CC4-SD	CC5-SD	CC6-SD	Exceeds 3 Times Background	Exceeds Screening Level
Arsenic	500	5.9	2.9	3.5 J	5 J	240 J	3.7 J	9.8 J	CC-4, CC6	CC4, CC6
Cadmium	100	0.596	4.3	5.3 J	5.1 J	14 J	5.2 J	6 J	CC-4	All
Copper	2500	35.7	39	48	62	830	42	69	CC-4	All
Iron	--	--	30000	34000	35000	86000	35000	40000	--	---
Lead	1000	35.0	0.62 U	0.62 U	0.72 U	28	0.62 U	0.64 U	CC-4	---
Mercury	20	0.174	0.025 U	0.025 U	0.029 U	2.2	0.025 U	0.079	CC-4, CC-6	CC-4
Molybdenum	3500	--	6.2 U	6.2 U	7.2 U	40	6.2 U	6.4 U	CC-4	---
Selenium	100	--	0.8	2.6 J	2.5 J	10 J	2.1 J	2.8 J	CC4, CC-6	---
Silver	500	--	1.2 UJ	1.2 U	1.4 U	1.5 U	1.2 U	1.3 U	--	---
Thallium	700	--	0.62 U	1.3	0.72 U	0.77 U	0.62 U	0.64 U	--	---
Zinc	5000	123.1	46	64 J	56 J	180 J	52 J	60 J	CC-4	CC-4

Notes:
Shaded cells exceed Freshwater Sediment Screening Level.
(a) National Oceanic and Atmospheric Administration, 1999, Screening Quick Reference Table for Inorganics in Solids, Freshwater Sediment
TEL = Thresholod Effects Level, dry weight.

U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.

UJ = The analyte was not detected above the reported sample quantitation limit, however, the reported quantitation limit is approximate due to exceedance in QC criteria.