

ABANDONED MINE LANDS SITE DISCOVERY PROCESS

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**Prepared by: California Environmental Protection Agency,
Department of Toxic Substances Control,
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Northern California-Central Cleanup Operations Branch**

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INTRODUCTION

The Department of Toxic Substances Control (DTSC) Northern California-Central Cleanup Operations Branch (NCCCOB) initiated an Abandoned Mine Lands (AML) Focused Site Discovery Project under the Fiscal Year (FY) 2005-2006 Preliminary Assessment/Site Inspection (PA/SI) Cooperative Agreement between DTSC and the United States Environmental Protection Agency (U.S. EPA). This discovery project was proposed because contaminants found in mine wastes on Abandoned Mine Lands (AML) in California may pose a risk to human health, the environment, and water quality. To this end, DTSC has evaluated various sources of information, including existing databases related to mining activities, population density maps, well location databases, and parcel identification in California, for use in developing this "AML Site Discovery Process". Additionally, the "Abandoned Mine Lands Preliminary Assessment Handbook", DTSC 1999, provides guidance for conducting site assessments for AML.

DTSC selected Nevada County, California to develop and apply the AML Site Discovery Process due to the County's numerous AML sites, available mining information, and the current and planned population growth communities (e.g., Grass Valley and Nevada City) are experiencing; and the cooperation DTSC has with the Nevada County Environmental Health Department.

Purpose

This AML Site Discovery Process document was developed to provide a process for conducting initial evaluations to discover potential AML sites that could be potential sources of contamination which may affect human health, the environment, and water quality in and around communities that are experiencing significant population growth, and areas that have current or planned development. It is intended to be used to discover AML sites that are not yet being addressed by state, federal or local agencies; and primarily for use by DTSC and other environmental regulators concerned with the release of AML site contaminants to the environment.

AML sites are found on both private and public lands. While not all AML sites have hazardous substances present, proper assessment of AML sites should be conducted prior to any development on or adjacent to these properties to determine whether threats to human health, the environment, or water quality may exist.

This AML Site Discovery Process emphasizes gathering information on the location, type of mining operation, scale of mining, ore processing, and other operation/disposal practices by means of existing mining databases in conjunction with current and future land uses. The AML Site Discovery Process also includes conducting site reconnaissance where possible (e.g. public lands) to identify AML locations to verify their current land use and location.

Background

Mining (excavating) minerals from the earth is the primary source of raw materials used in manufacturing and construction industries. Mineral commodities can be grouped into three categories 1) metallic minerals, also referred to as ore minerals, consisting of precious metals (gold and silver); base metal sulfides of (copper, lead, and zinc); and oxides of metals (aluminum, iron, titanium); 2) nonmetallic minerals (asbestos, calcite, dolomite, gypsum, quartz); and 3) solid fuel minerals (coal and tar sands).

California has been a major mineral producer since the days of the "Gold Rush" beginning in approximately 1849. Mining activities have occurred in all eleven of California's geologic provinces (Figure 1) with the highest density of mining activity occurring in the Sierra Nevada: (gold, base metal sulfides, tungsten and some chromite) and Klamath Mountains: (gold, base metal sulfides, chromite, and some mercury). The lowest density of mining activity has occurred in the Cascade Range and Modoc Plateau: (mostly cinders, pumice, and building stone). Significant mining has also occurred in the Coast Ranges and Transverse Ranges: (mercury, gold-silver, gypsum, phosphate, and coal); Mojave Desert: (gold/silver, lead-silver-zinc, limestone, aggregate, and gypsum); Great Valley: (sand gravel, and placer gold); Peninsular Ranges and Colorado Desert: (gold, tungsten, lithium, mica, and gemstones); and Great Basin: (gold-silver, tungsten, iron, lead-silver-zinc, borate, sodium carbonate, and clay).

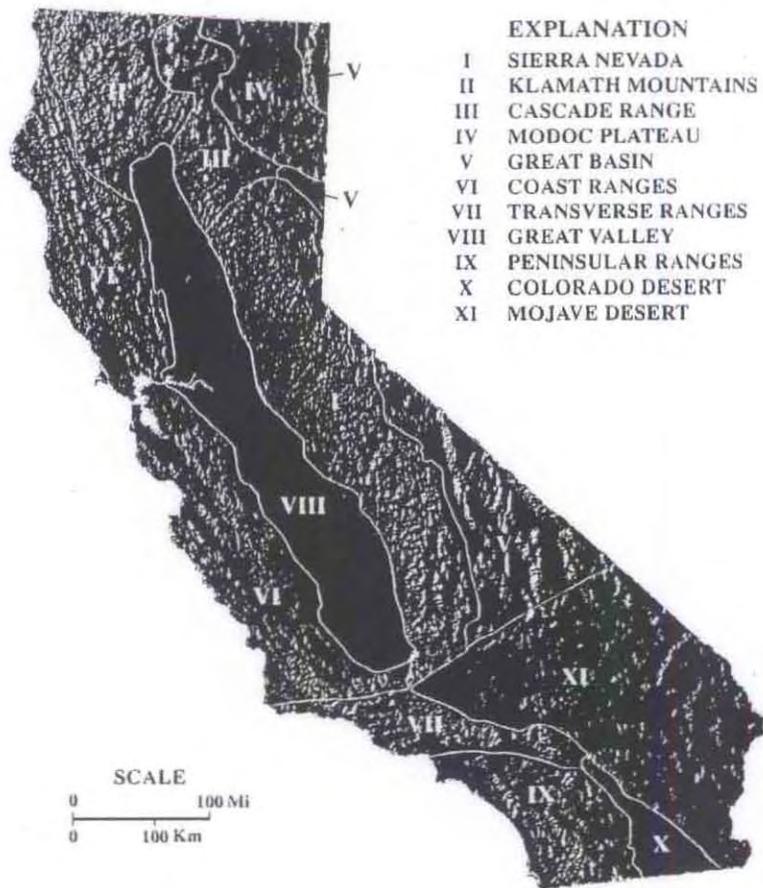
Extensive mining activities in California have resulted in thousands of inactive or abandoned mines. Historical mining practices, ore processing techniques, disposal practices, closure procedures, and/or surface exposure of ore deposits at AML sites have resulted in the generation and disposition of large quantities of mine wastes, including waste rock, mine tailings, mine drainage water, processing chemicals, and other wastes to the land and waters of the state. The interaction of natural processes such as climate, hydrology, geochemistry, and weathering with these wastes have resulted in the release of contaminants which may affect human health, the environment, and water quality.

SUMMARY OF TYPICAL MINING OPERATIONS AND ORE PROCESSING METHODS

Types of Mining

Mining operations for metals (e.g. gold) and other minerals, in general, consists of surface mining, and underground mining methods to find and excavate ore (rock containing the valuable mineral). Surface mining methods include open pit and placer mining. Open pit mining involves the removal of "overburden" material from the land consisting of non-grade ore to the ore grade material being mined. Placer mining is a type of surface mining for mineral deposits (e.g. gold) where minerals have accumulated as a result of fluvial action such as in deposits associated with streams, rivers, and alluvial fans.

**FIGURE 1
GEOLOGIC PROVINCES OF CALIFORNIA**



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Large scale placer mining includes dredging and hydraulic methods. Underground mining (e.g., hard rock mining) includes lode mining in which the mineral bearing ore is mined underground in enriched mineralized zones such as veins.

Waste rock consists of non-mineralized and/or low grade mineralized rock removed from, around, and within an ore body as a result of mining activities. Following the excavation of ore from the earth, ore is crushed and or ground to fine sand size particles and this milled/crushed material is processed by various methods to extract the desired mineral. Tailings are a waste product of this process.

Types of Processing/Milling Operations

Ore contains the valuable minerals (typically metals) which are being sought. Gangue minerals are the non-valuable minerals associated with the valuable minerals in the ore. Beneficiation are activities that separate and concentrate valuable minerals from gangue minerals using mechanical and chemical processes following the initial crushing and/or grinding of the ore in mills.

Gravity Concentration

Gravity concentration process involves differences in the density of minerals to separate the valuable mineral from the gangue minerals: 1) Coarse Fine Concentration - sluices are typically used to settle heavy materials from lighter materials where the slurry (crushed ore and water) is further processed or discharged to tailing impoundments; 2) Amalgamation - historically used to recover gold, uses mercury to form an amalgam. Gold is recovered by filtering off the mercury; 3) Sink/ Float Separation - also known as heavy media separation, uses buoyancy to separate minerals on the basis of a mineral's buoyancy/density in a liquid media.

Magnetic Separation

Magnetic separation is generally applied to ores of iron, columbium/tantalum, and tungsten where a magnetic field separates particle based on their affinity to magnetism.

Electrostatic Separation

Electrostatic separation is used to separate minerals based on their conductivity to an electric charge.

Flotation

Flotation is a process which involves adding chemicals to slurry which causes minerals to adhere to air bubbles forced through the slurry. The air bubbles containing the mineral are separated from the matrix.

Leaching

Leaching typically involves a pre-leaching process where ore is heated in furnaces, sometimes under pressure (autoclaving), and sometimes with chemicals such as sodium. The ore is subsequently placed in piles (dump and heap leaching) or in tanks (tank leaching) where liquids are applied such as cyanide, acids, or water. The applied liquid leaches the mineral from the ore for further processing.

SOURCES OF RELEASES

As noted above, the interaction of natural processes and mine wastes can result in the release of contaminants. Waste rock, mine tailings, mine drainage water (groundwater), surface impoundments, processing chemicals, and other wastes are common sources of releases. The mobility of a waste constituent is dependent on 1) chemical and physical properties of the constituent, 2) chemical and physical properties of the media, and 3) environmental factors, including, topography, climate, hydrology, geochemistry, mineralogy, and extent of weathering.

Following initial milling/beneficiation, smaller mines typically transport the mineral concentrates to off-site facilities for further mineral processing. Larger mines may conduct these additional operations on-site. These additional mineral processing operations include, pyro-metallurgical (smelting/refining); hydro-metallurgical (acid/precipitate); and electro-metallurgical (electrolytic/plating) operations. A conceptual site model depicting types of contaminant releases from mining, milling, and mineral processing activities is shown in Figure 2, titled "Summary of Contamination from Hardrock Mining Activities"

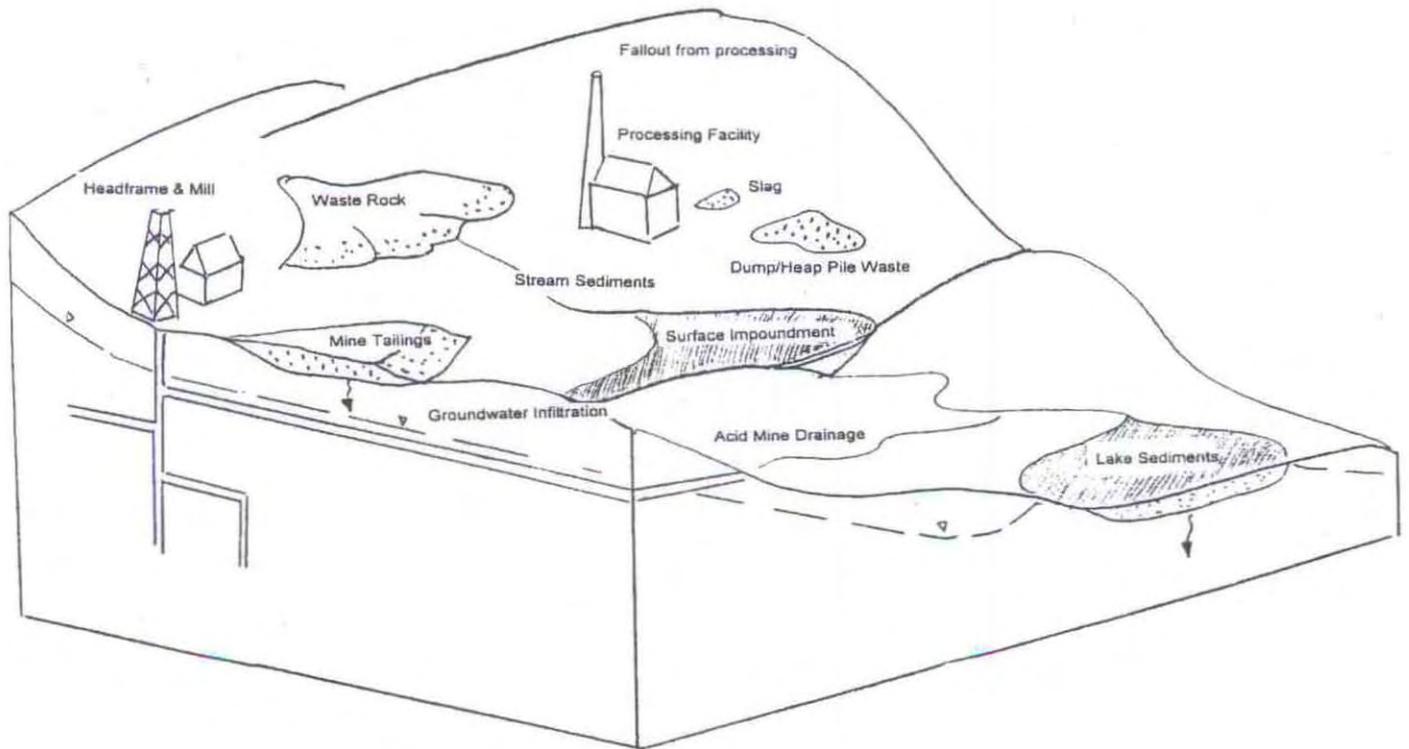
Waste Rock

Waste rock will contain some concentration of the mineral being sought in addition to other minerals. Waste rock geochemistry may vary from site to site depending on the site lithology and geochemical processes. Waste rock includes broken rock of varying size to fine sand size material. Waste rock is typically disposed of in piles adjacent to or down-slope of mine openings. Water migrating through waste rock piles, via rain or surface water may impact surface water and groundwater. Waste rock may also be a source of soil contamination and sediment contamination in streams and lakes.

Mine Tailings

Mine tailings contain the residual matrix material from the processed ore as well as chemical additives. They are commonly transported in slurry to tailings impoundments for disposal or other processing. These impoundments were commonly constructed by damming off natural drainages, often using waste rock as a construction material. Tailings are also commonly disposed of in a dried state and are located on hillsides, and in valleys. Mine tailings tend to pose more environmental problems than waste rock due their fine particle size. Like waste rock, water migrating trough tailings may impact surface water and groundwater, and be a source of soil and sediment contamination in streams and lakes. Tailings piles may also be a source air-born contamination.

FIGURE 2
SUMMARY OF CONTAMINATION FROM HARDROCK MINING ACTIVITIES



Ore Milling and Operation Facilities

Ore milling and other operations, often located on site, can be sources of contamination associated with milling and other machinery (e.g. lubricants, solvents, fuels). Locations where processing chemicals (e.g. mercury, cyanide, acids) are stored and used in the mineral concentration process and mineral assay facilities where ore samples are evaluated for mineral content can be sources of chemical contamination to surface water, groundwater, and soil.

Mine Drainage Water (Groundwater)

During mining operations, mines are often dewatered to provide access to ore bodies. Inactive mines provide both an inlet and outlet for surface and rain water. Water exiting a mine can contain leached metals and other minerals and have a lowered pH value producing "acid mine drainage". This mine drainage water may impact surface water, and groundwater.

Dump/Heap Pile Wastes

Dump and heap piles may remain on-site following the recovery of leachate containing the valuable mineral from these piles. Water migrating through these piles, via rain or surface water, may impact surface water, groundwater, surface soil, and air quality. They may also be a source of sedimentation in streams and lakes.

Surface Impoundments

Surface impoundments are used to 1) collect leachate from dump/heap leaching activities and are commonly located down gradient of dump/heap piles; 2) dispose of spent leachants; 3) dispose of spent electrolytic solutions; 4) recover valuable minerals by precipitation; and 5) store and provide a source of water for mine operations.

Slag

Waste associated with smelting/refining includes slag. Slag is partly fused impurities separated from metallic ore concentrates after being heated to a molten state in a furnace during the smelting process. Rain and surface water may leach out contaminants in the slag waste piles and may impact surface water and groundwater.

CONTAMINANTS OF CONCERN (COC) ASSOCIATED WITH MINE WASTES

Mine wastes is a general term applied to wastes that are associated with the mining and processing of ore. Mine wastes includes waste rock, mine tailings, mine drainage water (groundwater) surface impoundments, processing chemicals, slag, heap piles and other operational wastes.

COCs associated with mine wastes are related to 1) the chemical composition of the minerals which make up the ore and surrounding rock being mined; 2) mining methods; 3) ore processing methods, including chemicals used to process the ore (e.g., mercury and cyanide used in gold recovery); 4) mine waste disposal methods; and 5) the interaction of natural processes with mine wastes. Other COCs include residual explosives, fuels, solvents and lubricants used in mining operations.

Mineral Association with COC

Most minerals exist in soil and rock as a combination of two or more elements. Examples of minerals associated with ore include 1) native elements: gold, silver, copper, platinum, and iron; 2) metal oxides: chromite (FeCr_2O_4), cuprite (Cu_2O), magnetite (Fe_3O_4), Ilmenite (FeTiO_3); 3) metal sulfides: arsenopyrite (FeAsS), galena (PbS); cinnabar (HgS), pyrite (FeS_2); and 4) sulfates: barite (BaSO_4), anglesite (PbSO_4), anhydrite (CaSO_4). Additionally, minerals have association to other minerals or groups of minerals based on the rock type (e.g., igneous, including volcanic and plutonic; metamorphic; and sedimentary) and/or geologic processes in which mineral enrichment and alteration occurs through secondary processes such as hydrothermal enrichment, metamorphic alteration, and sedimentation. For example, ultramafic rock (rocks having mostly iron and magnesium minerals) are associated with chromite, Ilmenite, and asbestos minerals such as tremolite, actinolite, and chrysotile. Ultramafic rocks can be igneous and metamorphic in origin. Table 1, titled "Minerals Associated with Ore Deposits" list common minerals associated with ore deposits and weathering related minerals and can be used to identify COCs that may be associated with specific types of ore minerals that are mined.

Exposure Pathways and Media of Exposure

Exposure pathways at mine sites are similar to other sites having hazardous substances releases. The following exposure routes and media of exposure are applicable:

- Inhalation: airborne dust and volatile organic compounds in indoor air from solvents and fuels.
- Ingestion: surface water, groundwater, and incidental ingestion of soil.
- Dermal Absorption: direct contact with soil, surface water, and groundwater.

Figure 3, titled "Mine Waste Conceptual Site Model Diagram" is an AML conceptual site model describing potential mining COC sources, release mechanisms, migration pathways, exposure routes, and receptors. Collectively, mine wastes are the primary sources in which surface water runoff, infiltration/percolation, and erosion are primary release mechanisms. Secondary sources are surface water/sediments, groundwater, soil, and dust.

Not all sources, migrations pathways, and receptors may apply to a given AML site and the extent of exposure to human receptors varies depending on the existing and proposed land use.

TABLE 1
MINERALS ASSOCIATED WITH ORE DEPOSITS

1. ORE MINERALS

<u>a) SULFIDES</u>	<u>FORMULA</u>	<u>b) SULFOSALTS</u>	<u>FORMULA</u>
Pyrite	FeS ₂	Tennantite-tetrahedrite	(Cu,Ag,Fe,Zn) ₁₂ (As, Sb) ₄ S ₁₃
Marcasite	FeS ₂	Enargite	Cu ₃ AsS ₄
Pyrrhotite	Fe _(1-x) S	Luzonite-famatinite	Cu ₃ (As, Sb)S ₄
Chalcopyrite	CuFeS ₂	Proustite-pyrargyrite	Ag ₃ (As,Sb)S ₄
Bornite	Cu ₅ FeS ₄		
Chalcocite	Cu ₂ S	<u>c) NATIVE ELEMENTS</u>	<u>FORMULA</u>
Covellite	CuS	Electrum	(Au,Ag)
Gersdorffite	NiAsS	Gold	Au
Arsenopyrite	FeAsS	Silver	Ag
Arsenian pyrite	Fe(S,As) ₂	Copper	Cu
Loellingite	FeAs ₂	Quicksilver (native mercury)	Hg
Orpiment	As ₂ S ₃	<u>d) OTHER</u>	<u>FORMULA</u>
Realgar	AsS	Niccolite	NiAs
Cinnabar	HgS	Magnetite	Fe ₃ O ₄
Metacinnabar	HgS	Calaverite	AuTe ₂
Sphalerite	(Zn,Fe,Cd,Hg)S	Hessite	Ag ₂ Te
Greenockite	CdS	Petzite	Ag ₃ AuTe ₂
Stibnite	Sb ₂ S ₃		
Galena	PbS		
Millerite	NiS		

2. GANGUE MINERALS

<u>a) CARBONATES</u>	<u>FORMULA</u>
Calcite	CaCO ₃
Aragonite	CaCO ₃
Dolomite	CaMa(CO ₃) ₂
Ankerite	Ca(Fe,Mg)(CO ₃) ₂
Siderite	FeCO ₃
Rhodochrosite	MnCO ₃

TABLE 1 (continued)
MINERALS ASSOCIATED WITH ORE DEPOSITS

<u>b) SILICATES</u>	<u>FORMULA</u>
Quartz	SiO ₂
Albite	NaAlSi ₃ O ₈
Orthoclase	KAlSi ₃ O ₈
Anorthite (plagioclase)	Ca ₂ Al ₂ Si ₂ O ₈
Kaolinite	Al ₂ Si ₂ O ₅ (OH) ₄
Muscovite	KAl ₂ AlSi ₃ O ₁₀ (OH) ₂
Mariposite (Cr-phengite)	K(Al,Cr) _{1.5} (Mg,Fe) _{0.5} Al _{0.5} Si _{3.5} O ₁₀ (OH) ₂

<u>c) SULFATES</u>	<u>FORMULA</u>
Barite	BaSO ₄
Gypsum	CaSO ₄ ·2H ₂ O
Anhydrite	CaSO ₄

2. WEATHERING
MINERALS

<u>a)</u> <u>OXIDES/HYDROXIDES</u>	<u>FORMULA</u>
Hematite	Fe ₂ O ₃
Goethite	FeO(OH)
Ferrihydrite	Fe ₂ O ₃ ·2FeOOH·2·6H ₂ O
Cuprite	Cu ₂ O
Tenorite	CuO
Gibbsite	Al(OH) ₃
Boehmite, diaspore	AlO(OH)
Bunsenite	NiO
Theophrastite	Ni(OH) ₂

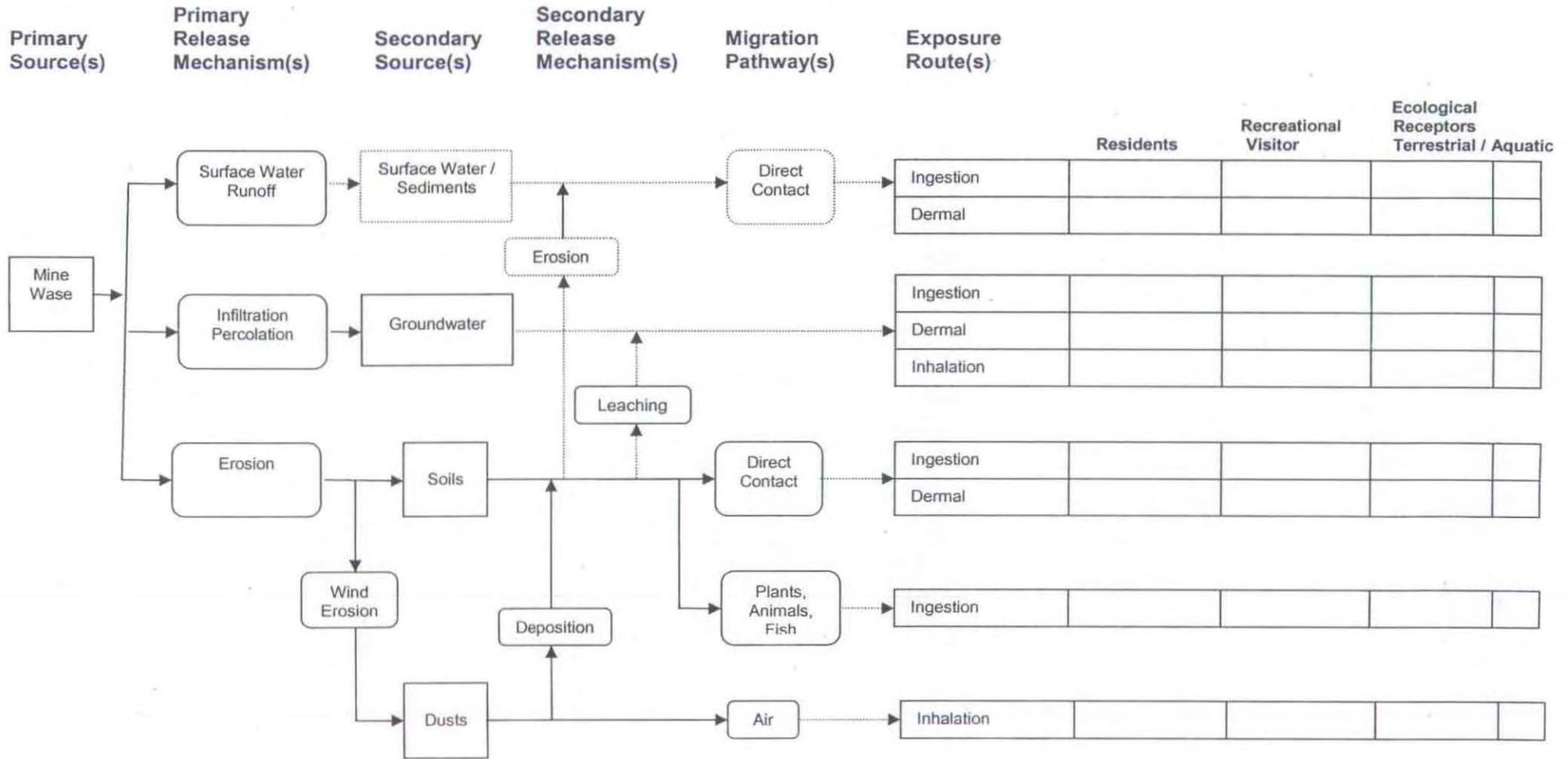
<u>b) SULFATES</u>	<u>FORMULA</u>
Antlerite	Cu ₃ (SO ₄)(OH) ₄
Brochantite	Cu ₄ (SO ₄)(OH) ₆
Gypsum	CaSO ₄ ·2H ₂ O
Melanterite	Fe ^{II} SO ₄ ·7H ₂ O
Rozenite	Fe ^{II} SO ₄ ·4H ₂ O
Szomolnokite	Fe ^{II} SO ₄ ·H ₂ O
Halotrichite	Fe ^{II} Al ₂ (SO ₄) ₄ ·22H ₂ O
Coquimbite	Fe ^{III} ₂ (SO ₄) ₃ ·9H ₂ O
Copiapite	Fe ^{II} Fe ^{III} ₄ (SO ₄) ₆ (OH) ₂ ·20H ₂ O
Ferricopiapite	Fe ^{III} ₅ (SO ₄) ₆ O(OH)·20H ₂ O
Schwertmannite	Fe ^{III} ₈ O ₈ (OH) ₆ SO ₄
Rhombochase	Fe ^{III} (H ₃ O)(SO ₄) ₂ ·3H ₂ O
Jarosite	KFe ^{III} ₃ (SO ₄) ₂ (OH) ₆
Alunite	KAl ₃ (SO ₄) ₂ (OH) ₆
Jurbanite	Al(SO ₄)(OH)·5H ₂ O
Anglesite	PbSO ₄
Goslarite	ZnSO ₄ ·7H ₂ O

<u>c) ARSENATES &</u> <u>ANTIMONATES</u>	<u>FORMULA</u>
Scorodite	Fe ^{III} AsO ₄ ·2H ₂ O
Mansfieldite	AlAsO ₄ ·2H ₂ O
Pharmacosiderite	KFe ^{III} ₄ (AsO ₄) ₃ (OH)·6·7H ₂ O
Beudantite	PbFe ^{III} ₃ (AsO ₄)(SO ₄)(OH) ₆
Stibiconite	Sb ₃ O ₆ (OH)
Bindheimite	Pb ₂ Sb ₂ O ₆ (O,OH)

<u>d) HALIDES</u>	<u>FORMULA</u>
Calomel	HgCl
Chloragryrite	AgCl
Atacamite, paratacamite	Cu ₄ Cl ₂ (OH) ₆

<u>e) CARBONATES</u>	<u>FORMULA</u>
Azurite	Cu ₃ (CO ₃) ₂ (OH) ₂
Malachite	Cu ₂ (CO ₃)(OH) ₂
Cerussite	PbCO ₃
Smithsonite	ZnCO ₃

**FIGURE 3
MINE WASTE CONCEPTUAL SITE MODEL DIAGRAM**



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However, since development is occurring on and near AML sites, various pathways may become relevant (e.g., use of groundwater or surface water as part of new development) and receptor scenarios may apply depending on the land use (e.g., residential versus recreational and trespasser receptors).

AML DISCOVERY PROCESS APPROACH

The AML Site Discovery Process approach has been developed to make use of readily available information sources (e.g., regulator agency files) and state-of-the-art information technology including databases and Geographic Information System (GIS) mapping systems to conduct an initial assessment that identifies AML sites that may be associated with releases of contaminants to the environment that are not yet being addressed by state, federal or local agencies. Once identified, these AML sites can be examined for the need to conduct a more detailed evaluation or investigation of the site.

The Discovery Process begins with identifying known AML sites through the evaluation of existing databases. DTSC acquired the following Geographical Information Systems (GIS) AML databases from various local, state, and federal agencies: 1) Topographic Occurring Mine Symbols (TOMS), California Department of Conservation; 2) Principle Areas of Mine Pollution (PAMP), California Department of Conservation; 3) Environmental Health Mines (EH mines), Nevada County Environmental Health Department; 4) Digital Mining Claims, U.S. Geological Survey; 5) Mineral Resources, U.S. Geological Survey; and 6) Abandoned Mine Module (AMM)⁽¹⁾, U.S. Bureau of Land Management. DTSC also obtained 1) County assessor parcel maps, Nevada County Environmental Health Department; 2) Population density maps for California, U.S. EPA; and 3) High resolution aerial photographs. With information on AML sites and their locations, regulatory agency files and historical mining records can be reviewed for information on the size, type, and processing activities associated with a given mining operation. Some of this information may also be included in the above AML databases. The numbers identified in "brackets" following the Process Discovery steps refer to respective information sources provided in Appendix A, titled "Information Resources".

The steps of this Discovery Process are:

1. Apply available AML databases on a statewide or regional basis and map locations of AML site. [1-6]
2. Conduct a statewide or regional query of, local, state, and federal databases that track agency oversight including, cleanup, complaint, and enforcement activities to identify AML sites that are currently being addressed by respective agencies. Agency oversight databases include DTSC, Regional Water Quality Control Boards (RWQCBs), Bureau of Land Management (BLM), Department of Conservation (DOC), the U.S. Forest Service (USFS), U.S. Geological Survey (USGS) and U.S. EPA. [9-19, 27, 29]

(1) BLM's AMM database is currently being updated and was not available for DTSC's use for this AML Site Discovery Process.

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3. Select a geographic area on which to focus the assessment based on an evaluation of statewide or regional growth trends; current and future land use, including commercial, residential, and recreational development. Consult with local agency planning departments and refer to "General Plans" and zoning maps developed by local agencies. Apply respective general plan and zoning GIS databases if available. [32, 34]
4. Consult with local agencies (e.g. counties, cities) for information regarding property ownership based on parcel identification. Apply respective parcel identification GIS databases if available. Note that multiple AML sites may exist on a given parcel and multiple parcels may be associated with a given mining operation and have multiple property owners. [28, 33]
5. Within the selected geographic area, identify the locations of AML sites that are not currently being addressed by local, state, and federal agencies that are potential sources of releases to the environment. Note that AML sites which are currently being addressed by agencies can be associated with multiple parcels or multiple AML sites may exist on a given parcel.
6. Apply Population density maps to selected geographic area to visualize the proximity of AML sites to population. [7, 32]
7. Apply aerial photographs to selected geographic area of interest to visualize proximity of AML to infrastructure and development; and to identify features associated with mining activities (e.g. tailings and waste rock piles, impoundments, head-frame structures, building foundations/structures, and other mining features). [21, 22, 23]
8. Apply topographic base map to identify topographic relief, streams, lakes, reservoirs, canals, etc. [21, 22, 23, 41]
9. Collect information on the location of municipal water wells and private water wells. For private and municipal well completion information in California contact DWR. For municipal well water information in California, contact DHS. Private well information may also be available from local agencies (e.g., county environmental health agencies). [25, 26, 37, 38]
10. Examine potential threats to the public health, environment, and water quality based on the proximity of AML features (e.g. tailings and waste rock piles, processing facilities, etc) to existing and/or planned development, surface water features and drinking water wells. [25, 26, 35, 40]
11. Collect information regarding operational history from identified AML sites from local and state libraries, libraries of state and federal agencies (e.g. BLM, USGS, U.S. EPA, DOC, RWQCBs etc.) [28, 36]

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12. Conduct a site visit to confirm location of AML and presence of mining activities. Note that conducting site visits on public lands may be readily accomplished. However, conducting site visits on private lands requires coordination with the land owner(s) and local agencies.
13. Identify needs for additional assessment or investigation, including sampling and analysis.

AML SITE DISCOVERY REPORT

The techniques and informational sources used in this AML Discovery Process are applicable to any format used for initial assessment of potential contamination related to AML sites (e.g. DTSC's Preliminary Endangerment Assessment, RWQCB's Site Assessment, and U.S. EPA's PA/SI). The information gathered and conclusions reached in implementing the Discovery Process for a particular area can also be documented using U.S. EPA's "Pre-Comprehensive Environmental Response, Compensation and Liability Information System (Pre-CERCLIS) Screening Assessment Checklist/Decision Form" (Appendix B); and presented in the U.S. EPA's Site Discovery Report Format (Appendix C). This AML Site Discovery Process was prepared in a manner consistent with the process for conducting a U.S. EPA PA/SI Site Discovery.

EXAMPLE OF AML SITE DISCOVERY PROCESS

As discussed, the AML Site Discovery Process was developed to help users conduct discovery level assessments for AML sites using existing information sources and state-of-the-art information technology including databases and Geographic Information System (GIS) mapping systems to conduct an initial assessment.

Typically, the AML Site Discovery Process would be used to discover AML sites that are not yet being addressed by state, federal or local agencies. However, DTSC selected the former Idaho Maryland Mine in Grass Valley, Nevada County, California an example for applying the subject AML Site Discovery Process. This site was selected because of its proximity to ongoing growth in the City of Grass Valley and to compare information (e.g. location of mining features, topography, well locations, property boundaries, etc.) acquired from this discovery process to similar information acquired for this site based on Preliminary Assessment work DTSC completed for the U.S. EPA in June 2002.

Please refer to Appendix D, titled "Example of AML Discovery Process (Idaho Maryland Mine, Grass Valley, California)" for a discussion of this application.

REFERENCES

Abandoned Mine Lands Preliminary Endangerment Assessment Handbook, Department of Toxic Substances Control, February 1999.

Foothill Counties Mining Handbook, Special Publication 86, Department of Conservation, Mines and Geology, October 1985.

Solid Minerals Reclamation Handbook, BLM Manual Handbook H-3042-1, U.S. Department of the Interior, Bureau of Land Management, February 7, 1972.

Abandoned Mine Site Characterization and Cleanup Handbook, EPA 910-B-00-001, U.S. Environmental Protection Agency, August 2000.

Reclaiming Inactive and Abandoned Mines Lands, National Mining Association, July 1998.

Abandoned Mine Land and Hazard Evaluation Handbook, U.S. Department of Interior, Bureau of Mines, May 1994.

"National Overview of Abandoned Mine Land Sites Utilizing the Minerals Availability System and Geographic Information System (GIS) Technology", David A. Ferderer, U.S. Geological Survey Open-File Report 96-549, 1996.

Northern California-Central Cleanup Operations Branch, Visalia Dry Cleaner Site Discovery Report, Department of Toxic Substances Control, September 30, 2005.

Dry Cleaner Site Discovery Process, Department of Toxic Substances Control, September 30, 2005.

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APPENDIX A INFORMATION RESOURCES

1. Topographic Occurring Mine Symbols (TOMS), Department of Conservation, California
http://www.consrv.ca.gov/OMR/abandoned_mine_land/toms/index.htm
2. Principal Areas of Mine Pollution (PAMP), Department of Conservation, California
http://www.consrv.ca.gov/OMR/abandoned_mine_land/pamp/index.htm
3. Environmental Health Mines (EH mines), Nevada County Environmental Health, California
<http://new.mynevadacounty.com/gis/index.cfm?ccs=630> (fee required)
4. Digital Mining Claims , United States Geologic Survey
<http://geopubs.wr.usgs.gov/open-file/of99-409/>
5. Mineral Resources (MR), United States Geologic Survey <http://tin.er.usgs.gov/mrds>
6. Abandoned Mine Module, formerly the Abandoned Mine Lands Inventory System (AMLIS), United States Bureau of Land Management
<http://www.blm.gov/aml/amlis.htm> (AMLIS database is being revised and is not currently available as of 6/1/06)
7. DTSC intranet - Population Density Maps and other databases for California
<http://dtscnet.dtsc.ca.gov/GIS/>
8. GIS resources for Nevada County including, General Plan, and Zoning
<http://new.mynevadacounty.com/gis/index.cfm?ccs=629>
9. DTSC Internet - Site Mitigation and Brownfields Reuse Program Database (Envirostor)
<http://www.envirostor.dtsc.ca.gov/public/>
10. California Certified Unified Program Agencies (CUPA) - <http://www.calcupa.net/>
11. U.S. EPA Enforcement and Compliance History Online (ECHO); search for Information by city or zip code - <http://www.epa.gov/echo/>
12. U.S. EPA Watershed Assessment Tracking and Environmental Results (WATERS) GIS web site - <http://www.epa.gov/waters/>
13. U.S. EPA Archived Sites - <http://cfpub.epa.gov/supercpad/arcsites/srchsites.cfm>
14. U.S. EPA CERCLIS Database <http://cfpub.epa.gov/supercpad/cursites/srchsites.cfm>
15. DTSC Internet- Hazardous Waste and Substances Site List (Cortese List)
http://www.dtsc.ca.gov/SiteCleanup/Cortese_List.cfm

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16. U.S. EPA Envirofacts Data Warehouse (A resource to find generators, transporters, treaters, storers, and disposers of hazardous waste in the area of interest)
http://oaspub.epa.gov/enviro/ef_home2.waste
17. U.S. EPA – AML sites with EPA removals/emergency responses
<http://www.epa.gov/aml/amlsite/removal.htm>
18. U.S. EPA - A list of mining sites and mineral processing sites on the NPL or deleted from the NPL <http://www.epa.gov/aml/amlsite/npl.htm>
19. AML CERCLIS Inventory – a list of AML sites from CERCLIS (EPA database of hazardous waste site, potential hazardous waste sites, and remedial activities)
<http://www.epa.gov/aml/amlsite/nonnpl.htm>
20. DTSC Intranet – Estimate location longitude and latitude from street address
<http://intranet/GIS/geocode/geocode1.cfm>
21. Mapping and aerial photos - MapQuest – <http://www.mapquest.com>
22. Mapping and aerial photos – <http://terraserver-usa.com>
23. Mapping and aerial photos – <http://terrafly.fiu.edu>
24. State Library – California History Room, Room 200, 900 N Street, Sacramento. (916) 645-0176. Email: csllcal@library.ca.gov Research hours 09:30 – 15:45 M-F.
25. Water Departments, Agencies and Companies: American Water Resources Association -
http://www.awra.org/state/socal/members_agencies_indivs/cawateragencies.htm
26. California Water Service Group, a large water purveyor that owns a number of water service systems in California - <http://www.calwater.com/>
27. Geotracker Web Site - Information on RWQCB UGT/LUST and SLIC sites; Some DHS water quality information - <http://geotracker.swrcb.ca.gov/>
28. Secretary of State – Corporation and LLC locator; can use as a resource to find current and past businesses - <http://kepler.ss.ca.gov/list.html>
29. DTSC intranet accessible GIS mapping of generators of hazardous waste -
<http://intranet/GIS/maaps/index.cfm>
30. SWRCB Water Quality Plans and Policies web address –
<http://www.waterboards.ca.gov/plnspols/index.html>
31. DWR – Basin maps and descriptions
<http://www.groundwater.water.ca.gov/bulletin118/index.cfm>

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32. Nevada County Community Planning Agency
<https://docs.co.nevada.ca.us/dsweb/View/Collection-1581>
33. Nevada County Assessor's Parcel Number (APN) Maps
<http://new.mynevadacounty.com/gis/index.cfm?ccs=630> (fee required)
34. Nevada County Zoning Maps
<https://docs.co.nevada.ca.us/dscgi/ds.py/View/Collection-9087>
35. California Department of Water Resources, Water Use and Planning
http://www.water.ca.gov/nav.cfm?topic=Water_Use_and_Planning
36. California Geological Survey Library
<http://www.consrv.ca.gov/CGS/information/publications/library/index.htm>
37. California Geologic Survey, Geologic Maps
http://www.consrv.ca.gov/CGS/information/geologic_mapping/index.htm
38. U.S. Department of Agriculture, Soil Survey Documents
<http://websoilsurvey.nrcs.usda.gov/app/>
39. California Soil Surveys, University of California, Davis
<http://casoilresource.lawr.ucdavis.edu/drupal/node/27>
40. California Department of Health Services, Drinking Water Program
<http://www.dhs.ca.gov/ps/ddwem/technical/dwp/dwpindex.htm>
41. U.S. Geological Survey, Topographic Maps
http://ngmdb.usgs.gov/Other_Resources/rdb_topo.html

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**APPENDIX B
PRE-SCREENING CERCLIS ASSESSMENT
CHECKLIST/DECISION FORM**

PRE-CERCLIS SCREENING ASSESSMENT FORM

Preparer Name:	Date:
Agency:	
Address:	
Phone: () - Ext.	E-Mail:

SECTION A.

Site Name:		
Previous Names:		
Site Location:		
City:	St:	Zipcode: -
CA DTSC Region:	CA DTSC Region #:	
CA RWQCB Region:	CA RWQCB Region #:	

Complete the following checklist. If "yes" is marked, please explain below.

	YES	NO
1. Does the site already appear in CERCLIS?	<input type="checkbox"/>	<input type="checkbox"/>
2. Is the release from products that are part of the structure of, and result in exposure within, residential buildings or businesses or community structures?	<input type="checkbox"/>	<input type="checkbox"/>
3. Does the site consist of a release of a naturally occurring substance in its unaltered form, or altered solely through naturally occurring processes or phenomena, from a location where it is naturally found?	<input type="checkbox"/>	<input type="checkbox"/>
4. Is the release into a public or private drinking water supply due to deterioration of the system through ordinary use?	<input type="checkbox"/>	<input type="checkbox"/>
5. Is some other program actively involved with the site (i.e., another Federal, State, or Tribal program)?	<input type="checkbox"/>	<input type="checkbox"/>
6. Are the hazardous substances potentially released at the site regulated under a statutory exclusion (i.e., petroleum, natural gas, natural gas liquids, synthetic gas usable for fuel, normal application of fertilizer, release located in a workplace, naturally occurring, or regulated by the NRC, UMTRCA, or OSHA)?	<input type="checkbox"/>	<input type="checkbox"/>
7. Are the hazardous substances potentially released at the site excluded by policy considerations (e.g., deferral to RCRA Corrective Action)?	<input type="checkbox"/>	<input type="checkbox"/>
8. Is there sufficient documentation that clearly demonstrates that there is no potential for a release that could cause adverse environmental or human health impacts (e.g., comprehensive remedial investigation equivalent data showing no release above ARARs, completed removal action, documentation showing that no hazardous substance releases have occurred, EPA approved risk assessment completed)?	<input type="checkbox"/>	<input type="checkbox"/>

Briefly explain all "yes" answers in section B.

PRE-CERCLIS SCREENING ASSESSMENT FORM

SECTION B.

Site Determination:

Site is eligible for CERCLA:

(Further assessment is recommended. / Non NPL Status = PA Needed / NPL Status = N)

The site is not eligible for CERCLA:

NPL Status = O for all options below

(Pick one below:)

Non-NPL Status = Not a Valid Site :

Non-NPL Status = Not a Valid Site - RCRA Lead:

Non-NPL Status = Not a Valid Site - NRC Lead:

Non-NPL Status = Not a Valid Site - State Lead:

Site is part of a NPL site:

(NPL Status = A)

DECISION/DISCUSSION/RATIONALE/SITE ACTION COMMENTS:

Regional EPA Reviewer: _____ Date: _____

State Agency/Tribe: _____ Date: _____

Date Submitted to IMC: _____

PRE-CERCLIS SCREENING ASSESSMENT FORM DATA ENTRY FORM FOR DISCOVERY OF SITE

FED FAC IND Federal Facility Not a Federal Facility Status Undetermined

SITE TYPES (Check all secondary subcategories that apply. Designate one subcategory as primary)

Manufacturing/Processing/Maintenance		
(Subcategory)		
Primary	Secondary	
<input type="checkbox"/>	<input type="checkbox"/>	Chemicals and allied products
<input type="checkbox"/>	<input type="checkbox"/>	Coal gasification
<input type="checkbox"/>	<input type="checkbox"/>	Coke production
<input type="checkbox"/>	<input type="checkbox"/>	Electric power generation and distribution
<input type="checkbox"/>	<input type="checkbox"/>	Electronic/electrical equipment
<input type="checkbox"/>	<input type="checkbox"/>	Fabrics/textiles
<input type="checkbox"/>	<input type="checkbox"/>	Lumber and wood products/pulp and paper
<input type="checkbox"/>	<input type="checkbox"/>	Lumber and wood products/wood preserving/treatment
<input type="checkbox"/>	<input type="checkbox"/>	Metal fabrication/finishing/coating and allied industries
<input type="checkbox"/>	<input type="checkbox"/>	Oil and gas
<input type="checkbox"/>	<input type="checkbox"/>	Ordnance production
<input type="checkbox"/>	<input type="checkbox"/>	Plastics and rubber products
<input type="checkbox"/>	<input type="checkbox"/>	Primary metals/minerals processing
<input type="checkbox"/>	<input type="checkbox"/>	Radioactive products
<input type="checkbox"/>	<input type="checkbox"/>	Tanneries
<input type="checkbox"/>	<input type="checkbox"/>	Trucks/ships/trains/aircraft and related components

Other		
(Subcategory)		
Primary	Secondary	
<input type="checkbox"/>	<input type="checkbox"/>	Agricultural
<input type="checkbox"/>	<input type="checkbox"/>	Contaminated sediment site with no identifiable source
<input type="checkbox"/>	<input type="checkbox"/>	Dust control
<input type="checkbox"/>	<input type="checkbox"/>	Ground water plume site with no identifiable source
<input type="checkbox"/>	<input type="checkbox"/>	Military/other ordinance
<input type="checkbox"/>	<input type="checkbox"/>	Product storage/distribution
<input type="checkbox"/>	<input type="checkbox"/>	Research, development, and testing facility
<input type="checkbox"/>	<input type="checkbox"/>	Retail/commercial
<input type="checkbox"/>	<input type="checkbox"/>	Spill or other one time event
<input type="checkbox"/>	<input type="checkbox"/>	Transportation (e.g. railroad yards, airports, barge docking site)
<input type="checkbox"/>	<input type="checkbox"/>	Treatment works/septic tanks/other sewage treatment

Mining		
(Subcategory)		
Primary	Secondary	
<input type="checkbox"/>	<input type="checkbox"/>	Coal
<input type="checkbox"/>	<input type="checkbox"/>	Metals
<input type="checkbox"/>	<input type="checkbox"/>	Non-metals minerals
<input type="checkbox"/>	<input type="checkbox"/>	Oil and gas

Waste Management		
(Subcategory)		
Primary	Secondary	
<input type="checkbox"/>	<input type="checkbox"/>	Radioactive waste treatment, storage, disposal
<input type="checkbox"/>	<input type="checkbox"/>	Municipal solid waste landfill
<input type="checkbox"/>	<input type="checkbox"/>	Mine tailings disposal
<input type="checkbox"/>	<input type="checkbox"/>	Industrial waste landfill
<input type="checkbox"/>	<input type="checkbox"/>	Industrial waste facility (non generator)
<input type="checkbox"/>	<input type="checkbox"/>	Illegal disposal/open dump
<input type="checkbox"/>	<input type="checkbox"/>	Co-disposal landfill (municipal and industrial)

Recycling		
(Subcategory)		
Primary	Secondary	
<input type="checkbox"/>	<input type="checkbox"/>	Automobiles/tires
<input type="checkbox"/>	<input type="checkbox"/>	Batteries/scrap metals/secondary smelting/precious metal recovery
<input type="checkbox"/>	<input type="checkbox"/>	Chemicals/chemicals waste (e.g. solvent recovery)
<input type="checkbox"/>	<input type="checkbox"/>	Drums/tanks
<input type="checkbox"/>	<input type="checkbox"/>	Waste/used oil

PREPARED BY:		DATE:	
IMC:	DATE:	ISS:	DATE:
QA/QC:		DATE:	

BOLD AND ITALIC FIELDS ARE REQUIRED

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**APPENDIX C
U.S. EPA DISCOVERY REPORT FORMAT**

1.0 INTRODUCTION

1.1 Apparent Problem

2.0 SITE DESCRIPTION

2.1 Study Area Location

2.2 Description and Operational History (study area sites)

2.4 Regulatory Involvement

2.4.1 U.S. Environmental Protection Agency

2.4.2 State

2.4.3 Local

2.4.4 Other Federal

3.0 INVESTIGATIVE EFFORTS

3.1 Previous Sampling

3.2 Current Sampling

4.0 HAZARD RANKING SYSTEM FACTORS

4.1 Sources of Contamination

4.2 Groundwater Pathway

4.3 Surface Water Pathway

4.4 Soil Exposure and Air Pathways

5.0 EMERGENCY RESPONSE CONSIDERATIONS

6.0 SUMMARY

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APPENDIX D
EXAMPLE OF AML SITE DISCOVERY PROCESS
(Idaho Maryland Mine, Grass Valley, California)

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EXAMPLE OF AML SITE DISCOVERY PROCESS

DTSC selected the former Idaho Maryland Mine in Grass Valley, Nevada County, California an example for applying the subject AML Site Discovery Process. This site (study area) was selected because of its proximity to ongoing growth in the City of Grass Valley and to compare information (e.g. location of mining features, topography, well locations, property boundaries, etc.) acquired from this AML Site Discovery Process to similar information acquired for this site based on a Preliminary Assessment (PA) DTSC completed for U.S. EPA in June 2002.

Idaho Maryland Mine Preliminary Assessment

The former Idaho Maryland Mine, owned and operated by the Idaho Maryland Mine Company, produced gold from approximately 1867 to 1956 (non- operational during World War II). As of June 2006, the site of the former Idaho Maryland Mine is occupied by commercial and light industrial buildings along Idaho Maryland Road. A majority of the former mine has been developed and is either occupied by buildings or paved roads. Based on the review of available literature, the Idaho Maryland Mine Company may have owned approximately 1000 acres in the vicinity of the mine site. Subsequently, property surrounding the mine site has been subdivided into smaller parcels ranging in size from approximately one-half to forty acres.

Using county parcel maps as a base map, a site visit in 2002 documented the following mining features. The main shaft to the mine is located on Assessor Parcel Number (APN) 09-690-21. A mill is located approximately 450 south of the main shaft on APN 09-68006. Tailings from this mining and milling operation are deposited in several locations beginning approximately 400 feet west of the mill on APN 09-550-38. The tailings piles range from approximately 800 x 350 feet, 200 x 400 feet, and 200 x 200 feet respectively in aerial extent. Please refer to Figure A, titled "Preliminary Assessment, Idaho Maryland Mine" for mapping details.

AML Site Discovery Process

For this same location, DTSC applied the following GIS AML databases: 1) Topographic Occurring Mine Symbols (TOMS), California Department of Conservation; 2) Principle Areas of Mine Pollution (PAMP), California Department of Conservation; 3) Environmental Health Mines (EH Mines), Nevada County Environmental Health Department; and 4) Mineral Resources, U.S. Geological Survey. DTSC also applied 1) County assessor parcel maps, Nevada County Environmental Health Department; 2) Population density maps for California, U.S. EPA; and 3) High resolution aerial photographs. This information is displayed on the following figures.

Figure B, titled "AML Database Example", includes information displaying the approximate location of mining features in the study area from the TOMS, PAMP, EH Mines, and Mineral Resources databases; and the approximate location of selected Department of Water Resources domestic water and monitoring wells overlain on a high resolution aerial photograph base map with topographic features. Figure C, titled "Aerial Photography Example" displays aerial photography of the study area. Figure D, titled "Zoning Map

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Example” displays zoning information for the study area. Figure E, titled “Population Density Example” includes population density information for the study area. The analysis of these figures reveals the following findings.

Figure B – AML Site Discovery Example

The plot of AML databases reveals approximately a dozen AML features including mine names (EH Mines, PAMP, and Mineral Resources), and related mining structures (TOMS) in the proximity of the study area. The Idaho Maryland Mine is plotted in the northeast portion of the study area. Notably, the Idaho Maryland Mine site is plotted in several locations depending on the source of the database. This is due in part to the “projection” that different databases use and that the representative features identified in the AML databases are not necessarily initially located with great accuracy. Additional mines, including the Idaho Gold, Gambler Gold and Silver, Moorehouse Quartz, Eureka Gold Quartz, and the Golden Gate Group are also plotted in the study area as shown. AML features plotted from the TOMS database are concentrated in the vicinity of the Idaho Maryland Mine site and the northeast portion of the study area.

Notably, a tailings pond feature is shown in the western portion of the study area. (The tailings pond is also a mapped feature on the U.S. Geological Survey 7.5 minute series topographic map, Grass Valley Quadrangle, California - Nevada). Wolf Creek traverses the study area approximately parallel to Idaho Maryland Road. Several domestic water wells and monitoring wells are plotted in the study area as shown.

Figure C – Aerial Photography Example

The aerial photography reveals several areas having no to sparse vegetation in an otherwise vegetated area. The areas of interest appear “white” in the black and white aerial photograph and are highlighted with a white border for identification. When considered in conjunction with other AML information, these non-vegetated features are suggestive of potential grading and/or other unnatural activities. Due to the proximity of mining features from the above AML databases, the highlighted areas of interest could likely be related to mining activities (e.g., mine waste rock, or mine tailings, as verified by the Idaho Maryland Mine PA).

Figure D – Zoning Map Example

The zoning map for this area reveals that the area of interest is zoned as BP - Business Park.

Figure D –Population Density Example

Figure D is from the Idaho Maryland Mine PA June 2002 and displays the population density, location of municipal water wells, and threatened and endangered species in the vicinity of the Idaho Maryland Mine. This figure reveals that areas north and west of the site are more densely populated. The municipal water wells are located approximately two to four miles northeast and southwest of the study area.

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The population of the City of Grass Valley and sphere of influence for planning purposes was approximately 15,220 in 1993 and is projected to be 22,695 by 2020.

Interpretation of Information

When interpreting the above information, the user should be aware that the location of features plotted from the AML databases are not necessarily representative of the exact location for a given AML feature. Additionally, the use of multiple AML databases may result in the plotting of multiple AML features (e.g. mine name) in slightly different locations. This is due in part to the "projection" that different databases use and that the representative features identified in the AML databases are not necessarily initially located with great accuracy. This is evident, especially when using parcel maps as a GIS layer and when the parcels are small in area (e.g., an AML feature may plot outside the boundary of a given parcel for which the feature is actually located). However, when used in conjunction high resolution aerial photography, the plotting of AML features in the general vicinity of interest can be of great value in identifying potential AML sites requiring further evaluation.

Other GIS databases providing information on zoning, population density, location of water wells and surface waters can provide valuable information in terms assessing pathways for potential AML contaminants associated with mine tailings, tailings ponds, and mine waste rock. As with any investigation, once an AML site is identified in an area of interest, a site visit should be conducted to verify AML features in the field. A hand held Global Positioning System (GPS) instrument is an ideal tool for this purpose.

For this study area it is apparent that due to the high density of mining features; presence of surface water (e.g., Wolf Creek); domestic water wells within 0.3 miles and municipal water wells within two miles of the study area; close proximity to populated areas; close proximity of ongoing development; and interpretation of aerial photography (e.g., apparent mine waste features), further assessment would be recommended. Specifically, these mine wastes features and associated contaminants (e.g., arsenic, lead, and mercury which are typically associated gold lode mining) may be sources of contamination that can migrate to human receptors via air, groundwater, and surface water and sediment pathways and migrate to biological receptors via air, surface water, and sediment pathways. Both human and biological receptors may be exposed via inhalation of dust, ingestion water and soil/sediments, and via direct contact with water, soil/sediments.

Conclusion and Future Work

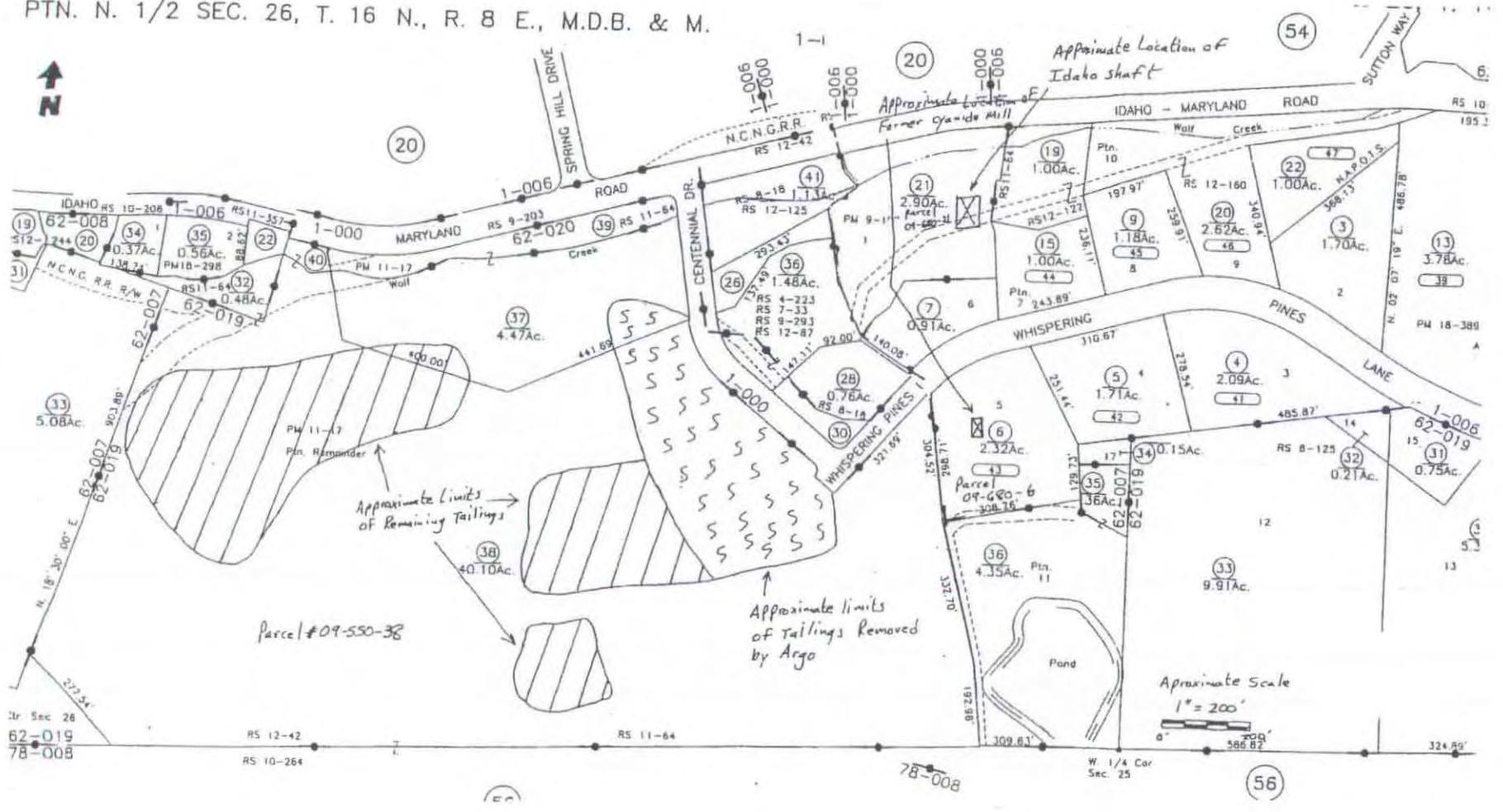
Based on the application of the AML Site Discovery Process, the Idaho Maryland Mine is an AML site that requires further assessment (e.g., the Idaho Maryland Mine PA recommends a SI). In general, AML sites having the characteristics discussed in this example are good candidates for preparing a Pre-CERCLIS Screening Assessment Checklist/Decision Form and follow-up documentation in a Site Discovery Report.

Following U.S. EPA's approval of the draft AML Site Discovery Process, DTSC proposes to apply the final AML site Discovery Process to the communities of Grass Valley and Nevada City, California under a future U.S. EPA Preliminary Assessment/Site Inspection Cooperative Agreement and prepare a Site Discovery Report which focuses on AML sites.

PTN. N. 1/2 SEC. 26, T. 16 N., R. 8 E., M.D.B. & M.



Figure A
Preliminary Assessment Idaho Maryland Mine



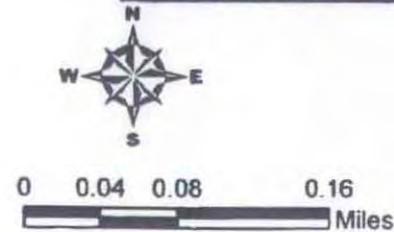
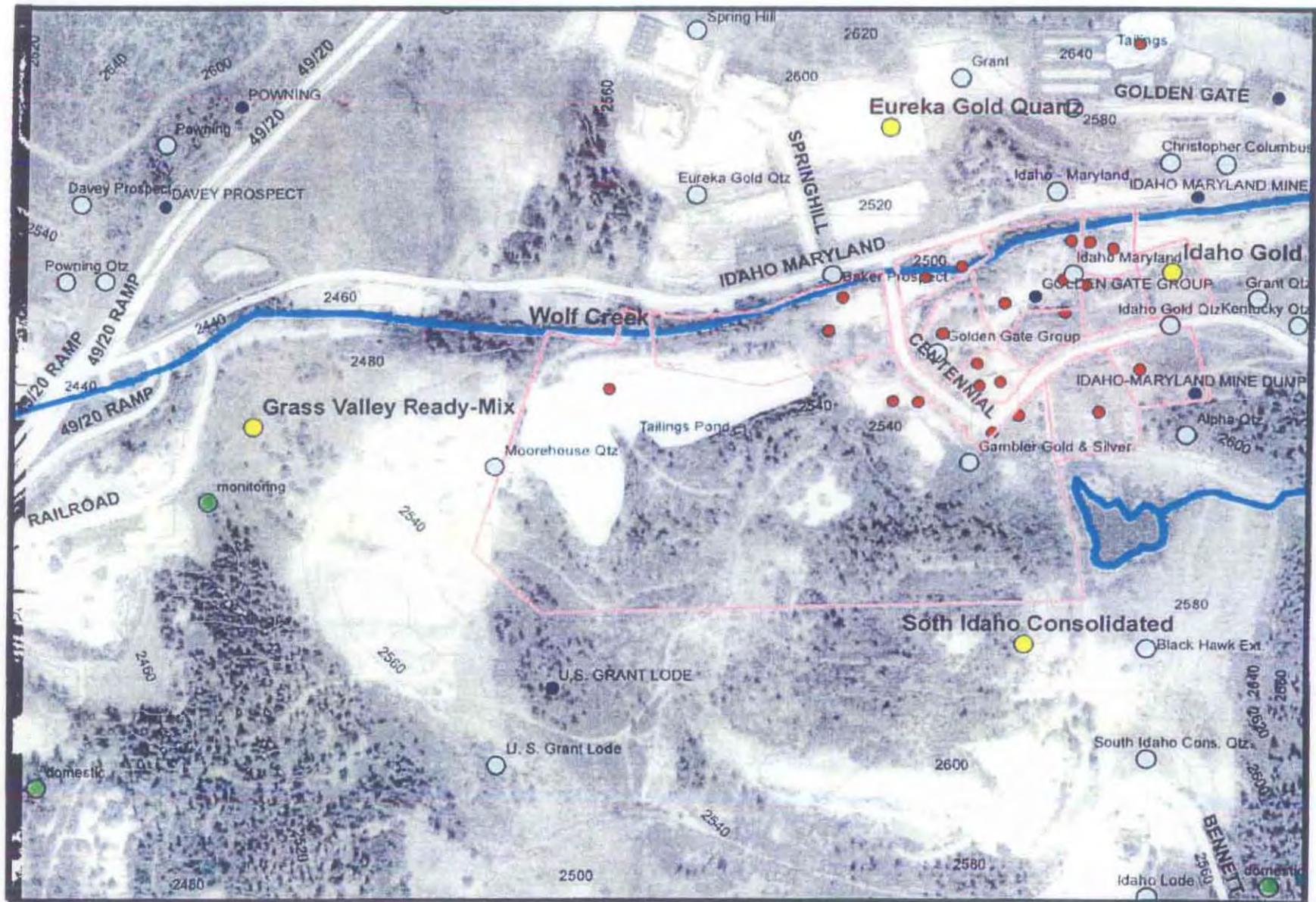
1/2 Sec 26
62-019
78-008

RS 12-42
RS 10-264

RS 11-64

W 1/4 Cor
Sec 25

56



- Legend**
- Department of Conservation PAMP
 - Idaho Maryland Mine Study Area
 - USGS Mineral Resources
 - Nevada County Environmental Health (EH) Mines
 - Department of Conservation Topographic Occurring Mine Symbols (TOMS) Points
 - 20 Foot Contours
 - Streams and Rivers
 - Department of Water Resources (DWR) Wells
 - Topographic Occurring Mine Symbols (TOMS) Poly

FIGURE B
ABANDONED MINE LAND (AML) DATABASE EXAMPLE

Location: Grass Valley, Nevada County, California
 Data Provided Courtesy of Nevada County Department of Environmental Health, State of California Department of Conservation, State of California Department of Water Resources and the United States Geological Survey

Send To Printer Back To TerraServer Change To 11x17 Print Size Show Grid Lines Change to Landscape
USGS Grass Valley, California, United States 16 Aug 1998



Image courtesy of the U.S. Geological Survey
© 2004 Microsoft Corporation [Terms of Use](#) [Privacy Statement](#)

Figure C
Aerial Photography Example

IDAHO-MARYLAND MINE

Latitude: 39 13 14.99 Longitude: 121 02 46.0,



PRODUCED BY: USEPA Region 9 GIS Center

DATE: June 27, 2006

SOURCES:

Population Density:
PL94-171, Bureau of the Census, 2000 Census

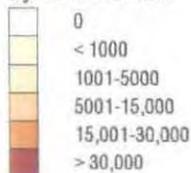
Drinking Water Supply:
California Dept. of Health, 2004

Endangered/Threatened Species:
Natural Diversity Database, Ca. Dept. of Fish & Game, 2004

 Drinking Water Supply Wells

 Threatened and Endangered Species

Population Density per Square Mile by Census Block



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NOTE: Radius in Miles.

