



Improving California's Response to the Environmental and Safety Hazards Caused by Abandoned Mines

Executive Summary

Abandoned Mine Lands (AMLs) Pose Serious Environmental and Safety Risks

Abandoned Mines Are Located Throughout the State. AMLs are those lands, waters, and surrounding watersheds where mining has stopped and mining-related excavations, structures, equipment, and wastes have been left behind in a state of disuse and disrepair. It is estimated that there are 47,000 abandoned mines in California, most of which date from the late 19th and early 20th centuries. While there are concentrations of AMLs in certain regions, abandoned mines exist in every county of the state. About two-thirds of these mine sites are located on federal lands, with most of the remaining mines on private property.

AMLs Can Cause Environmental Contamination and Physical Safety Hazards. The Department of Conservation (DOC) estimates that there are about 5,000 abandoned mines in California causing environmental contamination that could affect ground and surface waters, vegetation, soils, and air quality. For example, AMLs can impair water quality by causing acid mine drainage, metal contamination, and mercury poisoning. In addition, DOC estimates that 84 percent of abandoned sites contain features—such as shafts or abandoned buildings—that are physical dangers and potentially pose a threat to human life by causing injury or death.

Key Challenges to Systematically Remediating AMLs

Lack of a Centralized, Coordinated Approach Hinders Progress. There currently is no centralized approach for completing the inventory, assessment, and characterization of AMLs in California and prioritizing them for remediation. Instead, these responsibilities are spread across various state and federal agencies, each with its own jurisdiction, core mission, and approach to prioritizing amongst abandoned mine sites when funds become available for remediation projects. For example, environmental agencies—particularly the U.S. Environmental Protection Agency, State Water Resources Control Board, regional water quality control boards, and the Department of Toxic Substances Control—work to remediate environmental contamination from AMLs, and DOC usually is the state’s lead agency on projects to inventory and remediate physical safety hazards. Meanwhile, AMLs are spread across a patchwork of lands owned by federal agencies (such as the United States Forest Service and Bureau of Land Management), state departments (such as the Department of Parks and Recreation), and private land owners. While there are some informal efforts to communicate regularly across government agencies, project coordination occurs mainly on an as-needed basis when funding for individual remediation projects is available. Consequently, this decentralized approach is unlikely to result in the most efficient use of limited state and federal government resources.

Costly to Remediate Environmental Impacts and Physical Safety Hazards. The costs to remediate the environmental contamination caused by AMLs can be high, with costs as high as hundreds of millions of dollars for large, complex sites. Costs to remediate physical safety hazards are typically lower, often ranging from a few thousand dollars up to several hundred thousand dollars. The costs to remediate all AMLs in California could total billions of dollars. However, the funding to remediate abandoned mines is limited, spread across the budgets of

several state and federal agencies, and often has to compete with other types of environmental cleanup projects.

Recommendations to Increase the Pace of AML Remediation

Designate a Lead Agency to Coordinate Abandoned Mine Remediation Efforts. We recommend the Legislature adopt legislation to designate a lead agency to assume responsibility for the coordination of the remediation of AMLs on a statewide basis. Specifically, the lead agency would be responsible for establishing the state's cleanup priorities, coordinating with federal land management agencies, and developing a strategic plan. We believe that the improved coordination that could result from having a lead agency would facilitate longer-term planning and better ensure efficient use of limited state and federal resources for the remediation of AMLs.

Require the Lead Agency to Develop a Statewide Strategic Plan. We recommend that the designated lead agency develop a statewide strategic plan to address physical safety hazards and environmental contamination from AMLs. The strategic plan should establish specific goals, measurable objectives, and prioritize remediation projects. The prioritization should be based upon clear, publicly available criteria developed with input from state and federal agencies, experts in the field, stakeholders, and advocates. A strategic plan—particularly one that is updated regularly—would facilitate a more systematic approach to project selection, help ensure that limited resources are targeted to the most critical projects, improve transparency, and facilitate interagency planning and collaboration.

Establish State Fund to Support AML Remediation. We recommend the Legislature enact legislation to establish a special fund to provide a dedicated ongoing funding source for the remediation of environmental contamination and physical safety hazards at AMLs in California. Monies deposited into the fund could be used by state environmental protection agencies, state land management agencies, and DOC to fund remediation projects and other AML-related work. Allowable uses of the fund would include the full range of inventorying, assessing, remediation, and ongoing operations and maintenance activities at AML sites. A state fund designated for AML remediation work would provide easier accounting of available funds—which are currently dispersed among several departments—as well as help leverage additional funds by providing federal agencies with clearer information about what state funds could be available to match federal funding.

This new fund could be supported by both existing revenue sources, as well as future state bonds, federal allocations, and General Fund transfers for AML-related work. We recognize that providing additional funding for AML remediation in the near term will be challenging given the state's fiscal condition at the time this report was completed. However, given the number of sites requiring remediation in California and the associated costs, the state will not make substantial progress addressing AMLs with the worst environmental and safety hazards without significant additional resources. Moreover, to the extent the Legislature was interested in funding additional capital projects during a period of reduced economic activity, AML remediation could be a worthy consideration. For example, future state bonds could be a funding source for one-time AML-related construction projects to address environmental or physical safety hazards. In addition, the new fund we recommend could hold federal funds, such as when the American Recovery and Reinvestment Act of 2009 included funding for mine remediation projects in order to promote economic recovery and growth. Another example the Legislature could consider if it wanted to generate an ongoing revenue source would be a new charge on mineral extractions, similar to the state's existing charge on gold and silver, which fund a limited amount of remediation work for physical safety hazards.

INTRODUCTION

Abandoned Mine Lands (AMLs) are those lands, waters, and surrounding watersheds where mining has stopped and mining-related excavations, structures, equipment, and wastes have been left behind in a state of disuse and disrepair. AMLs are a nationwide problem and can pose serious threats to human health, public safety, and the environment. The United States Environmental Protection Agency (U.S. EPA) estimates that there are over 200,000 inactive and abandoned mines across the nation, mostly located in the western states. It is estimated that there are roughly 47,000 abandoned mines spread throughout every county in California.

This report consists of three sections. First, in the background section, we describe (1) historical mining practices, (2) the risks AMLs pose to the environment and the physical safety hazards they

cause, (3) the coordination across the many state and federal agencies to address AML issues, and (4) laws and programs governing the remediation of AMLs. In the second section of the report, we discuss key challenges to systematically remediating AMLs, such as a lack of a centralized statewide approach, land ownership issues, and lack of funding. In the third and final section, we recommend steps the Legislature could take to improve California's approach to addressing the threats to public health and the environment caused by AMLs.

In preparing this report, we met with officials from state and federal agencies that work on inventorying, assessing, and remediating AMLs. We also visited projects to remediate the environmental impacts and physical safety hazards caused by AMLs.

BACKGROUND

BRIEF HISTORY OF MINING IN CALIFORNIA AND ITS REGULATION

Gold Rush Led to Major Increase in Mining in California. California has deposits of hundreds of different mineral commodities (such as gold, silver, tungsten, and boron) that have been mined over the state's history. Small-scale mining was well established in Southern California under Spanish and Mexican rule, but the discovery of gold in 1848 at Sutter's Mill near Coloma and the ensuing gold rush to the Sierra Nevada foothills in 1849 resulted in an enormous increase in mining activity in California.

Figure 1 (see next page) provides a time line that highlights selected events in California's mining history beginning with the gold rush.

Major Regulation of Mining Implemented in the 1970s. As shown on the time line, it was not until the 1970s that the state Surface Mining and Reclamation Act (SMARA) and the federal Surface Mining Control and Reclamation Act (SMCRA) established comprehensive programs for the

regulation of surface mining operations and the reclamation of mined lands. For a description of SMARA, SMCRA, and another key federal mining law, see the text box on page 8. (We discuss the laws related to abandoned mines later in this report.)

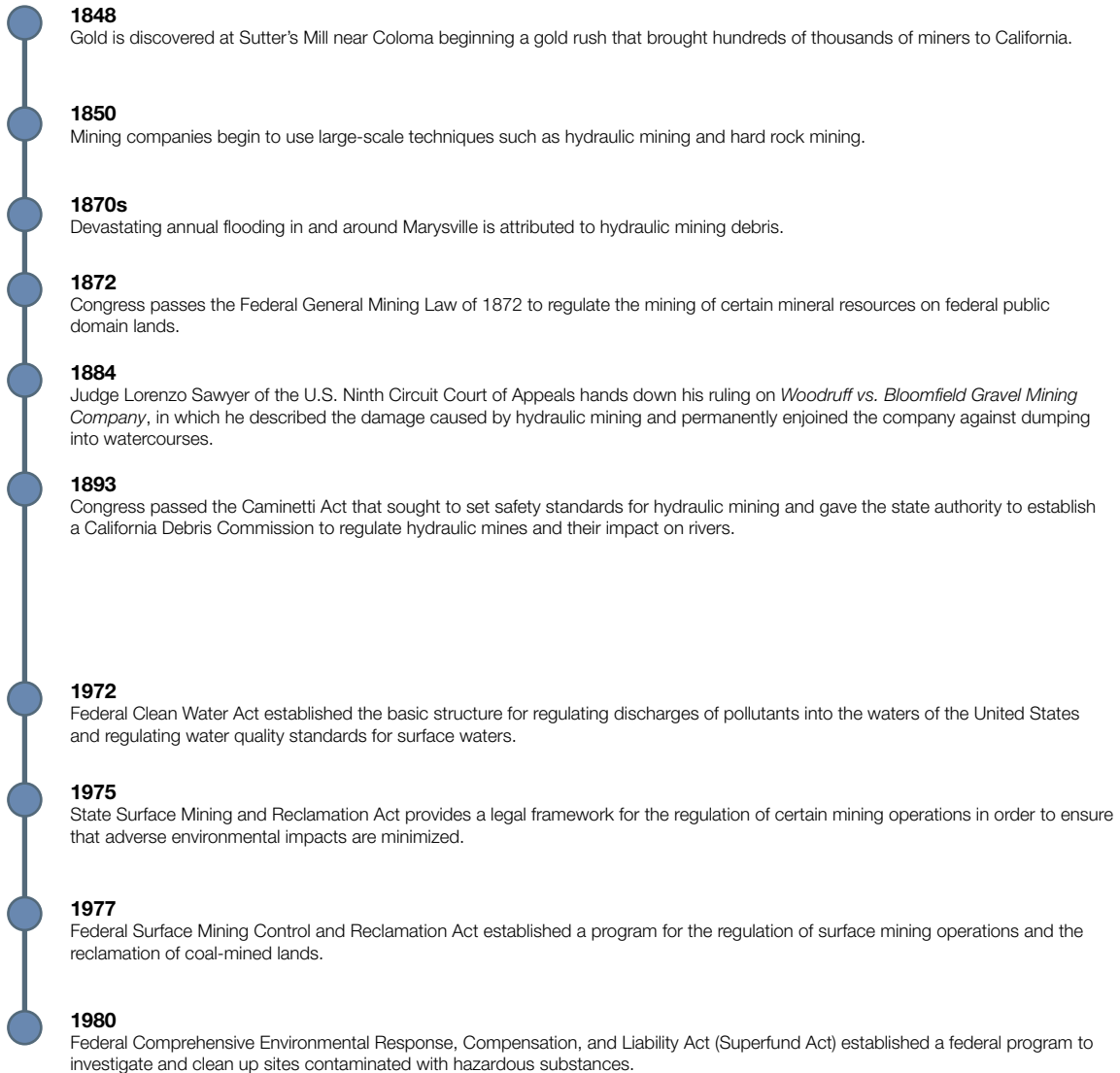
Tens of Thousands of Abandoned Mines in California. Part of California's mining legacy is an estimated 47,000 abandoned mine sites spread throughout the state. While there are concentrations of abandoned mines in certain regions—such as gold mines in the Sierra Nevada Mountains—there are abandoned mines in every county of the state. Many of these sites have features—such as dilapidated buildings, rusted machines, abandoned explosives, and unmarked tunnels and shafts—that are serious physical safety hazards for the public. Thousands of these sites are potential sources of contamination to surface water, groundwater, air quality, and soil. The majority of them date back to the 19th and early 20th centuries, and the individuals and companies that owned and operated them are no longer present.

As shown in **Figure 2**, more than two-thirds of the estimated 47,000 abandoned mines in California are located on the 46 million acres of federal lands administered by five federal land management agencies. Most of the remaining abandoned mines in California are located on

private lands. About 2 percent are located on state lands administered by the California Department of Parks and Recreation (DPR), the Department of Fish and Wildlife (DFW), and the State Lands Commission (SLC). Less than 1 percent are located on local government lands.

Figure 1

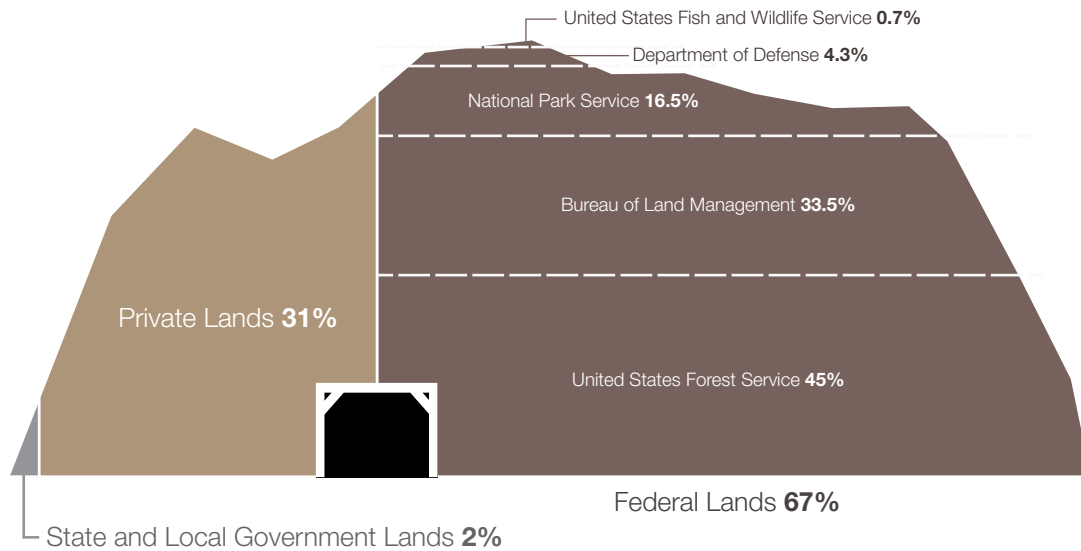
Selected Events in California’s Mining History



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Figure 2

California's Abandoned Mines Are Mainly Located on Federal Lands



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AMLS CAUSE ENVIRONMENTAL CONTAMINATION AND PHYSICAL SAFETY HAZARDS

The methods miners used to extract and process minerals, as well as dispose of mining waste and by-products, are often the root cause of present-day environmental contamination and physical safety hazards. Below, we describe some of the most common mining methods and how they contribute to such contamination and hazards. Since gold mines are thought to represent the greatest number of abandoned mine sites in the state, we mostly focus on the methods used to extract gold.

California's Early Miners Used a Variety of Methods

Over time, gold miners shifted from individual and small groups of prospectors using small scale mining methods to larger mining companies that used capital-intensive mining methods to reach

deposits buried deep underground. Some of the methods they used include:

- **Placer Mining.** Placer is a deposit of silt, sand, or gravel in the bed of a stream, river, or lake that can contain particles of gold (or other metals). Placer mining typically involves panning for gold and using sluices to extract gold from placer. (Sluices used the flow of water, silt, sand, and gravel through troughs and long wooden boxes lined in the bottom with a series of riffles—similar to shallow fences—to separate the heavier gold from the slurry.) The waste material, known as tailings, was discharged out the end of the sluice.
- **Hydraulic Mining.** When the Sierra Nevada range was created by upward movement of tectonic plates, it raised up ancient riverbeds so that they are now found buried in the range's mountains and canyons. Miners used high pressure water cannons to wash away mountainsides and expose the gold-rich placer from these long-buried riverbeds. Hydraulic mining in the 19th century

dramatically increased the sediment loads of rivers in the Northern California foothills and Central Valley, leading to raised river bottoms and forcing riverside cities such as Sacramento and Marysville to build miles of levees to prevent flooding.

- **Dredging.** Dredges, sometimes the size of buildings, were designed to float on a body of water and excavate as they moved along. They travelled along rivers and streams processing placer and separating out gold as they went. Extensive areas on the Feather, Yuba, American, and Tuolumne Rivers, as well as hundreds of miles of small streams, remain in a substantially altered state as a result of dredging activities.

- **Underground Mining.** In order to reach ore deposits buried deep underground, miners dug, drilled, or blasted through earth and surface rocks to make shafts, tunnels, and adits. (Ore is typically a hard rock, such as quartz, which is why underground mining is sometimes called “hard rock mining.”) This produced a by-product, known as waste rock that can range in size from fine sand to large boulders. Waste rock was often disposed of in piles near mine entrances. As shown in **Figure 3**, miners were sometimes lowered down mine shafts in cages to reach ore deposits deep underground. The ore was then brought up to the surface in the cage to be milled and processed to extract the gold.



Hydraulic mining caused erosion and increased sediment loads in rivers and streams.

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- **Open Surface Mining.**

Surface mines typically target deposits of industrial minerals and construction aggregates that are less valuable than minerals targeted by underground mines. The topsoil, sand, and rock overlying the target mineral, known as overburden, often is transported to a waste dump area or piled near the edge of the mine. Excavations into the side of hills or mountains create high walls that can be several stories high. Excavations into the ground create mine pits that are often deep with steep sides and benches and sometimes fill with water in the absence of drainage.

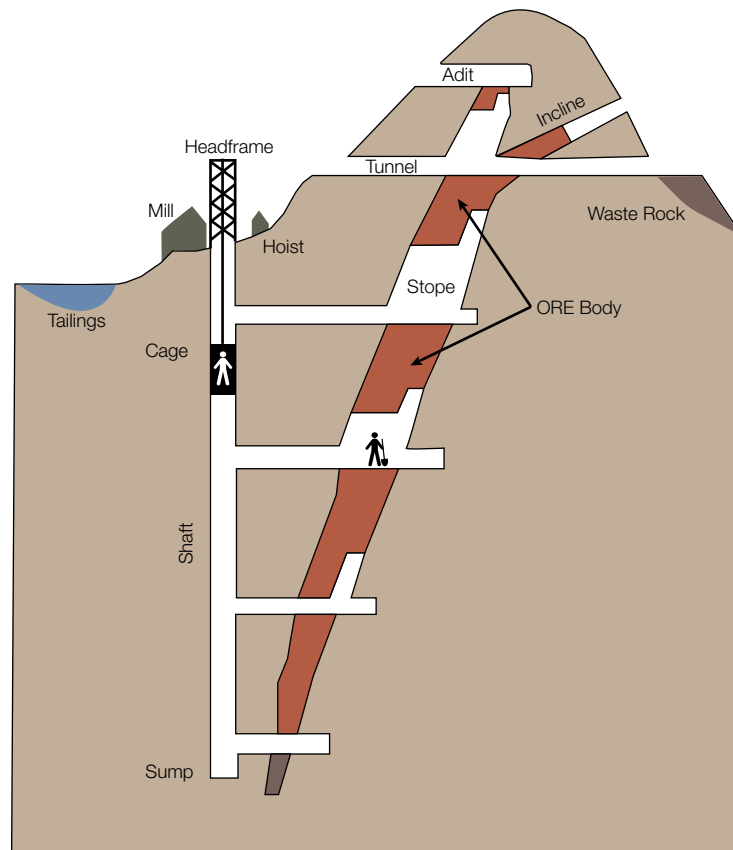
- **Beneficiation.** Beneficiation includes a variety of methods used to separate unwanted waste mineral (known as gangue) from the target mineral in order to make the latter suitable for further processing or direct use.

For gold, the main purpose of beneficiation is to prepare the ore for processing that concentrates the gold. To accomplish this, miners constructed mills where metal stamps crushed ore into sand and gravel that was then ready to be further processed.

- **Processing.** Miners used several processes to extract precious metals from placer and ore. For example, mercury was added to the bottom of sluices where it formed an amalgam with gold, and the gold was then separated out by heating and evaporating off the mercury. (Mercury was widely mined in California's coastal mountain ranges.) In stamp mills, crushed ore was washed over mercury-coated copper sheets and the

Figure 3

Underground Mining Terminology



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fine gold particles formed an amalgam with the mercury. The wastes from these and other processes used to separate precious metals were typically disposed of in piles or tailings ponds near where the ore was milled and processed. The unused or discarded chemicals associated with processing operations (including mercury and sodium cyanide) remain onsite at some abandoned mines.

Some Abandoned Mines Cause Environmental Contamination

Prior to passage of state and federal mining laws in the 1970s, mining companies were not obligated to minimize the adverse environmental impacts

from mining and reclaim mined lands to a usable condition after mining had ended. Of the estimated 47,000 abandoned mines in California, the Department of Conservation (DOC) estimates that about 5,000—about 11 percent—are likely sources of environmental contamination that could affect ground and surface waters, vegetation, soils, and air quality. Below, we describe some of the most common types of environmental contamination caused by AMLs.

AMLs Can Affect Water Quality. According to the U.S. EPA, over 10,000 miles of rivers, streams, and other receiving waters in the United States are affected by historical mining activities, including many waters in California. For example,

the Central Valley Regional Water Quality Control Board (RWQCB) regulates 102 sites, many of which have known or potential water quality impacts on the Sacramento-San Joaquin Bay Delta, which is the source of much of the state's water used for drinking and irrigation. Common types of water contamination caused by AMLs include:

- **Acid Mine Drainage.** Acid mine drainage occurs primarily when the mineral ore pyrite contained in tailings, waste rock piles, underground mine workings, and surface excavations is exposed to water and oxygen, producing soluble iron and sulfuric acid that can run off and affect surrounding areas. Acid

Key Federal and State Laws Regulating Mining

Federal General Mining Law of 1872. This law regulates the mining of certain mineral resources on federal public domain lands. The law permits individuals and corporations to prospect on public lands and to stake claims on the mineral discoveries they make. The primary purposes of the 1872 law were to promote mineral exploration and development on federal lands in the western United States, offer an opportunity to obtain a clear title to mines already being worked, and help promote settlement of the American west. The law contains no environmental provisions and does not require the reclamation of abandoned mines.

State Surface Mining and Reclamation Act (SMARA) of 1975. SMARA provides a legal framework for the regulation of surface mining operations in order to ensure that adverse environmental impacts are minimized and mined lands are reclaimed to a condition adaptable to alternative uses. Under SMARA, mine operators must submit a reclamation plan for review and approval by local lead agencies (cities and counties) and the Division of Mine Reclamation within the Department of Conservation. The law requires that mines be regularly inspected for compliance with their reclamation plans by local lead agencies or state regulators. Under SMARA, mining companies must pay annual fees to fund the law's enforcement, as well as provide financial assurances to ensure that adequate funding will be available to reclaim a mine site if the company goes out of business or is otherwise unable or unwilling to reclaim the site. Lands mined prior to the enactment of SMARA are not subject to its requirements.

Federal Surface Mining Control and Reclamation Act (SMCRA) of 1977. Congress enacted SMCRA to establish a program for the regulation of surface mining operations and the reclamation of coal-mined lands. The Office of Surface Mining Reclamation and Enforcement, a bureau within the federal Department of the Interior, is responsible for administering SMCRA. Under SMCRA, coal mining companies must meet certain environmental performance standards for operations and reclamation of mined lands, as well as provide financial assurances meant to ensure that the mining site will be reclaimed if the company goes out of business. SMCRA imposes a fee on coal producers that can be used for the remediation of abandoned coal mines and some other mining-related purposes. Coal mining revenues fund the abandoned mine mitigation programs in most western (and eastern) states. However, California generally does not qualify for this funding because it does not have active coal mines.



Acid mine drainage contaminates rivers and streams.

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mine drainage can (1) contaminate surface water and groundwater; (2) damage aquatic ecosystems; (3) corrode infrastructure such as bridges, culverts, and stormwater pipes; and (4) reduce the recreational and scenic value of streams and water. Acid mine drainage can also dissolve heavy metals such as lead and copper from rocks it comes into contact with, further contaminating groundwater and surface water with heavy metals.

- **Metal Contamination.** Metal contamination is often caused by rainwater and runoff flowing over and through tailings and waste rock piles that sometimes contain metals such as lead, zinc, and copper. The water interacts with the metals and transports them to nearby streams and rivers. Trace amounts of heavy metals found in water can be toxic and cause serious health problems to humans and damage and kill aquatic plants and animals.
- **Sedimentation.** Sedimentation occurs when fine grained mining waste from tailings, waste rock piles, and erosion resulting from past mining activities such as hydraulic mining and dredging is washed into streams and rivers by rain or snowmelt. Sedimentation can cause the loss of spawning habitat for fish and reduce reservoir capacity for flood control, power generation, and water storage.

- **Mercury Poisoning.** About 10 percent to 30 percent of the mercury used in California gold mining operations—up to 10 million pounds by some estimates—was released downstream where it can still be found in the sediments at the bottom of rivers, lakes, and reservoirs. Mercury accumulates in the muscle and fatty tissue of fish, and mercury poisoning can occur in humans when they eat these fish. Mercury poisoning impairs the nervous system and is especially detrimental to developing fetuses and young children.

AMLs Can Affect Air Quality. While the research in this area is limited, there are concerns that AMLs can cause respiratory ailments when fine dust containing lead, zinc, arsenic, asbestos, and other constituents from mine tailings, waste rock piles, stamp mills, and other mining-related sources are inhaled into the lungs. These constituents are known to cause adverse health consequences that vary depending on the length of exposure and the concentration levels of the constituents. For example, one study released in 2010 sampled soils from abandoned mine sites on or near hiking trails or all-terrain vehicle tracks in the Sierra Nevada foothills. The study identified elevated levels of lead, arsenic, and asbestos in some of the assessment areas.

AMLs Are Often Physical Safety Hazards

Every year, people are injured or die when they explore abandoned mines. However, comprehensive statistics are not kept regarding the number of people who are hurt or killed in accidents involving abandoned mines. DOC estimates that about 84 percent of abandoned mine sites in California likely include features that could pose a threat to human life. The physical safety problems caused by these sites are so widespread that the United States Department of Labor’s Mine Safety and Health Administration launched the “Stay Out—Stay Alive” campaign in 1999, a national public awareness campaign aimed at warning people about the dangers of exploring and playing on mine sites. Some typical accidents at abandoned mine sites include falls into unmarked mine shafts and pits, being trapped when unstable tunnels or structures collapse, and asphyxiation from lack of oxygen or the presence of toxic gases in underground mines.

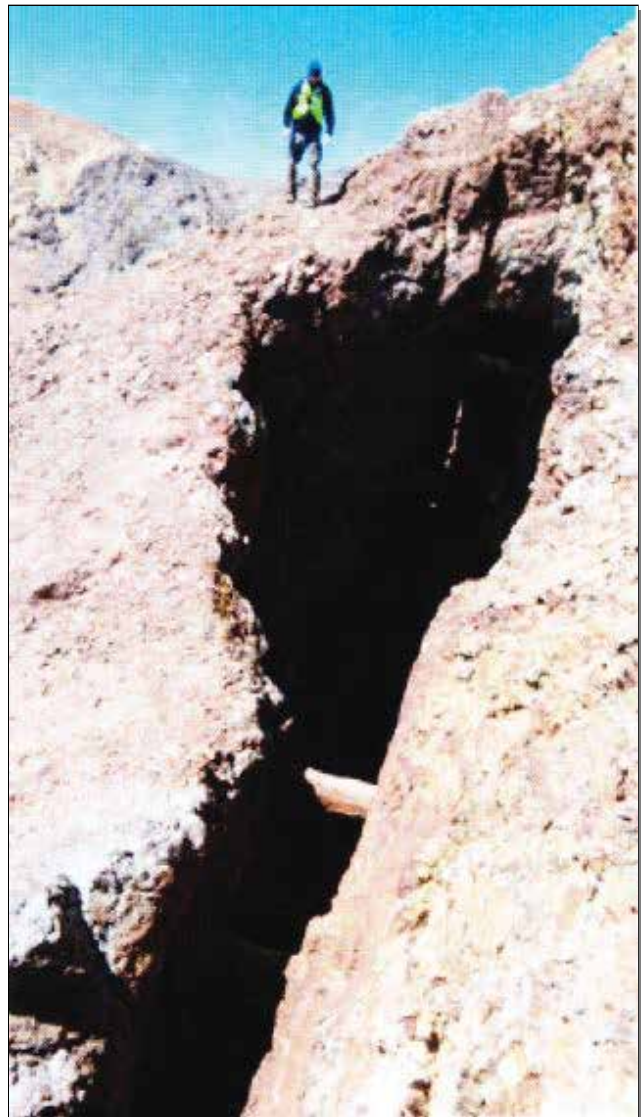
ADDRESSING AML ISSUES OFTEN REQUIRES COORDINATION ACROSS MULTIPLE AGENCIES

There are several functions performed by state, federal, and local government agencies that work on AML-related issues. Typically, multiple agencies must work in coordination to remediate environmental or physical safety hazards at an AML site. The functions these agencies perform mostly fall into one or more of the following general categories:

- **Land Management.** Agencies with land management responsibilities typically (1) identify and inventory abandoned mine sites on their lands, (2) perform preliminary assessments of abandoned mine sites, (3) remediate physical safety hazards (often in collaboration with technical support agencies), and (4) collaborate with other government agencies on environmental cleanup projects.
- **Environmental Regulation.** Environmental regulatory agencies typically (1) establish and enforce standards for clean water, air,

soil, and other environmental concerns that apply to AMLs; (2) perform site assessments, investigations, and characterizations to identify sources of environmental contamination; and (3) enforce environmental laws and regulations and issue permits.

- **Site Remediation.** Agencies that remediate sites that are physical safety hazards and/or sources of environmental contamination typically (1) design, review, and/or approve site remediation projects; (2) ensure that all permitting and other project requirements are met; and (3) supervise government contractors



Department of Conservation staff assesses an unmarked mine shaft.

Photo courtesy of the California Department of Conservation.

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and responsible parties that clean up sites and construct approved remedies.

- **Technical Support and Other Functions.** Several agencies (1) gather, analyze, and distribute data that supports efforts to identify and remediate AMLs; (2) advise other agencies undertaking remediation work; and (3) perform various other functions to support AML-related activities.

Group Formed to Facilitate Communication About AML Issues Across Agencies. The California Mine Land Agency Group (CAMLAG) has been meeting since 2005. CAMLAG is a voluntary governmental interagency forum—facilitated by DOC—for coordination and collaboration on AML issues in California. **Figure 4** shows CAMLAG’s membership and the main AML-related functions each member agency typically performs. We

Figure 4

California Abandoned Mine Land Agency Group Membership and Main AML-Related Functions

	Land Management	Environmental Regulation	Site Remediation	Technical Support and Other Functions
State Agencies				
Department of Conservation		✓	✓	✓
Department of Fish and Wildlife	✓	✓	✓	✓
Department of Parks and Recreation	✓		✓	
Department of Toxic Substances Control		✓	✓	✓
Sierra Nevada Conservancy				✓
State Lands Commission	✓		✓	
State Water Resources Control Board		✓	✓	✓
Federal Agencies				
Bureau of Land Management	✓		✓	
National Oceanic and Atmospheric Administration				✓
National Park Service	✓			
United States Army Corps of Engineers			✓	✓
United States Environmental Protection Agency		✓	✓	✓
United States Fish and Wildlife Service	✓		✓	
United States Forest Service	✓		✓	
United States Geological Service				✓
Local Government Agencies and Academic Institutions				
Nevada County	✓			
Placer County	✓			
Sacramento County	✓			
California State University, Chico				✓
California State University, Sacramento				✓
University of California, Davis				✓

discuss the AML-related functions performed by some CAMLAG members in greater detail later in this report.

Other Entities Also Play Important Roles.

Some other organizations actively work on AML-related issues but are not regular participants in CAMLAG. These entities include the following:

- ***California Indian Environmental Alliance.*** This alliance was created in 2006 by California tribal representatives and advocates to address mining contaminants, including mercury. One of the alliance’s core programs is the Mercury Tribal Health Program that trains tribal members and the health care providers who serve them on how to avoid the mining toxins found in local food sources.
- ***Sierra Fund.*** The Sierra Fund is a nonprofit organization that works with governmental agencies, universities, businesses, and environmental and community organizations to protect and restore the natural resources and communities of the Sierra Nevada. Its work includes sponsorship of research projects on the environmental effects of AMLs. For example, the Sierra Fund published a report in 2008 titled *Mining’s Toxic Legacy: An Initiative to Address Mining Toxins in the Sierra Nevada*, which makes recommendations to create funding mechanisms for the cleanup of AMLs and to improve coordination among state and federal government agencies that work on AML remediation projects.

ENVIRONMENTAL REMEDIATION OF AMLS

Federal Law Guides Many Environmental Remediation Efforts

While the state and federal mining laws cited earlier in this report largely focus on the operation of active mines, there are several federal environmental laws that apply to the remediation of environmental contamination at abandoned mine sites. **Figure 5** provides a summary of selected federal environmental laws that frequently apply to remediation of AMLs. For example, the

federal Clean Air Act of 1972 regulates dust emissions from tailings disposal, and the federal Endangered Species Act can limit remediation options at abandoned mine sites that are habitat for threatened or endangered species. However, the main two federal laws that provide the framework for assessment and remediation of AMLs are the (1) Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980 and (2) Clean Water Act (CWA) of 1972.

Under CERCLA, U.S. EPA Lead Agency on Major AML Environmental Remediation Projects.

CERCLA (commonly known as the “Superfund Act”) provides a framework for the assessment, investigation, detailed site characterization, and remediation of contaminated sites, including AMLs. This includes a process for addressing the sites with the worst levels of contamination. Cleaning up Superfund sites is a complex, multiphase process and is overseen by the U.S. EPA, which uses its Hazard Ranking System (HRS) to place sites on the National Priorities List (NPL). The NPL includes the highest-priority sites among the known releases of hazardous substances, pollutants, or contaminants throughout the U.S. CERCLA requires parties responsible for the contamination—if they can be identified—to remediate the site (or reimburse the government for U.S. EPA-led cleanup work). Sites on the NPL are eligible for funding from the Trust Fund (or “Superfund”) established under CERCLA to pay for emergency responses and remediation projects, including for NPL projects for which no responsible parties (RPs) can be identified, known as orphan sites. States reimburse the U.S. EPA for 10 percent of the remediation costs at NPL orphan sites and pay the full operations and maintenance (O&M) costs (100 percent once the remedy is in place) for these sites. **Figure 6** (see page 14) illustrates U.S. EPA’s Superfund site assessment process.

At the time this report was prepared, the NPL included 10 California mine sites (out of a total of 99 NPL sites in California). Most of the thousands of abandoned mine sites in California that cause environmental contamination will never be candidates for the NPL because they do not score high enough on U.S. EPA’s HRS to qualify as a Superfund site. As discussed in more detail later in

this report, remediation of these sites typically are overseen by state agencies such as the Department of Toxic Substance Control (DTSC) and RWQCBs.

CERCLA Also Establishes Liability for Cleanup Costs. CERCLA imposes liability on parties responsible for, in whole or in part, the presence of hazardous substances at a site. Under CERCLA, liability is (1) retroactive, meaning that parties may be held liable for acts that happened before the Superfund’s enactment; (2) joint and several, meaning that any one potentially responsible party (PRP) may be held liable for the entire cleanup of the site (when the harm caused

by multiple parties cannot be separated); and (3) strict, meaning that a PRP is responsible even if it did not act negligently. Because the majority of abandoned mines in California date back over 100 years, the individuals or companies responsible for causing the environmental harm are no longer present and, therefore, cannot bear the costs for the reclamation. Searches to identify PRPs can be lengthy and may involve legal actions as PRPs sometimes dispute their liability and the issue has to be settled through the courts.

Under CERCLA liability rules, the existing land owners generally can be held responsible for

Figure 5

Key Federal Environmental Laws Applicable to Abandoned Mine Land Remediation

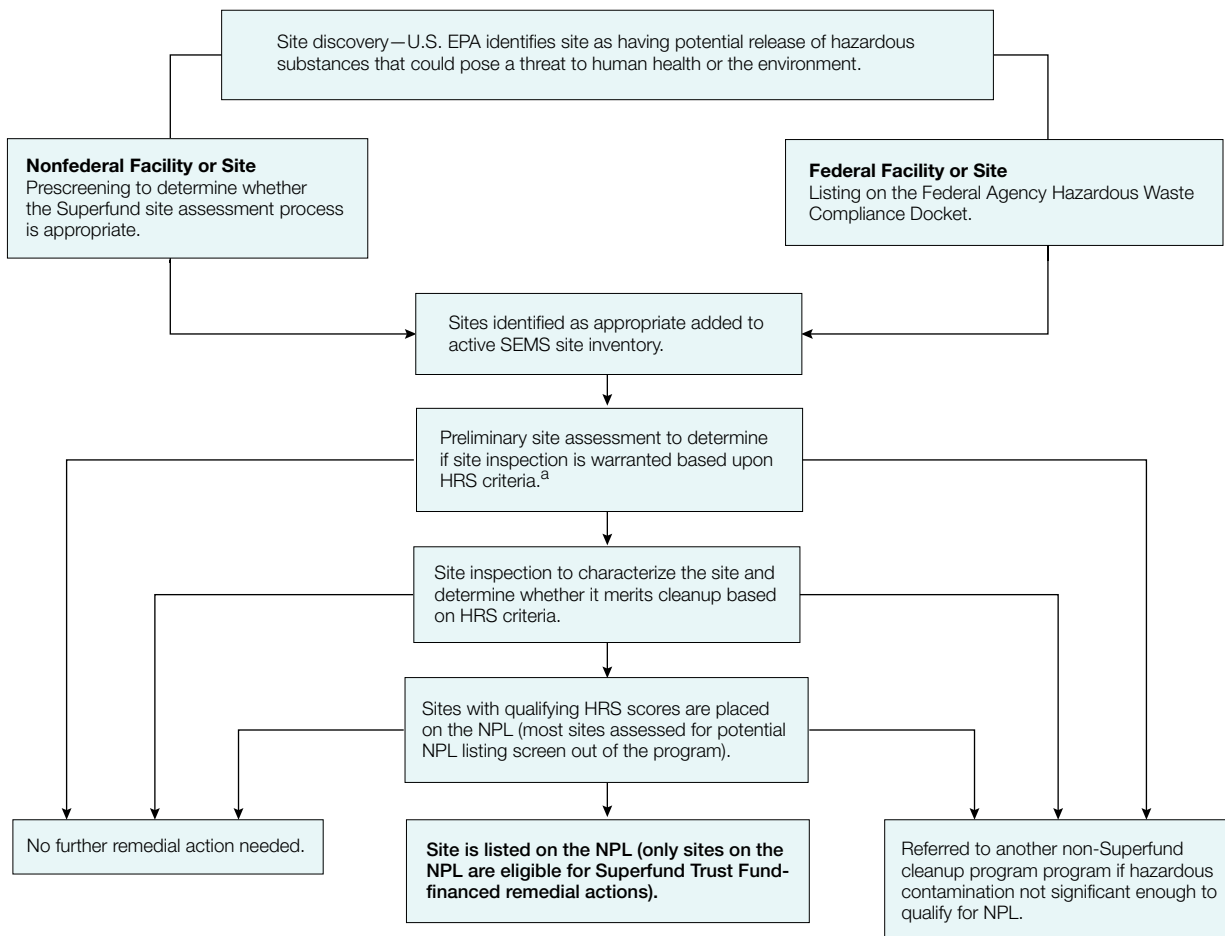
Law	Administering Federal Agency	Description
National Environmental Protection Act of 1969	U.S. Environmental Protection Agency (U.S. EPA)	Requires federal agencies to assess the environmental effects of their proposed actions prior to making decisions on a range of actions including (1) permit applications, (2) adopting federal land management actions, and (3) constructing publicly owned infrastructure and facilities.
Clean Air Act of 1970	U.S. EPA	Authorizes U.S. EPA to establish National Ambient Air Quality Standards to protect public health and welfare, and to regulate emissions of hazardous air pollutants.
Clean Water Act of 1972	U.S. EPA	Establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters. Authorizes U.S. EPA to implement pollution control programs and develop national water quality criteria recommendations for pollutants in surface waters.
Endangered Species Act of 1973	U.S. Fish and Wildlife Service and the U.S. Commerce Department’s National Marine Fisheries Service	Protects animal and plant species currently in danger of extinction (endangered) and those that may become endangered in the foreseeable future (threatened). Provides for the conservation of ecosystems upon which threatened and endangered species of fish, wildlife, and plants depend, both through federal action and by encouraging the establishment of state programs.
Safe Drinking Water Act of 1974	U.S. EPA	Protects public drinking water supplies throughout the nation. Authorizes U.S. EPA to set standards for drinking water quality, and implement various technical and financial programs to ensure drinking water safety.
Resource Conservation and Recovery Act of 1976 (amended the Solid Waste Disposal Act of 1965)	U.S. EPA	Establishes goals for: (1) protecting human health and the environment from the potential hazards of waste disposal, (2) conserving energy and natural resources, (3) reducing the amount of waste generated, and (4) ensuring that wastes are managed in an environmentally sound manner.
Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (Superfund Act)	U.S. EPA	Establishes prohibitions and requirements concerning closed and abandoned hazardous waste sites, provides for liability of persons responsible for releases of hazardous waste at these sites, and establishes a trust fund to provide for cleanup when no responsible party can be identified.

remediation costs regardless of whether they caused the contamination. However, CERCLA provides exemptions from Superfund liability for qualifying private landowners. For example, landowners that acquired property without knowledge of the contamination on the property despite conducting all appropriate inquiries at the time of purchase can be eligible for the innocent landowner defense to CERCLA liability.

Under CWA, U.S. EPA Establishes National Water Quality Standards. The CWA establishes the basic structure for regulating discharges of pollutants into the waters of the United States. This includes regulating quality standards for surface waters affected by AMLs. Under the CWA, the U.S. EPA has developed national water quality criteria recommendations for pollutants in surface waters. The CWA requires states to establish water quality standards for waters within their jurisdiction

Figure 6

U.S. EPA Superfund Site Assessment Process



^a The HRS is a numerically based screening system that uses information from preliminary site assessments and site inspections to assess the potential of sites to pose a threat to human health or the environment.

U.S. EPA = United States Environmental Protection Agency; SEMS = Superfund Enterprise Management System; HRS = Hazard Ranking System; and NPL = National Priorities List.

that take into account beneficial uses including for drinking water supplies, protection of fish and wildlife, recreation, agricultural and industrial water supplies, and navigation. AMLs can be found to violate water quality standards if, for example, the runoff from those sites carry heavy metals or other contaminants that contribute to water pollution.

CWA Establishes Liability. Under CWA, any party that in any way affects a discharge of water becomes fully responsible to meet water quality standards in perpetuity. Thus, a remediating party must meet water quality standards specified by CWA whatever the cost. This assignment of liability can apply to parties attempting to remediate water contamination from AMLs even though the remediating party did not create the conditions causing or contributing to the water quality degradation and had no previous responsibility or liability for the condition of the site. Because CWA imposes strict liability, cleanup volunteers, often called Good Samaritans, wanting to undertake cleanup efforts are sometimes discouraged because by undertaking a project to clean up a site, they become RPs.

State Environmental Agencies Administer Most Environmental Remediation Projects

While the U.S. EPA focuses on the largest, most complex sites under the Superfund program, investigation and remediation of smaller and generally less complex environmentally contaminated AMLs in California are typically funded and overseen by state agencies, typically DTSC and the State Water Resources Control Board (SWRCB).

DTSC's EnviroStor Tracks Abandoned Mines and Other Sites. EnviroStor is DTSC's data management system for tracking cleanup, permitting, enforcement, and investigation efforts at hazardous waste facilities and sites with known contamination or sites where there may be reasons to investigate further. EnviroStor contains records on more than 10,000 cleanup sites (including both federal Superfund sites and sites overseen by the state) and lists them by their remediation status. While there are estimates of 5,000 contaminated

AMLs in California, at the time this report was prepared, EnviroStor contained records of just 150 sites where mines are listed as the past use that caused contamination. Of this total, only 9 of the sites were certified as remediated, and another 23 sites were "active" and undergoing investigation or remediation. Of the remainder, it had been determined that 47 were in need of evaluation or remediation; 38 sites were not in need of remediation; and 22 should be referred to other state, federal, or local environmental agencies. We note that many abandoned mine sites affecting water quality are tracked by RWQCBs and may not be included in EnviroStor.

DTSC Addresses AMLs Through a Variety of Programs. The mission of DTSC is to protect California's environment from the harmful effects of toxic substances by restoring contaminated lands and enforcing hazardous waste laws. This includes coordination with the U.S. EPA related to sites on the NPL, as well as performing O&M work at remediated Superfund sites. In addition, DTSC has an AML team, which is composed of chemists, biologists, engineers, toxicologists, and geologists who provide oversight and technical support to government land management agencies, landowners, and local governments addressing AML issues. The AML team also collaborates with other federal, state, and local agencies to analyze and address environmental threats posed by AMLs through a variety of DTSC's programs and activities, including the following:

- **Site Mitigation and Restoration.** One of DTSC's core responsibilities is to identify, investigate, and remediate hazardous waste sites. This includes conducting a preliminary endangerment assessment to assess the threat to human health or the environment. If warranted, this is followed by a remedial investigation to determine the type and extent of contamination at a site. Subsequent analysis is used to evaluate remedial options and develop a remedial action plan to be undertaken. DTSC has the authority to issue orders to require RPs to cooperate with site investigations and remediation. DTSC oversees the remediation work and certifies when the project is completed.

- **Orphan Sites.** DTSC also manages “state orphan sites” that pose a threat to public health and where the RPs for the site could not be located or are unable to pay for clean up activities. To the extent funds are available, DTSC directly manages the cleanup and ongoing O&M of state orphan sites.
- **Voluntary Cleanup Program (VCP).** Under VCP, landowners and project proponents voluntarily sign agreements to investigate and, if necessary, clean up property. DTSC provides technical assistance and oversight of these activities. Counties often refer development projects with potential AML issues to DTSC under the VCP. As a result, it has become a key program for assessing abandoned mine sites.
- **Grants.** DTSC has completed and supported grant applications to help cities, counties, and other local agencies secure U.S. EPA grants to address AML issues in their areas. These grants are aimed at providing funding to communities that do not have the financial means to address AML issues, so they can carry out assessments and cleanups of AML sites. Available grants support preliminary assessments and site inspections, cleanup activities, training, research, and technical assistance.

SWRCB Monitors Water Quality and Addresses AML Issues. The State Water Quality Control Act (SWCA) of 1969 established the SWRCB, along with nine RWQCBs and gave those agencies primary responsibility for monitoring water quality in rivers, lakes, and other waterways in the state, as well as for the enforcement of water quality standards. This includes oversight and coordination of efforts to remedy sites—such as abandoned mines—that violate those standards. SWRCB administers the Water Quality Program, which implements the SWCA and the federal CWA. RWQCBs issue and enforce compliance with waste discharge permits, monitor water quality, and carry out water pollution control programs in accordance with state board policies. In addition to oversight over specific remediation projects, the following are

examples of broader programs to address water quality issues caused by AMLs.

- **Central Valley RWQCB Mining Program.** This program has staff who investigate and monitor AMLs. The program is intended to eliminate surface and groundwater contamination from past mining activities and prevent further degradation. RWQCB staff oversee the discharge of mining waste from active and inactive mines. Mine sites can require long-term maintenance to ensure that contaminants do not affect water quality, and the RWQCB regulates activities at these sites through waste discharge requirements. The RWQCB also can issue enforcement orders to parties that refuse to voluntarily comply with laws and regulations regarding discharges.
- **Statewide Mercury Control Program (SMCP) for Reservoirs.** SWRCB and RWQCB staff are in the process of developing the SMCP, a statewide water quality control program to address reservoirs with high levels of mercury concentration. The program will address 131 reservoirs identified as mercury-impaired as of January 2018.
- **Fish Advisory Program.** This program includes sampling and collecting fish and shellfish tissue for analysis for constituents that could impact human health through consumption. The Office of Environmental Health Hazard Assessment evaluates the collected tissue, and other data, and develops site-specific fish and shellfish consumption health advisories, which contain recommended safe eating guidelines based on concentrations of chemicals, such as methyl mercury, in the fish and shellfish species found in that specific waterbody.

Many Options to Remediate Environmental Contamination From AMLs

Abandoned mine sites typically undergo water and soil sampling that are evaluated in laboratories in order to make an initial determination of the

physical and chemical characteristics of the mine waste that could affect its potential to cause environmental contamination. Once a site has been characterized and is determined to pose a threat, teams of experts from various fields including engineers, geologists, hydrologists, biologists, and botanists evaluate various options to remediate the site and decide on the preferred remedy. There are often several remedies to choose from. For example, the U.S. EPA's *Reference Guide to Treatment Technologies for Mining-Influenced Water* identifies 30 different treatment technologies to capture and treat various metals and acid mine drainage.

Costs to remediate environmental contamination from AMLs vary considerably and can range from as little as \$100,000 to hundreds of millions of dollars in the case of large, complex cleanup projects. In addition, most remediation projects require ongoing O&M once they are installed to

ensure their ongoing effectiveness. Annual O&M costs for an individual project can range from a few thousand dollars to more than \$1 million, and these costs can persist for years or decades. In the nearby box, we provide examples of two very large remediation projects to illustrate the complexity and costs associated with some of the most challenging AML remediation efforts.

REMEDICATION OF PHYSICAL SAFETY HAZARDS CAUSED BY AMLS

State Program Focused on Remediating Physical Safety Hazards

DOC Program Investigates and Inventories Abandoned Mines. In 1997-98, the Legislature established the Abandoned Mine Lands Program

Examples of Mine Remediation Projects in California

Iron Mountain Mine Remediation Project. The Iron Mountain Mine near Redding, California is a 4,400 acre federal Superfund site. The former gold, iron, silver, copper, zinc, and pyrite mine includes underground tunnels, waste rock dumps, piles of mine tailings, and an open mine pit. Prior to the beginning of cleanup operations by the United States Environmental Protection Agency (U.S. EPA), acid mine drainage from Iron Mountain—among the most acidic and metal-laden on earth—was transported downstream to the Sacramento River, threatening aquatic life and drinking water supplies for the City of Redding. Remediation measures include (1) installation of a full-scale neutralization system to reduce the acidity of the water, (2) capping of areas of the mine to reduce contaminated runoff, and (3) construction of the Slickrock Creek Retention Reservoir to collect contaminated runoff for treatment. According to U.S. EPA, cleanup costs for the site could approach \$1 billion.

Empire Mine State Historic Park Remediation Project. The Empire Mine—now a state park—was a large underground gold mine located in Nevada County near the City of Grass Valley. The site contained a remnant tailings material stockpile, which generated acidic leachate. In addition, the remnant tailings material stockpile had high concentrations of heavy metals and arsenic, exceeding safe drinking water standards, that were being transported by stormwater runoff into a nearby creek. Several steps were taken to remediate this site. First, the area was regraded, and a clay cap was installed to prevent the percolation of water into the tailings material stockpile. Cover material was placed over the clay cap, and the area was revegetated. A parking lot was also built over part of the site. Second, diversion channels were constructed to divert water around the site in order to prevent erosion of the cover materials which could expose the original tailings stockpile. Combined, these remediation measures prevent water from eroding the tailings material stockpile, potentially releasing harmful chemicals from entering surface water. The state spent over \$40 million over a decade for the cleanup of Empire Mine.

(AMLPL) within DOC's Division of Mine Reclamation (DMR) to identify AMLs and inventory the state's abandoned mines. DMR's main responsibility is the oversight of active mining operations and the return of those mined lands to a usable and safe condition. DMR also formed an Abandoned Mine Lands Unit (AMLU), which includes a team of geologists, scientists, and geographic information system professionals to compile a statewide database of abandoned mine sites and mine features and work to identify and remediate the physical safety hazards and environmental threats they pose. The discovery, inventory, and preliminary assessment of AMLs typically follows three steps:

- **Step One—Identify Potential Abandoned Mine Sites.** The AMLU uses maps and other information provided by United States Geological Survey and other mapping services, as well as eye-witness reports, high-resolution aerial photographs, county assessor parcel maps, and other sources, to identify potential abandoned mine sites, many of which might have been inactive for over a century. Federal, state, and local government land management agencies also work to identify abandoned mine sites on the lands they manage and typically report them to AMLP.
- **Step Two—Confirm Location, Inventory Site, and Make a Preliminary Assessment.** Teams from the AMLU and state, federal, and local land management agencies go out into the field to confirm the location of abandoned mine sites and inventory their features. Usually the field team also makes a preliminary assessment to determine whether a site merits additional investigation, or whether a site presents no physical and/or environmental hazards and is acceptable for unrestricted land use. The site may undergo some limited water and/or soil sampling during the preliminary site assessment to determine the site's potential to impact water, soil, and air quality, and whether hazardous wastes are present at the site.
- **Step Three—Notify Environmental Protection Agencies if Warranted.** The AMLU typically is not directly involved in remediating environmental contamination associated with AMLs. Instead, if a site merits additional investigation to determine whether it is a source of environmental contamination, the AMLU or land management agency notifies the appropriate federal and state environmental agencies. These agencies typically take the lead in performing in-depth assessments and inspections to characterize the contamination at a site and determine what further actions are warranted to remediate it.

The most recent estimates from AMLU are that the estimated 47,000 AMLs in California have roughly 100,000 abandoned mine features. About 70,000 mine features have been inventoried, and around 30,000 are pending. The exact number of abandoned mine sites and features remains uncertain for several reasons. For example, recent wildfires in California burned away vegetation exposing previously overgrown abandoned mine sites, leading to the discovery of new mine features.

AMLPL Typically Takes Lead on Remediation of Physical Safety Hazards. Given its extensive technical expertise, the AMLPL often takes the lead on behalf of state and federal land management agencies to coordinate projects to remediate physical safety hazards caused by abandoned mine features. The remediation work is typically performed by contractors under the supervision of AMLPL staff.

Options to Remediate Physical Safety Hazards Depend on Specific Features

Examples of some common remediation options to address physical safety hazards include installing fencing and warning signs to prevent people and animals from falling into pits and shafts and to keep them away from other dangerous features, such as dilapidated structures. Tunnels and mine shafts can be plugged with concrete or polyurethane and then covered with earth to return the land to its natural state. In some cases, tunnels and mine

shafts provide habitat for wildlife, such as bats and desert tortoises. In these situations, metal grates and cupolas can be installed that allow wildlife to have access while preventing people from entering them.

On average, the cost to implement a remedy to a physical safety hazard at an abandoned mine site generally is much smaller than addressing a site with environmental contamination. While they can vary, the costs to remedy sites presenting physical hazards typically range from a few thousand dollars—for example, to fence off a small area—to several hundred thousand dollars to plug and backfill an abandoned mine shaft. Most remedies incur ongoing O&M costs.



Cupola prevents people and animals from falling into an abandoned mine shaft.
Photo courtesy of the California Department of Conservation.

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KEY CHALLENGES TO SYSTEMATICALLY REMEDIATING AMLS

The state has made progress over the past several decades towards remediating AMLs, but much work still remains to be done. One impediment to moving forward is the lack of a centralized, coordinated approach across all of the state and federal agencies involved in AML remediation. Another impediment is how costly it is to remediate environmental impacts and physical safety hazards and the limited funding available for these projects.

Remediation of Many AMLs Still Needed in California

State Has Made Progress Over the Past Few Decades... Beginning with the passage of SMARA, CERCLA, and the other state and federal environmental laws, the state has made progress towards regulating the mining industry and developing programs and resources to address AML issues. Many of the largest and

most toxic abandoned mine sites in the state have been listed on the NPL and are either in the process of being remediated or are eligible for Superfund cleanup subject to the availability of federal funds. AMLP within DOC, as well as state and federal land management agencies, have made significant progress towards inventorying abandoned mine sites throughout the state and performing preliminary assessments to determine whether these sites merit further investigation or are acceptable for alternative uses. State environmental agencies have completed projects to remediate environmental contamination at many abandoned mine sites and identified other sites that warrant additional investigation. As previously discussed, special units and work teams have been formed within state and federal agencies that focus on addressing AML issues. Furthermore, many environmental, land management, and technical agencies have developed tools to prioritize

amongst mine remediation projects when funds become available to implement them.

...But Much Work Remains to Be Done. In spite of all of the progress towards addressing AML issues over the past few decades, much work remains to be done. There are an estimated 30,000 mine features remaining to be inventoried and tens of thousands of mine features that present physical safety hazards and are in need of remediation. It is also estimated that there are a few thousand abandoned mine sites that are in need of initial or further assessment, investigation, and characterization to determine whether they are sources of environmental contamination. An unknown number of these abandoned mine sites will need to be remediated to prevent them from further contaminating the state's water, soil, and air.

Lack of a Centralized, Coordinated Approach Hinders Progress

While there are some informal efforts to communicate regularly across agencies, there currently is no formal centralized approach for completing the inventory, assessment, and characterization of abandoned mine lands and prioritizing them for remediation. These responsibilities are spread across various state and federal agencies and project coordination occurs mainly on an as-needed basis. Land ownership issues also complicate efforts to coordinate projects.

Agencies Prioritize Remediation Projects Differently. Several government agencies have developed their own approaches to prioritize amongst abandoned mine sites when funds become available for remediation projects. Importantly, these different approaches can end up prioritizing projects differently based on the specific mission of the agency. For example, the U.S. EPA prioritizes sites based on the NPL scoring system that takes into account a broad array of toxics and their impacts on the environment. By comparison, the SWRCB has a narrower mission and prioritizes sites based on their impacts on water quality.

DOC's AMLP has developed its own methodology to prioritize abandoned mine features for remediation of physical hazards on a statewide basis. Federal land management agencies, such as

NPS, generally use internally developed criteria to prioritize abandoned mine features for remediation based on the level of danger presented by a feature and the public's access to it, and usage of the mine site where the feature is located. While state and federal agencies typically use similar criteria when evaluating potential physical hazards, they each prioritize projects on their own lands when funding becomes available.

This decentralized approach to prioritizing remediation projects is unlikely to result in the most efficient use of limited state and federal government resources. Instead, state land management and environmental protection agencies often prioritize projects based on their own internal prioritization criteria and core mission. Each agency then uses their own prioritization approach to select projects to implement as funding becomes available for their specific geographic or environmental jurisdiction. This can result in situations where certain projects are completed because of availability of funds but other projects with potentially greater environmental or physical safety risks are left unaddressed.

Notably, some initial steps were taken to develop a prioritization tool that would take into account both physical safety and environmental risks and could be used by all the government agencies involved in the remediation of AMLs to prioritize projects on a statewide basis. However, this project is no longer active. Specifically, DOC, Sierra Nevada Conservancy, and the University of California at Davis partnered on the California Abandoned Mine Prioritization Tool (CAMPT) project to begin development of a methodology that could prioritize and rank abandoned mine sites in California for further study and cleanup taking into consideration the comparative environmental risks and physical safety hazards of individual sites. The project originated from various CAMLAG participants who have experience inventorying, assessing, prioritizing, and remediating AMLs. The CAMPT tool was intended to (1) serve multiple governmental agencies and other entities, (2) rank abandoned mine sites based on specified criteria, and (3) utilize information residing in data systems managed by multiple governmental agencies and other entities. CAMPT would have divided work flow into "tiers" which would have described the

different steps in prioritizing mine sites for further investigation. Such a work flow could have formed the basis for a new statewide system that could be used by multiple federal and state agencies to prioritize funding to address physical safety hazards and environmental contamination at abandoned mines.

Project Coordination Across Agencies Generally Occurs on an As-Needed Basis. Based on our conversations with different entities, state and federal agencies generally collaborate well together on individual projects. Also, coordination on broad AML-related issues often occurs through informal processes, such as voluntary participation in CAMLAG. However, because funding is often directed to specific agencies or projects, there often is not a formal process for identifying opportunities to pool resources across agencies and projects. For example, in some cases it may make sense to conduct multiple remediation projects in a watershed because each AML is contributing to a collective contamination problem. However, if these projects are located on properties with different owners, the relevant land management agencies might take too narrow of a view, only focusing on the environmental contamination that occurs on the lands under their control. In some cases, were better coordination to occur, it might reduce total remediation costs if, for example, projects undertaken near each other could be coordinated under a single contract.

Coordination Complicated by Land Ownership Issues. When abandoned mines are located on land managed by a single government agency or held by a single private owner, access to inventory, assess, characterize, and remediate the site can generally be obtained by seeking permission from a single party. However, land owners are not always aware of the hazards on their lands. This is because mine sites were often clustered in historic mining districts such as the ones located throughout the Sierra Nevada foothills. In some places, AMLs were later subdivided into parcels and sold as sites for homes, businesses, farms, ranches, and other purposes. In many cases, persons who purchased, inherited, or otherwise acquired these parcels may have been unaware that they were formerly mine lands.

In addition, land ownership issues can impede the state's efforts to assess the environmental risk posed by abandoned mine sites on private lands. In some cases, private land owners refuse access to government officials who want to inventory, assess, or remediate these sites. Land owners can have various reasons for refusing government access to their properties, but one factor cited frequently is concern about legal and financial liability if hazards are identified. Under state law, land owners who knowingly have a dangerous abandoned mining shaft, pit, or other abandoned excavation on the property without covering or fencing it in is guilty of a misdemeanor. State law also permits local legislative bodies such as city councils and county boards of supervisors to declare as public nuisances and abate all abandoned excavations located upon private property. Under state and federal law, private landowners are also potentially liable for the cleanup and abatement of wastes discharged from an abandoned mine site on their property. (As described in the box on the next page, federal liability laws also disincentivize "Good Samaritans" from remediating AMLs.) However, many private landowners lack the financial resources needed to address the environmental impacts from abandoned mines. Government agencies often may obtain a court order in order to gain access to a parcel, though this can be a lengthy and contentious process.

Remediation efforts are more complicated when abandoned mine sites span two or more properties owned by different parties. Any efforts by state and/or federal agencies to access the site in order to inventory, assess, characterize, and remediate it are complicated by the need to obtain approval from two or more private property owners. In some cases, where state and federal agencies are trying to determine the effects on a watershed of one or more abandoned mines, the agencies need to obtain access to properties held by many individual private owners. In such cases, the refusal of some of the property owners to cooperate can make it difficult or impossible to measure the cumulative effects on the environment of a cluster of mines on a watershed or landscape.

Liability Under CERCLA and CWA – The Implications for Good Samaritans

With the responsible parties (RPs) for the environmental contamination from some abandoned mines long gone, impacted parties often seek ways to fund remediation projects for abandoned mine sites that will not be listed on the National Priorities List and eligible for Superfund resources. In some cases, organizations and volunteers, often called “Good Samaritans,” who are not responsible for the pollution at the sites and otherwise have no liability, are sometimes interested in undertaking cleanups. State law has been enacted to encourage Good Samaritan projects. Under Chapter 878 of 1995 (SB 1108, Leslie), a remediating agency that implements an approved reclamation plan would not be deemed, based on these remediation activities, to be a RP. However, potential Good Samaritans could still face potential liability under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Clean Water Act (CWA) of 1972, which creates a disincentive for those who might otherwise be willing to undertake mitigation work at abandoned mine.

The United States Environmental Protection Agency (U.S. EPA) initiated the Good Samaritan Initiative in 2007 to reduce barriers under CERCLA for Good Samaritans to perform cleanups. Under the initiative, U.S. EPA has developed administrative tools to allow Good Samaritan cleanups to move forward under existing federal laws. These tools include U.S. EPA-issued “comfort/status letters” intended to help shield parties wishing to undertake cleanups from legal liability. However, even with these assurances, the liability created under CERCLA and CWA still acts as a disincentive that deters would-be Good Samaritans in many cases from undertaking projects.

Some groups have advocated for changes to federal law to grant more protections to potential Good Samaritans. For example, the U.S. EPA has recommended that changes be made to CWA to reduce liability risks for Good Samaritans who want to implement cleanup projects. Good Samaritans may include citizens, government agencies, nongovernmental organizations, and mining companies. Good Samaritan bills have been introduced in Congress but have been unsuccessful. Environmental advocates tend to argue against them because they would relax strict liability standards to which current cleanup activities are held under traditional CERCLA and CWA rules. In addition, some are concerned that if a Good Samaritan law providing regulatory relief also allowed for re-mining of any ore found at a site, it would create the possibility of increasing mining activities and potential contamination risks at that site.

Costly to Remediate Environmental Impacts and Physical Safety Hazards

The costs to remediate the environmental contamination caused by AMLs can be high, with some large, complex projects costing hundreds of millions of dollars. The funding to remediate physical safety hazards and environmental contamination from abandoned mines is spread across the budgets of several state and federal agencies. In addition, projects to remediate environmental contamination at AML sites often

compete for funding against other environmental cleanup projects. For example, federal Superfund monies can be used to remediate abandoned mine sites and many other different kinds of toxic waste sites. As a result of these funding constraints, only projects to remediate the abandoned mine sites that pose the most serious and immediate threats to public health and safety are currently being funded.

Total State Costs to Remediate Environmental Impacts Is Highly Uncertain... For several reasons, there is considerable uncertainty about the total

costs to remediate all of the estimated 5,000 abandoned mine sites in California that are causes of environmental contamination. First, most of the abandoned mine sites in California have not been fully characterized. As a result, there is uncertainty about the extent of contamination at these sites and whether the contamination is likely to worsen over time. Second, most sites have not undergone the remedy design and selection phase. Therefore, there is uncertainty about both the costs of the construction of the remedy and the ongoing O&M costs after a remedy is selected and implemented. Moreover, it is unclear how much of these costs would ultimately need to be borne by the state. For many abandoned mine sites, the state has not completed the research to rule out the existence of RPs and declare the site an orphan. Therefore, RPs could be identified in the future to pay some or all of the remediation costs at some abandoned mine sites. Also, the U.S. EPA might add more of the most contaminated abandoned mine sites to the NPL and, therefore, pay 90 percent of the remediation costs out of the Superfund if no RP can be identified.

...But Could Total Billions of Dollars or More. While we do not have precise estimates of the potential costs to remediate environmental contamination at abandoned mine sites, the limited information available suggests that it could cost billions of dollars to remediate all of the sites. For example, in 2007 DOC prepared for Congress a list of 117 abandoned mines in California that represented priority sites for environmental remediation. The sites were assigned to three tiers based upon incurred and future estimated remediation costs as follows: (1) Tier 1 included 12 mines where costs ranged from \$10 million to \$100 million or more, (2) Tier 2 included 52 mines where costs ranged from \$1 million to \$10 million, and (3) Tier 3 included 53 mines where costs ranged from \$100,000 to \$1 million. Despite representing only a small subset of AML sites and being more than a decade old, these estimates total hundreds of millions of dollars and, therefore, might be considered a conservative estimate of potential costs. Hypothetically, if half of the estimated 5,000 abandoned mine sites that pose a threat to the environment in California were state-only orphans and require the construction of

remedies at an average cost of \$1 million apiece (which is at the low end of the cost range to design, select, and construct a remedy), this would result in state costs of \$2.5 billion. However, this estimate represents the low end of the range. Actual costs would likely be significantly higher, potentially by tens of billions of dollars or more. Furthermore, once the remedies are in place, some would require O&M that will generate costs that could continue for years or decades.

Limited State Funding Available for Environmental Remediation. The main source of funding at DTSC for the remediation of mines (and other types of sites) is the Site Remediation Account (SRA), which is funded primarily by a shift of funds from the Toxic Substances Control Account (funded by charges, fines, and penalties on organizations that use, generate, store, or conduct activities related to hazardous materials). The 2020-21 budget includes \$13 million for the SRA, which can be used to pay the state share of costs at NPL sites, including O&M. (The budget does not include any funding to pay for the cleanup of state orphan sites in 2020-21.) Notably, abandoned mine sites are not the only type of site eligible for these funds, which also support other types of state orphan sites associated with a wide range of operations, such as industrial manufacturing, dry cleaning, metal plating, wood treating, and pesticide manufacturing and storage. Historically, these funds have been insufficient to address all known federal and state orphan sites. For that reason, DTSC prioritizes funding the state share of costs associated with federal NPL sites with remaining funds prioritized to the worst state orphan sites. In addition, the budget sometimes provides additional funding for specific priority AML projects. For example, the 2016-17 budget plan included \$14.3 million from the General Fund to retrofit the Argonaut Mine Tailings Dam, located on private property in the City of Jackson, in response to assessments by the U.S. EPA and the U.S. Army Corps of Engineers that the dam was structurally unstable and had a significant chance of complete failure. (Importantly, federal funding for Superfund cleanups has declined somewhat in recent years and totals about \$1 billion annually for all projects nationwide.)

SWRCB can use funds from the Cleanup and Abatement Account (CAA)—which receives revenues from a variety of sources, such as loans and penalties—to assist in cleaning up the effects of AMLs on water quality. However, these funds are available for a wide variety of projects to address water quality issues. In some cases, a court settlement or judgement determines how CAA funds are to be spent. SWRCB has discretion over the use of about \$4 million to \$6 million in CAA funds per year. Current funding levels constrain the state’s ability to initiate projects to remediate environmental contamination at abandoned mine sites. (The federal government also provides grants for a range of activities to address nonpoint source water pollution, but according to the U.S. EPA, only a small amount of this grant funding has gone to AML projects around the nation.)

Limited State Funding for Remediation of Physical Safety Hazards. DOC administers the Abandoned Mine Reclamation and Mineral Fund, which receives \$5 per ounce of gold and \$0.10 per ounce of silver mined within the state. In recent years, these charges have raised about \$800,000 per year, which is used to fund the remediation of mines mostly for physical hazards. AMLP has partnered with state and federal land management agencies and other entities—who typically contribute funds or in-kind services—to remediate more hazards than it could with just the state’s resources. Since it was created about 20 years ago, AMLP has been able to remediate about 1,400 of the tens of thousands of abandoned mine features in California that have the potential to present a physical safety hazard.

Total Costs to Remediate Remaining Physical Safety Hazards Unknown. There is uncertainty

about the total costs the state would incur to remediate all of the tens of thousands of features at abandoned mine sites in California that are physical safety hazards. While AMLP has made significant progress inventorying abandoned mine features, it has not completed its statewide inventory. In addition, as discussed earlier in this report, costs to remediate a feature can vary widely depending on the remedy chosen. Lastly, it is unclear the extent to which some costs might be covered by the federal government—for example, if they are located on federal lands or as part of remedies that are put in place to address environmental contamination.

Current Funding Levels Leave Tens of Thousands of Potential Physical Safety Hazards Unaddressed. While the roughly \$800,000 available annually to remediate physical safety hazards caused by features at abandoned mines ensures that the state makes some progress every year, it likely will take many decades or more to remediate the bulk of the mine features in the state that pose a threat to physical safety. Given the number of sites, the cost to remediate even just the most hazardous sites could total tens of millions of dollars or more. We note that in the past the state has received one-time federal funding to address safety hazards. For example, under the federal American Recovery and Reinvestment Act of 2009, one-time funding was provided to implement capital improvement and maintenance program projects on federal lands nationwide including the remediation of abandoned mines. This included (1) \$22.7 million on National Forest land, (2) \$13 million on NPS land, and (3) \$30 million on the Bureau of Land Management (BLM) land.

RECOMMENDATIONS TO INCREASE THE PACE OF AML REMEDIATION

In order to address the challenges discussed above, we recommend the Legislature take steps to ensure the state takes a systematic approach to prioritizing and remediating AMLs. In all likelihood, the state will be dealing with

the environmental impacts from AMLs for many decades. However, there are several measures the Legislature could enact that would allow the state to build off of the work that has already been done, and move towards a more efficient, effective

approach to addressing AML issues. Specifically, we recommend the designation of a lead agency to coordinate the state's remediation efforts, development of a strategic plan, and establishment of a flexible fund that can be used for high-priority projects. Importantly, while we think these changes can help the state utilize limited resources in a more targeted fashion, the state is unlikely to be able to make substantial progress in addressing the level of environmental and physical safety risks without additional resources. However, we recognize that the state's fiscal condition at the time this report was released makes it difficult to dedicate additional resources to these problems.

Designate Lead Agency to Coordinate Abandoned Mine Remediation Efforts

We recommend the Legislature adopt legislation to designate a lead agency to assume responsibility for the coordination of the remediation of AMLs on a statewide basis. Specifically, the lead agency would be responsible for prioritizing remediation projects on a statewide basis and coordinating with federal land management agencies. We believe that the improved coordination that could result from having a lead agency would facilitate longer-term planning and better ensure efficient use of limited state and federal resources for remediation of AMLs.

There are multiple state entities that would be reasonable candidates for this lead agency role. For example, both the California Environmental Protection Agency (CalEPA) and the California Natural Resources Agency (CNRA) are potential choices to be the designated lead agency. Both agencies oversee and coordinate the activities of departments and boards that play key roles in the remediation of AMLs. On the one hand, CalEPA oversees DTSC and SWRCB, both of which work closely with the U.S. EPA on AML environmental contamination issues. On the other hand, CNRA oversees state land management agencies as well as DOC's AMLP, which inventories AMLs, facilitates CAMLAG, and manages the remediation of physical safety hazards at abandoned mine sites. Regardless of which entity was designated the lead agency, it would likely require one or two additional staff to help coordinate projects across agencies and develop a strategic plan (discussed below).

Require Lead Agency to Develop a Statewide Strategic Plan

Strategic Plan Would Outline State's Remediation Priorities. We recommend the Legislature enact legislation requiring the designated lead agency to develop a statewide strategic plan to address physical safety hazards and environmental contamination from AMLs. The strategic plan should be developed in collaboration with federal agencies and other key entities (such as local government agencies in regions with high concentrations of AMLs) that have a major role in AMLs remediation. It would likely take one to two years to develop the initial strategic plan. Thereafter, the strategic plan should be updated at least once every five years, establish specific goals and measurable objectives, and prioritize remediation projects. The prioritization should be based upon clear, publicly available criteria developed with input from state and federal agencies, experts in the field, stakeholders, and advocates. This would facilitate collaboration with federal agencies that also work on AML remediation projects because it would send them a clear signal about the state's top priorities for remediation projects. At minimum, the strategic plan should include the following.

- ***Baseline Summary of Known AMLs.*** The strategic plan should establish a baseline of AMLs that have been inventoried, assessed, and characterized. Sites should be categorized by federal, state, private, or other land ownership categories. The strategic plan should also denote whether the land owner has been identified and has granted permission to access the AML site.
- ***Summary of Mine Features That Pose a Physical Safety Hazard.*** The strategic plan should include a summary of inventoried mine features ranked to identify high-, medium-, and low-priority sites for remediation. For high-priority sites, the summary should include the mine name, ownership, administrative agency, and estimated cost of remediation. The plan should also include a list of projects to address physical safety hazards pending

or underway, broken out by administering agency.

- **Summary of Known AMLs Posing an Environmental Threat.** For sites that are pending remediation, the summary should prioritize them based on the threat they pose to the environment and public health and categorize them into three tiers based on the estimated capital cost of cleanup. These tiers could be similar to those used by DOC to categorize abandoned mine sites for Congress in 2007: (1) Tier One costs more than \$10 million, (2) Tier Two costs range between \$1 million to \$10 million, and (3) Tier Three costs range between \$100,000 and \$1 million.
- **Summary of Pending AML Remediation Projects.** The strategic plan should provide a description of ongoing AML remediation projects and projects planned to be initiated over a five-year planning period. The summary of planned projects should include information on the state and federal agencies that will undertake the projects, funding sources, estimated completion dates, and projected O&M costs.
- **Summary of AMLs Undergoing Environmental Remediation.** The strategic plan should include a summary of abandoned mines known to pose a threat to the environment and public health. This summary should include a list of mines that have been remediated, are under remediation, and are pending remediation. For sites that have been remediated or are under remediation, the summary should provide information about the mine name, location, ownership, administrative agency(ies), type of environmental contamination, capital costs, O&M costs, and sources of funding for the project.

Initial Prioritization Strategy Should Take Into Account Several Key Factors. In addition to the risk factors posed by AMLs, the strategic plan should take into account several factors that complicate planning for and implementation of remediation projects. For example, the strategic plan should take into account (1) long-term

liability concerns created by CERCLA and CWA, (2) time and resources needed to identify RPs and determine whether a site qualifies for orphan status, and (3) property boundaries that may necessitate cooperation between private land owners and government land management agencies. Other key parties such as tribes, mining interests, environmental advocates, local organizations, and other regional stakeholders should be consulted and included in the strategic plan development process. Initially, the state might want the strategic plan to prioritize remediation projects on state-owned lands or where responsible parties can be easily identified in order to expedite remediation efforts. For example, from 1997 to 2008, AMLU inventoried 341 abandoned mines on state lands containing over 5,000 mine features. (In 2008, preliminary site assessments were completed on 15 of these sites, which determined that further evaluation was warranted for ten sites.) Once these projects are under way, the state could initiate planning for larger more complex projects, such as remediation of clusters of abandoned mine sites located on properties with multiple owners.

A Strategic Plan Would Encourage a Systematic Approach and Promote Interagency Coordination. A strategic plan would identify the abandoned mine lands that present the greatest physical safety hazards and are the sources of the worst environmental contamination from a statewide perspective. There are several advantages to this approach compared to the current decentralized approach. Specifically, it would:

- **Facilitate a More Systematic Statewide Approach to Project Selection.** Development of a strategic plan would encourage the sharing and synthesis of information about AMLs that is currently spread across the data systems of several government agencies. A strategic plan would utilize this information to prioritize projects using a standard set of criteria that would be applied to abandoned mine lands across the state.
- **Help Ensure Limited Resources Are Targeted to Most Critical Projects.** The prioritization of AMLs that present the

greatest threats would help decision makers to target limited resources to the projects that are likely to have the greatest impact on improving safety and reducing environmental contamination.

- **Facilitate Long-Term Planning.** A strategic plan that prioritizes AML remediation projects on a statewide basis would assist the Legislature, as well as state and federal agencies, in identifying what efforts and resources would be needed over the longer term—including the next several years and even decades—to reach its desired remediation goals.
- **Facilitate Interagency Cooperation.** A strategic plan that communicates the state's top priorities for remediation would better ensure that all relevant entities—including state, local, and federal agencies—would have a clearer sense of where the state is most likely to undertake remediation projects. For example, this could reduce confusion by federal agencies that currently must track the efforts of multiple state agencies. For example, one federal administrator we spoke with indicated that his agency manages lands in basins regulated by several different RWQCBs. Each RWQCB has priority sites within the basins it administers, but it was unclear from a federal perspective how these sites would be prioritized across the state.
- **Provide Up-to-Date Source of Data to Inform Funding Decisions.** A strategic plan that is regularly updated—at least every five years to take into account recently completed site assessments, investigations, and characterizations—would provide decision makers with key information to inform decisions about funding remediation projects.

Establish State Fund to Support AML Remediation

New Fund Would Support Activities by Multiple State Departments. We recommend the Legislature enact legislation to establish a special fund within CalEPA or CNRA—depending on which is designated as the lead agency—to

provide a dedicated ongoing funding source for the remediation of environmental contamination and physical safety hazards at AMLs in California. Monies deposited in the fund could be used by state environmental protection agencies (such as DTSC and SWRCB), state land management agencies (such as DPR, DFW, and SLC), and DOC to fund remediation projects and AML-related work. Because remediation projects often require the collaboration of two or more state and federal agencies, we believe it makes sense to establish a flexible funding mechanism that allows for the distribution of funds to the agencies involved in specific projects. Allowable uses of the fund would include the full range of inventorying, assessing, remediation, and ongoing O&M activities at AML sites.

Individual projects would be funded through the annual budget act. As part of the Governor's budget plan, the designated lead agency would propose to fund AML remediation projects based on priorities identified in the strategic plan. The Legislature would review the Governor's proposal and appropriate monies from the special fund as part of the annual budget process. (This is similar to how DTSC's SRA operates to fund NPL and state orphan site cleanups.) The special fund that we envision would primarily be intended to hold funds that could be used flexibly for different types of projects administered by different state agencies. Some existing funding streams—such as DOC's Abandoned Mine Reclamation and Mineral Fund—are designated for specific purposes and may not be appropriate for the new fund.

A state fund designated for AML remediation work would have several benefits. Currently, funding sources for AML work are dispersed among several departments and are also available for other types of non-AML work. A designated fund would provide easier accounting of how much total funding is available for AML-related activities. It could also help to leverage federal funds. When regional administrators for federal agencies such as BLM and the United States Forest Service allocate funding for remediation projects, they take into account whether other sources of funding, such as state funds, are available to match the federal funds. In order to increase the state's chances

of having federal funds allocated to projects in California, we recommend the authorizing legislation specify that the fund be eligible for providing matches for federal funds.

Fund Could Be Supported by Various Revenue Sources. The new fund we recommend could be supported by both existing revenue sources, as well as future state bonds, federal allocations, and General Fund transfers for AML-related work. For example, future state bonds could be a funding source for one-time AML-related construction projects to address environmental or physical safety hazards, which sometimes cost tens of millions of dollars or more. In addition, the fund could hold federal funds, such as when the American Recovery and Reinvestment Act (ARRA) of 2009 included funding for mine remediation projects in order to promote economic recovery and growth.

While the fund could be supported by different revenue sources, given the number of sites requiring remediation in California and the associated costs, the state will not make substantial progress addressing AMLs with the

worst environmental and safety hazards without significant additional resources. We recognize that it will be very difficult for the state to identify additional resources for mine remediation in the near term—particularly ongoing funding needed for O&M costs—given the state’s fiscal condition at the time this report was released.

In addition, if the Legislature were to impose new charges to support AML remediation activities, the resulting revenue could be deposited into the new fund. For example, one such option would be to impose an additional charge on the mining industry. As noted earlier in this report, there is already a per ounce charge for gold and silver production in California with the proceeds used to fund the Abandoned Mine Reclamation and Mineral Fund. Similarly, the federal government charges the coal industry a reclamation fee on each ton of coal that is produced, and proceeds from the fee are deposited into the federal Abandoned Mine Land Reclamation Fund where they are mainly used to pay for coal mine reclamation projects. Similarly, California could implement a charge on active mining operations in the state and use the

State Has Established Charges on Certain Industries to Fund Cleanup Activities

Here we provide descriptions of two charges established by the state to pay for the cleanup of contamination caused by lead-acid batteries and underground storage tanks (USTs).

Lead-Acid Battery Cleanup Fund (LABCF). Chapter 666 of 2016 (AB 2153, C. Garcia) created new charges on lead-acid battery manufacturers and purchasers with the resulting revenue deposited into the LABCF. Monies in the fund can be expended for investigation, site evaluation, cleanup, remedial action, removal, monitoring, or other response actions at any area of the state that is reasonably suspected to have been contaminated by the operation of a lead-acid battery recycling facility, amongst other purposes. The Department of Toxic Substances Control (DTSC) administers the LABCF and is implementing a Lead-Acid Battery Recycling Facility Investigation and Cleanup Program to identify, characterize, and clean up lead contamination that DTSC believes resulted from the operation of lead-acid battery recycling facilities.

Underground Storage Tank Cleanup Fund (USTCF). The primary source of revenue for this fund is a per gallon mill fee on the owners of underground petroleum storage tanks. The primary purpose of the fund is to provide financial assistance to the owners and operators of USTs containing petroleum in order to remediate environmental harms caused by leaking USTs, as well as fund other related purposes. Money from USTCF, which is administered by the State Water Resources Control Board, can also be used for local oversight, cleanup of emergency and abandoned UST sites, and program administration.

proceeds to fund the remediation of abandoned mine sites, including ongoing O&M costs. Precedents for this type of charge in California are the Lead-Acid Battery Cleanup Fund and the Underground Storage Tank Cleanup Fund, both of which impose charges on specific industries to fund the cleanup of environmental contamination

related to industry practices. (For more information on these funds, see the nearby text box.) We note, however, due to the many different types of minerals mined in California and their wide variation in value, it would be complex to develop a charge structure.

CONCLUSION

Over the past few decades, the state has made progress towards addressing the environmental contamination and physical safety hazards caused by AMLs. However, the bulk of the work to remediate the state's abandoned mine sites still remains to be completed. Many factors complicate the state's AML remediation efforts, including (1) the high level of collaboration that is often necessary between various state and federal agencies; (2) land ownership issues (particularly when a mine site straddles property lines); and (3) the high costs for site assessment, remediation, and ongoing O&M.

In our view, the Legislature should build upon work that has already been done and also ensure continued progress by taking three key steps. Specifically, we recommend that the Legislature enact legislation to (1) designate a lead agency to coordinate AML remediation issues across state and federal government agencies, (2) require the

lead agency to develop a strategic plan to prioritize the state's efforts, and (3) create a special fund that would provide an ongoing source of funding for projects to address AML issues.

We recognize that providing additional funding for AML remediation is challenging given the state's fiscal condition at the time this report was completed. Yet, some policymakers have suggested that the state and federal government implement one-time spending packages that could provide economic stimulus. If a bond package was considered at the state level, for example, we would suggest that the Legislature consider designating some funds to pay for the construction costs of AML remediation, similar to what was included in ARRA. Doing so could help address a significant environmental and safety problem in the state, and construction projects to remediate AMLs can be implemented in communities throughout the state, particularly in rural areas.

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This report was prepared by Shawn Martin, and reviewed by Brian Brown and Anthony Simbol. The Legislative Analyst's Office (LAO) is a nonpartisan office that provides fiscal and policy information and advice to the Legislature.

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