Appendix D

Draft Remediation Plan

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Draft

Remediation Work Plan for Reed Mine and Upper Davis Creek

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Acronyms and Abbreviations

ACM	asbestos containing material
AMSL	Above Mean Seal Level
ASTM	American Society for Testing and Materials
Basin Plan	Central Valley Regional Water Quality Control Board's Water Quality Control Plan for the Sacramento and San Joaquin River Basins
BLM	Bureau of Land Management
BMP	Best Management Practice
Burleson	Burleson Consulting Inc.
CAO	Cleanup and Abatement Order
CCR	California Code of Regulations
CEQA	California Environmental Quality Act
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
cm	centimeter
CQA	Construction Quality Assurance
CQC	Construction Quality Control
CWA	Clean Water Act
DAS	Dispersed Alkalinity Source
DCR	Davis Creek Reservoir
DI WET	De-Ionized Waste Extraction Test
DTSC	Department of Toxic Substances Control
DWR	Department of Water Resources
EPA	U.S. Environmental Protection Agency
ERA	Ecological Research Associates
g	gram
GIS	geographic information system
HASP	Health and Safety Plan
Homestake	Homestake Mining Company of California
kg	kilogram
lb	pounds
µg/L	microgram per liter
MCL	maximum contaminant level
mg/L	milligrams per liter
mg/kg	milligram per kilogram
ml	milliliter
NPL	National Priorities List
OLRA	Old Lower Reed Adit
OSHA	Occupational Safety and Health Administration
ppm	parts per million
QA	quality assurance
QA/QC	quality assurance /quality control
QAPP	quality assurance project plan
QC	quality control
RCRA	Resource Conservation and Recovery Act

RL	reporting limit
RoG	rock land
RSL	Regional Screening Levels
RWQCB	Regional Water Quality Control Board Central Valley Region
SDWA	Safe Drinking Water Act
SI	site investigation
Site	Reed Mercury Mine
SWPPP	Storm Water Pollution Prevention Plan
SWRCB	State Water Resources Control Board
TTLC	Total Threshold Limit Concentration
UC Davis	University of California at Davis
US	United States
USACE	Unite States Army Corps of Engineers
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service

1.0 Introduction

Homestake Mining Company of California (Homestake) has requested that Burleson Consulting Inc. (Burleson) prepare this Remediation Work Plan to describe activities intended to prevent further erosion and impact to surface waters at the former Reed Mercury Mine Site (Site) and Upper Davis Creek. Upper Davis Creek is that portion of Davis Creek upstream from the Davis Creek Reservoir (DCR). The Reed Mine comprises mine workings associated with the Andalusia, Fusiyama, and Reed mines located along the southwest bank of Upper Davis Creek in Yolo County, California (Figures 1 and 2).

This project was entered into voluntarily by Homestake to address water quality concerns associated with the Reed Mine expressed by the California Regional Water Quality Control Board—Central Valley Region (RWQCB 2014). In response to the RWQCB letter of August 25, 2014, Homestake prepared work plans and characterized the Reed Mine to determine if the Site continued to contribute mercury and/or other constituents to Upper Davis Creek, a tributary to DCR.

Site characterization was conducted in accordance with the *Final Site Characterization Work Plan for Reed Mine and Upper Davis Creek*, prepared in 2015 (Burleson, 2015a), and approved by the RWQCB (2015a). Table 1 summarizes the results of Reed Mine Site characterization. In the July 24, 2017 Final Site Characterization Report for Reed Mine and Upper Davis Creek, Homestake recommended preliminary remedial activities at six locations (Burleson, 2017). Homestake requested and the RWQCB prepared a Cleanup and Abatement Order (CAO) directing activities at the Reed Mine (Order No. R5-2017-0710). In accordance with the CAO, Homestake submitted the Reed Mine Alternatives Analysis to RWQCB on April 30, 2018.

The Alternatives Analysis recommended the following waste removal activities at six locations:

- **Remediation Area 1:** Fusiyama Adit Waste Rock
- **Remediation Area 2:** Reed North Waste Rock
- **Remediation Area 3:** Waste Rock and Drainage at the Old Lower Reed Adit (OLRA)
- **Remediation Area 4:** East Bank Upper Davis Creek Waste Rock
- **Remediation Area 5:** West Bank Furnace Area
- **Remediation Area 6:** Former Reed Mine Processing Area

The goal of these project activities is to mitigate adverse impacts resulting from mining wastes in the Upper Davis Creek drainage and reduce the threat of further erosion of such material with the potential to impact surface waters and the environment. The project intends to meet these goals by removing mine wastes (waste rock and tailings) that are in contact with surface water along Upper Davis Creek and tributaries. Additionally, the project is intended to protect human health and the environment by removing process residuals on the Site that contain elevated levels of mercury.

The project consists of removing mine waste (waste rock, ore, and tailings) from five locations, stabilizing waste rock in a gully in waste rock at one location, implementing erosion controls including revegetation of disturbed areas, and monitoring. Table 2 summarizes mine waste and anticipated remediation activity by location. Project components are described below.

Remediation Area 1: Excavate waste rock, place excavated materials in an on-site repository proposed to be located at the Andalusia Pit (Figure 2), and implement erosion controls at the disturbed area. The goal is to remove waste rock to the extent necessary to prevent direct contact between waste rock and surface water in the adjacent stream. If not feasible to remove all waste rock from the area, then stabilize any remaining waste rock in place to minimize continued sheet wash and gully erosion. Protect exposed toe of slope at stream from erosion.

Remediation Area 2: Stabilize and revegetate the existing erosional feature (e.g., gully) in waste rock. The goal is to minimize future erosion of waste rock by emplacing erosion controls and establishing vegetation to reduce erosion.

Remediation Area 3: Excavate waste rock, place excavated material in an on-site repository proposed to be located at the Andalusia Pit (Figure 2) and implement erosion controls at the disturbed area. The goals are to remove waste rock from the bank of the tributary to Davis Creek, remove waste rock extending across the County Road, and stabilize the excavated bank to promote vegetation and prevent erosion. Mine drainage would be directed to infiltrate into the Site soil after semi-passive treatment in a vertical flow system.

Remediation Area 4: Excavate waste rock, place excavated material in an on-site repository proposed to be located at the Andalusia Pit (Figure 2), implement erosion controls, and restore Upper Davis Creek at the disturbed area. The goals are to prevent direct contact of waste rock with Davis Creek, remove waste rock from the margins of Davis Creek, and to stabilize the excavated margins of Upper Davis Creek. In order to minimize environmental degradation associated with creek bank disturbance the project would avoid excavation in the creek channel any lower than the bankfull level.

Remediation Area 5: Excavate mine materials and dispose of off-site. Implement erosion controls and restore the disturbed area at Upper Davis Creek and properly dispose of them at a permitted off-site facility. The goals are to remove calcine tailings and furnace debris from the bank of Davis Creek, and to stabilize the excavated bank of Davis Creek. In order to minimize environmental degradation associated with creek bank disturbance the project would avoid excavation in the creek channel any lower than the bankfull level.

Remediation Area 6: Excavate ore, place excavated ore in an on-site repository proposed to be located at the Andalusia Pit (Figure 2) and implement erosion controls at the disturbed area. Collect processing residuals and dispose of off-site. Demolish and remove former processing equipment. The goals are to remove the process residuals from the Site and properly dispose of them at a permitted off-site facility, to demolish the remaining process equipment, recycle the iron, and stabilize disturbed areas to minimize erosion.

This Remediation Work Plan is organized in the following order: introduction; a description of the remediation activities, environmental conditions, and Site restoration measures at each area; construction quality assurance (CQA) protocols; and monitoring and maintenance to be completed following remediation. The contents of Sections 2.0 through 5.0 are briefly described below.

- Section 2.0 describes the remediation areas and remediation activities anticipated within each area. General safety requirements are identified including Site controls,

communications, and access preparation. Environmental conditions and Site restoration measures are described, and remediation designs are included.

- Section 3.0 describes CQA procedures including how the limits of remediation activity will be documented, and how the remediation activities will be documented in as-built diagrams.
- Section 4.0 presents the monitoring and maintenance needed to ensure the ongoing effectiveness of the remediation activities.
- Section 5.0 presents a list of references cited in this Remediation Work Plan.

Figures and tables are presented after the report text.

1.1 Site Location and Background

This section presents background information on Reed Mine pertinent to this Remediation Work Plan. Information includes a description of the mine location and topography, mine history and features, climate, geology and soils, hydrology and hydrogeology, vegetation and wildlife, significant historical and archaeological features, and land use and population.

1.1.1 Location and Topography

The Reed Mine (aka Reid Mine in older reports) is an inactive mercury mine located along the canyon of Upper Davis Creek in Yolo County, California about 13.4 miles southeast of Lower Lake in Lake County, California (Figure 1). The Reed Mine Site consists of approximately 370 acres in a rural area along the upper tributary of Davis Creek, located within private property surrounded by Bureau of Land Management (BLM) property. DCR is located 0.5 mile downstream of the Reed Mine features and covers approximately 267.5 acres (Figure 1).

The Reed Mine is situated in Sections 23, 24, 25, and 26; Township 12N, Range 5W, Mount Diablo Baseline and Meridian at an elevation of about 1600 feet above mean sea level (amsl), along Yolo County Road 40 (aka Rayhouse Road and Rieff Road).

The Site consists of the Andalusia Mine, Fusiyama Mine, and Reed Mine, associated underground workings (including 13 adits), historical waste rock and tailings piles, and the former Reed Mine processing area (Figure 2). Features associated with the Reed Mine extend about 1.3 miles along the Upper Davis Creek Canyon from the vicinity of the Andalusia Pit to the former Reed Mine processing area upstream from the DCR.

The Site is reached by following Morgan Valley Road about 12.4 miles east-southeast of the intersection with California State Highway 53 in Lower Lake, Lake County, California, and turning left (northeast) onto Rayhouse/Reiff Road, then following Rayhouse/Reiff Road about 3.2 miles easterly to the Andalusia Pit, the northern most workings of the Reed Mine

1.1.2 History and Features

Mercury mining began at the Reed Mine in 1871 (Warne et al., 1958). The Reed Mine was operated between 1873 and 1880 under ownership of A.H. Breed and ceased operations in 1880 due to the low price of mercury (Bechtel, 1993). All of the workings (the associated Andalusia, Fusiyama, and California mines) were consolidated as the Reed Mine by the Bradley Mining Company, which purchased the Reed Mercury Mine in 1939 (Bechtel, 1993). About 995 flasks of mercury were produced by 1873, production totaled about 9,648 flasks by 1880, and about 21,177 flasks by the end of 1945 (O'Brien, 1950).

Cordero Mining Company dewatered the mine during 1956 and conducted exploration activities. Universal Silver Company leased the property and produced about 1,400 flasks of mercury in 1961. Reed Mercury Mine has not operated since 1961 (Bechtel, 1993).

Homestake purchased the Reed Mine property in 1982, and purchased mineral rights for the Reed Mercury Mine from Bradley Mining Company in 1988.

Description of Reed Mining Operations
Underground and open pit methods were used to develop the ore bodies at the Reed Mine. The pre-1940s workings focused on development of the volume of rock between the outcrops along the southwest canyon wall of Upper Davis Creek and the Davis Creek Level. Development during the 1940s reportedly extended below the creek level (Averitt, 1945).

Not much is known regarding operations during the 1800s, other than that underground workings were advanced to access ore, and that the mercury was extracted from cinnabar and metacinnabar ore in furnaces located on the west bank of Upper Davis Creek. Mercury vapor from the furnaces was transferred to a condensing unit where it would cool and liquefy into pools.

During 1914 to 1915, brick and mortar from older furnaces were burned in a D-retort to extract mercury (Bradley, 1918; Ransome and Kellogg, 1939). During the 1930s and 1940s, coarse ore was hauled uphill from the lower mine workings on an inclined cable train to the former Reed Mine processing area on the northeast side of Upper Davis Creek, and dumped into a coarse ore bin. After crushing, the ore was batch-fed into the furnace. In 1942, a Gould rotary furnace was installed and ore was fed continuously. Mercury vapor was cooled and condensed in a trough beneath condenser coils. During processing, ash containing elemental mercury and metals was periodically removed from the furnaces and disposed on site at the foot of the furnaces. Tailings, called calcines, left over after mercury was extracted, were disposed on the northeast bank of Upper Davis Creek (Bechtel, 1993).

1.1.3 Climate

The Davis Creek area in Yolo and Lake counties generally is characterized as a Mediterranean climate with arid, warm summers; relatively wet winters; and moderate temperatures (38 to 93.4 °F). However, the area can be subject to freezing temperatures during winter months (Western Regional Climate Center, 2012). Precipitation in the area generally occurs as rainfall, but the northern high elevation areas typically receive some snowfall annually. Due to the region's dynamic topography, noticeable variations in precipitation totals and temperature averages can be experienced over relatively small distances. In upper reaches of the Cache Creek watershed, precipitation averages exceed 52 inches annually in the highest elevations. However, near the headwaters of Davis Creek, precipitation averages approximately 33 inches annually (PRISM, 2012).

1.1.4 Geology and Soils

Figure 1 includes the geologic map of Reed Mine and surrounding area. Reed Mine is located along a steep northwest trending regional thrust fault contact between serpentinite and sandstone (US Bureau of Mines, 1965; Warne et al., 1958). The Knoxville formation, which is part of the Great Valley Group, comprises siltstone, mudstone, sandstone and conglomerate, of which siltstone and mudstone are prevalent in the Upper Davis Creek area (Holloway et al., 2009). According to Averitt and Eberlein (1943) the fault dips 80° to 90° to the southwest. Mercury occurs as cinnabar and metacinnabar within bodies of silica carbonate rock within

serpentinite and in fault-bound blocks. Silica carbonate rock extends about one mile along the fault and is up to about 300 feet thick.

Serpentinite at Upper Davis Creek is considered to be part of the Coast Range Ophiolite, which lies structurally and depositionally below the Great Valley Group (Knoxville formation at Reed Mine) along the Stony Creek Fault. The Coast Range Ophiolite is considered to be depositionally overlain by the Great Valley Group, a late Jurassic-Cretaceous forearc submarine fan sequence of interbedded sandstone and shale. Hydrothermal alteration of the serpentinite resulted in the formation of silica carbonate rock and deposition of mercury minerals. Hydrothermal fluids appear to have been localized along permeable zones such as the Stony Creek Fault.

The Upper Davis Creek subwatershed is characterized by relatively steep slopes. The soil surrounding Reed Mine and Upper Davis Creek consists largely of rock land (RoG) that is well drained, but does not have any water capacity (Figure 3). The area also contains Millsholm rocky loam (15 to 75 percent slopes, eroded) and Climara clay (2 to 30 percent slopes, eroded) and to a lesser extent Dibble clay loam (30 to 50 percent slopes, eroded) and Henneke gravelly loam (30 to 75 percent slopes) (USDA, 2012).

Background soil samples collected from soils developed on the three principal rock types (serpentinite, silica carbonate rock, and Knoxville Formation) at Reed Mine yielded total mercury concentrations similar to those detected in the waste rock; and total nickel concentrations similar to and higher than those detected in mine waste (Burleson 2017 Table 2). These observations show that soil at the Reed Mine contains naturally elevated mercury and nickel concentrations.

1.1.5 Hydrology and Hydrogeology

Davis Creek is a tributary to Cache Creek, and originates near the Lake County and Yolo County border about 3.25 miles upstream from the Reed Mine. Davis Creek hydrology was modified following construction of a dam on the southern reach in 1984 that led to the formation of DCR which served as a water source for the McLaughlin Mine during operations. The creek continues southeast before turning north at DCR and continuing for approximately five miles to the confluence of Davis Creek with Cache Creek (Curtis, 1993) (Figure 1). Neither Davis Creek nor the DCR has been used as a potable drinking water source for over a decade.

The Reed Mine is located on northeast-facing steep slopes on the southwest canyon wall along Upper Davis Creek, upstream from DCR. Mine features are located within the watersheds of intermittent tributaries to Upper Davis Creek (Figure 2). These tributaries typically flow only for brief periods during and shortly after rainfall events.

The upper reach of Davis Creek averages a flow of 8 cubic feet per second (cfs) annually (Curtis, 1993). Quarterly flow monitoring from the unusually dry 2001/2002 season recorded 0 to 5 cfs in the upper reach of Davis Creek (above DCR). Flow in Upper Davis Creek during December 2014 at the Lower Reed Mine adit was measured at about 1 cfs. Upper Davis Creek is typically dry upstream from the vicinity of the Lower Reed Adit from June through November, and flows only for short periods after the rainy season.

The Reed Mine is not located within a groundwater basin (DWR, 2003). The Capay Subbasin of the Sacramento Valley Groundwater Basin occurs about 7.5 miles east of the Reed Mine, and is separated from the Reed Mine by several very steep bedrock ridges. Groundwater in the Capay Valley subbasin occurs mostly in Pliocene to Holocene continental sedimentary deposits. Older and deeper Cretaceous deposits underlying the Pliocene water bearing formation have

been found to contain saline water (DWR, 2003). The Reed Mine is located on serpentinite and sandstone bedrock (Jurassic/Cretaceous Knoxville Formation). Local groundwater within these geologic units was encountered during mining. Only three of the existing mine openings are known to yield drainage (the successfully plugged Lower Reed Adit, the Old Lower Reed Adit, and the Upper Reed Adit No. 2). Homestake has shown that groundwater at the McLaughlin Mine Pits, located about 1.4 miles southeast of the Reed Mine in the same geologic setting is present at minor amounts and is of low quality (Order R5-2012-0010 Waste Discharge Requirements for Closure and Post Closure Maintenance of McLaughlin Mine, Lake, Napa, and Yolo Counties). Groundwater at the Reed Mine is considered herein to be of limited extent and quantity, and of low quality due to location of the Reed Mine in geologic units similar to the nearby McLaughlin Mine pits, lack of significant drainage flows at most mine openings, and poor water quality in a spring that discharges near the Lower Reed Mine. Groundwater at the Reed Mine is not connected with aquifers used for drinking water or agriculture.

1.1.6 Vegetation and Wildlife

The primary vegetation types at the Site are chaparral and oak woodland. Surveys of the wildlife, insects, aquatic biota, and fish at DCR and Davis Creek were conducted from 1986 through 2002 by Ecological Research Associates (ERA). The composition of bird populations observed remained substantially the same in species and numbers throughout most years. The results were documented in the 2002 report, *Mercury Distribution in the Sediment and Biota of Davis Creek and Davis Creek Reservoir*, *Final Annual Report after 17 years of Monitoring and Research: 1985-2002* (ERA et al., 2002).

The area has many of the typical species of lizards, salamanders, snakes, turtles, frogs, and toads from the Coast Range. Western fence lizards and California whiptail lizards are present in chaparral and oak woodland. California newts and rough-skinned newts are present in ponds and streams. A full list of insects, crustaceans, reptiles, and amphibians can be obtained from the McLaughlin Natural Reserve website at http://nrs.ucdavis.edu/McL/natural/. According to McLaughlin Natural Reserve data, 38 mammalian species have been seen in the area and 16 others are thought to potentially occur. These include three rare mammals: ringtail cat, Tule elk, and Townsend's big-eared bat.

The DCR supports the native Sacramento Sucker and the non-native Bluegill and Florida largemouth bass which were introduced to assess mercury concentrations. Public fishing is not allowed in the DCR.

1.1.7 Significant Historical and Archeological Features

Cultural resource surveys and any necessary consultations with the State Historic Preservation Officer will be undertaken by Homestake for each of the remediation areas as necessary.

1.1.8 Land Use and Population

Reed Mine is located in a rural setting on private lands within the McLaughlin Natural Reserve. Nearby parcels are administered by the BLM.

Public access to Reed Mine features is limited to trespassing associated with travel along the County Road through the Site. Other than mine-related features, the area remains undeveloped chaparral and oak woodland.

The nearest residence to the Reed Mine is a rural single-family dwelling about one mile southwest of the Andalusia Pit. This residence is located outside of the Davis Creek watershed.

2.0 Remediation Area Activities

2.1 Remediation Objectives

The remediation objectives are intended to protect human and ecological receptors and abate discharges into waters of the state that create or threaten to create a condition of pollution or nuisance.

Based on California Water Code requirements, the following remediation objectives were identified for the remediation areas at Reed Mine:

(1) Reduce the potential migration of metals and sediment from mine waste to surface water.

(2) Reduce interactions of mine drainage with mine waste and potential migration of metals to surface water.

(3) Reduce the threat of human or ecological exposure to high concentrations of mercury.

Attaining these objectives is expected to result in satisfying Homestake's responsibilities to protect water quality under the California Water Code.

2.2 Remediation Goals

The remediation goal for Reed Mine remediation areas is to reduce the potential risk of water quality degradation posed by mining wastes, and includes the following steps:

- Remove hazardous materials and dispose at a permitted off-site facility.
- Remove mine waste from banks of Upper Davis Creek and tributaries.
- Minimize erosion of mine waste at Reed Mine North.
- Prevent contact of mine drainage with mine waste at the Old Lower Reed Adit (OLRA).
- Minimize, to the extent practical, the concentration of arsenic, cobalt, copper, mercury, and nickel in drainage at the OLRA.

Implementing these remedial steps is expected to minimize risks to Site visitors from exposure to mine waste at Reed Mine, and is expected to abate potential degradation of surface water beneficial use potentially associated with mine waste in the remediation areas.

2.3 Remediation Area Activities

Prior to implementing remediation activities at any of the areas, safety requirements will be identified, site controls will be established, and equipment and personnel will be mobilized to the Site. Mobilization will include establishing a command post and equipment staging area, and preparing safe access to each of the remediation areas.

Site Safety: The project-specific Health and Safety Plan (HASP) will be completed as part of the mobilization phase. The HASP will be finalized prior to beginning field activities, with input from the selected contractor during the pre-mobilization phase of work. The HASP will be compliant with US Department of Occupational Safety and Health Administration (OSHA) requirements, California OSHA

requirements for hazardous waste site operations, and provide for properly addressing asbestos containing material (ACM) present at Remediation Area 6.

A Site Transportation Plan will be prepared during pre-mobilization activities and will cover both on- and off-site transport of mining-related material and other material generated during Site removal and restoration activities. The transportation plan will identify procedures to minimize the environmental and health and safety risks associated with materials transportation associated with the project.

Command post: The command post will be located at the South Pit staging area (Figure 4) and will provide a check-in location for all personnel entering the Site for work and leaving the Site at the end of each day, and a meeting location for all Site visitors. Equipment inspections will be completed here before delivery to a remediation area. Work crews will assemble at the command post each day prior to work to participate in daily safety briefings. The command post will also provide a muster point in the event of the need to evacuate the Site.

Staging area: The main staging area will serve as a delivery point and storage area for materials and equipment. The approximate location of the main staging area is shown on Figure 4. Field offices, temporary facilities, and storage containers will be located in this area. Final determination of the main staging area and command post location will be approved by the Field Engineer prior to mobilization. Each remediation area will also have a temporary staging area for equipment and personnel while work is active at the area. Approximate locations for site-specific staging areas are shown on Figure 4.

Access preparation: Safe access to each remediation area for equipment and personnel will be necessary to complete the work. Prior to mobilizing to any remediation area, the project engineer will inspect the County Road from the vicinity of the Andalusia Mine to the Lower Reed Mine and recommend any grading necessary for safe equipment and personnel access. At each remediation area there may be a variety of access preparation steps.

Descriptions of remediation area activities are summarized in Table 2 and the following subsections.

2.3.1 Remediation Area 1

Remediation Area 1 comprises a waste rock pile extending from north of County Road 40 to the bank of a tributary to Upper Davis Creek (Figure 5). Waste rock forms a very steep slope over 30 feet high from the top of the waste rock to the tributary. The waste rock is poorly vegetated, erodible, and readily transported into the adjacent tributary via sheet flow, rills, and rock falls. The waste rock was emplaced over a pre-existing irregular surface that formed the bank of the tributary.

Figure 6 presents a section view of Remediation Area 1 showing County Road 40, the waste rock pile, and tributary.

The goal of remediation activities at Remediation Area 1 is to remove waste rock and stabilize the excavated area so that waste rock is no longer eroded and deposited into the tributary. Given the uncertainty of the waste rock volume present, the possibility exists that stabilized waste rock may remain at the Site after completion of remediation. Remediation tasks are:

1) Excavate about 575 cubic yards of waste rock from the bank of the tributary, and to a minimum distance of ten feet from the bank of the tributary, or to native soil/rock. Transport excavated waste rock to the Group B repository at the Andalusia Pit for long-term storage. The material will be removed using a straight edge bucket and through moving material from the outside edges of the pile inward. Excavation will minimize mixing of native

material with waste rock, over-excavation of material, and spreading of material into the adjacent creek and clean areas. To the extent possible, work will proceed from the furthest downslope location of waste rock back toward the upslope extent.

Waste rock will be loaded directly into bulk transporters or into on-site trucks, where access is limited. Materials that are loaded into on-site trucks will then be stockpiled in the staging area for loading into bulk carriers for transport to the repository.

The extent of excavation will be determined in the field as excavation progresses and will stop where native materials are encountered, or where the downslope edge of waste rock is at least 10 feet from the tributary channel, and the slope of any remaining waste rock is 3:1 (horizontal to vertical) or matches the grade of adjoining native material.

Trained personnel familiar with the local geology and mine waste will evaluate the extent of excavation based on color changes, textural changes, stratification, soil horizons, bedrock, and topography as described in Section 3.0 of this work plan. These lines of evidence will be used to determine when excavation should stop due to encountering native soil and/or rock.

2) Grade any remaining waste rock to a 3:1 (horizontal to vertical) slope or leave the exposed native soil/rock in place.

   Waste rock spoils from grading will be loaded and transported to the repository as described above. Native material spoils from grading (if any) will be used in Site restoration.

3) Restore the tributary bank using acceptable fill.

   Native material spoils from grading and supplementary fill from an acceptable borrow area will be used to restore the bank of the tributary by placing and wheel-rolling the material in one-foot lifts until the bank height matches the adjacent undisturbed bank height. This work will be completed in accordance with applicable permits.

4) Install erosion controls consistent with the project storm water pollution prevention plan (SWPPP) and Erosion Control Plan (Appendix A).

   Slopes will be stabilized by track rolling with a dozer, will comply with storm water best management practices (BMP) in accordance with the Construction General Permit as detailed in the SWPPP, and will be finished with hydroseeding per the Revegetation Plan. For areas requiring fill along slopes, the material will be keyed in and compacted.

5) Revegetate using a locally sourced native seed mix.

   Revegetation will be initiated via hydroseeding using a seed mix consistent with the Revegetation Plan (Appendix B).

   Where appropriate, vegetation filter strips may be employed to facilitate stabilization and mitigate sediment transport. A vegetation filter is essentially a vegetated buffer zone lying on a flat to gently sloping surface between the toe of the excavated slope and the top of the nearby channel bank. Vegetation slows the velocity of sediment-laden runoff causing the sediment to deposit on the surface within the limits of the vegetation coverage before reaching the edge of the stream bank. It relies on a high cover density of grass or grass-like vegetation. The vegetation filter can be formed either by preserving an existing stand of dense vegetative cover (i.e., leaving a buffer zone) or by re-establishing a dense vegetative cover on a newly disturbed surface.

Remediation performance in the short term will be assessed by documenting removal of waste rock from the bank of the adjacent tributary, the final grade of the excavated area, and installation of

erosion controls. Photographs will be taken from defined locations for comparison with future monitoring inspections. Pre-remediation photographs are included in Attachment 1, along with a figure showing photo viewpoint locations and coordinates.

Longer-term performance will be documented through annual inspections during monitoring of the remediation area. As described in Section 4.0 of this Work Plan, inspections will entail photography, and visual assessment of surface features and vegetation at the excavated area. Annual inspections will be conducted for five years after remediation.

2.3.2 Remediation Area 2

Remediation Area 2 is a waste rock pile located at the Reed North area (Figure 7). An erosional feature (e.g., gully) has formed on a steep slope in the waste rock, which is gradually enlarging and contributing to erosion of the waste rock pile. The goal of remediation activity at Remediation Area 2 is to minimize future erosion of waste rock by conducting preventive maintenance to include emplacing erosion controls to foster vegetation growth. Remediation Area 2 is at a remote area of the Site that is inaccessible to motorized vehicles. Therefore, the erosional feature will be stabilized using hand tools and materials carried to the Site by workers. BMPs will be field fit to the erosional feature.

Remediation tasks are:

1) Divert storm water flow at head of the existing gully.

   Hand tools will be used to construct an earthen berm to minimize water flow from the road surface into the gully. The water flow will be minimized from entering the gully by erecting an earthen berm around the head of the gully. Any resulting water retained by this berm will be directed to flow into the mine pit across the road to the south by erecting a second berm.

2) Install velocity dissipaters (i.e. straw wattles, brush dams, and rock dams) within the existing gully.

   Velocity dissipation structures, consisting of entrenched straw wattles, brush dams and/or rock dams, will be installed along the gully. The purpose for these structures is to temporarily slow the velocity of water flowing along the gully and entrap sediment and seeds on the upstream sides that will foster revegetation. Reduced flow velocity is intended to reduce erosion and associated sediment transport.

   Erosion control materials will be installed level and will be entrenched to prevent underflow of water. Erosion control materials will extend across the gully to slow water and entrap sediment. The gully is too steep to allow installation of properly stepped velocity dissipaters (i.e. spaced so that the bottom of each structure is at the same elevation as the top of the next downstream structure). Velocity dissipater structures will be installed as close to each other as is practical and safe based on field conditions.

3) Revegetate using a locally sourced native seed mix.

   Revegetation will be initiated via hand broadcasting using a seed mix consistent with the Revegetation Plan (Appendix B). Seeds will be broadcast to the gully sides above straw wattles, and upstream of each velocity dissipater.

Remediation performance in the short term will be assessed by documenting the location of run-on diversion at the head of the gully, the number and locations of velocity dissipaters, and the quantity (weight) of seeds broadcast. Photographs will be taken from defined locations for comparison with

future monitoring inspections. Pre-remediation photographs are included in Attachment 1, along with a figure showing photo viewpoint locations and coordinates.

Long-term performance will be documented through annual inspections during monitoring of the remediation area, as described in Section 4.0 of this Work Plan. Inspections will entail photography and visual assessment of surface features and vegetation at the excavated area. Annual inspections will be conducted for five years after remediation.

2.3.3 Remediation Area 3

Remediation Area 3 consists of waste rock at the OLRA and drainage flowing from the adit. Waste rock extends from the adit to the bank of a tributary to Upper Davis Creek, and subsidiary waste rock is also present northeast across County Road 40 (Figure 8). Mine drainage seeps from the adit, infiltrates into the waste rock, and flows through the subsurface to the tributary.

Waste rock and drainage are associated with an occurrence of elevated arsenic, cobalt, copper, mercury, and nickel in surface water within the tributary. It is likely that the drainage interacts with waste rock to mobilize metals at the Site. Thus, removing waste rock and managing the drainage is expected to improve water quality in the nearby tributary and Upper Davis Creek.

Figure 9 is a section view of Remediation Area 3 showing the adit, semi-passive treatment system, waste rock pile, and tributary.

The goals of waste rock remediation activities at Area 3 are to remove waste rock present at the bank of the tributary to Davis Creek, remove waste rock extending across the County Road, and stabilize the excavated bank to promote vegetation and minimize erosion. Given the uncertainty as to the volume of waste rock present there is the possibility that stabilized waste rock may remain at the Site after completion of remediation.

The goal of drainage remediation is to reduce the mobilization of metals including arsenic, cobalt, copper, mercury, and nickel to surface water within the tributary.

Remediation tasks for waste rock are:

1) Excavate about 1,400 cubic yards of waste rock from the bank of the tributary and northeast of County Road 40. Along the tributary banks, remove waste rock to a distance of ten feet away from the bank of the tributary, or to native soil/rock. Transport excavated waste rock to the Group B repository at the Andalusia Pit for long-term storage.

   The material will be removed using appropriate mechanized excavation equipment, moving material from the outside edges of the pile inward. This is intended to minimize spreading of material into the adjacent creek and clean areas, mixing of native material with waste rock, or over-excavation of material. To the extent possible, work will proceed from the furthest downhill location of the waste rock toward the uphill extent of the waste rock.

   Waste rock will be loaded directly into bulk transporters or into on-site trucks in areas where access is limited. Materials that are loaded into on-site trucks will then be stockpiled in the staging area for loading into bulk carriers for transport to the repository.

   The extent of excavation will be determined in the field as excavation progresses. Excavation will stop where native materials are encountered, or where the downslope edge of waste rock is at least 10 feet from the tributary channel and the slope of remaining waste rock is 3:1 (horizontal to vertical) or matches the grade of nearby native material.

Trained personnel familiar with local geology and mine waste will evaluate the extent of excavation based on color changes, textural changes, stratification, soil horizons, bedrock, and topography as described in Section 3.0 of this Work Plan. These lines of evidence will be used to determine when excavation should stop due to encountering native soil and/or rock.

2) Grade any remaining waste rock to a 3:1 (horizontal to vertical) slope OR leave the exposed native soil/rock in place.

   Waste rock spoils from any such grading will be loaded and transported to the repository as described above. Native material spoils from grading (if any) will be used in Site restoration.

3) Restore the tributary bank using acceptable fill material per engineer's design and approval.

   Native material spoils from grading and supplementary fill from the borrow area will be used to restore the bank of the tributary by placing and wheel-rolling the material in one-foot lifts until the bank height matches the adjacent undisturbed bank height exposed by waste rock removal along the north bank of the tributary. This work will be completed in accordance with applicable permits.

4) Install erosion controls consistent with the project SWPPP and Erosion Control Plan (Appendix A).

   Slopes will be stabilized by track rolling with a dozer, will comply with storm water BMPs in accordance with the Construction General Permit, and will be finished with hydroseeding per the Revegetation Plan. For areas requiring fill along slopes, fill material will be keyed in and compacted.

   A locally sourced native seed mix will be used for revegetation. Revegetation will be initiated via hydroseeding the disturbed area using a seed mix consistent with the Revegetation Plan (Appendix B).

   Where appropriate, vegetation filter strips may be employed to facilitate stabilization and mitigate sediment transport. A vegetation filter strip is essentially a vegetated buffer zone lying on a flat to gently sloping terrace surface between the toe of the excavated slope and top of the nearby channel bank. Vegetation slows the velocity of sediment-laden runoff, causing sediment to deposit on the surface within the limits of the vegetation coverage before reaching the edge of the stream bank. It relies on a high cover density of grass or grass-like vegetation. The vegetation filter can be formed either by preserving an existing stand of dense vegetative cover (i.e., leaving a buffer zone) or by re-establishing a dense vegetative cover on a newly disturbed surface.

Remediation Tasks for Adit Drainage are:

1. Construct a semi-passive treatment system to reduce and properly dispose of them at a permitted off-site facility, arsenic, cobalt, copper, mercury, and nickel concentrations in adit drainage. Design of the semi-passive system is based on adit drainage flow and chemistry monitoring and treatability studies (Appendix D).

   Ongoing drainage monitoring and the column test results showed that separation of iron minerals and mineraloids from the drainage reduced concentrations of arsenic, cobalt, copper, mercury, and nickel (Appendix D). Simple oxidation during the column test removed all iron from the influent to below detection levels, and comparison of Site monitoring data of drainage along a flow path from the source to where it infiltrates showed reductions in arsenic (11 percent), cobalt (85 percent), copper (46 percent), mercury (>80 percent), and nickel (83 percent) respectively.

The treatment system would consist of an aeration cascade into a settling/filtration basin. The settling basin would consist of two identical chambers so that as solids accumulate the entire flow could be directed to one chamber to allow uninterrupted treatment while drying and removal of the accumulated precipitate is accomplished. The settling basin would collect iron oxide-hydroxide minerals and mineraloids and the basin effluent would flow by gravity into an infiltration system (Figure 9). Effluent would infiltrate into the subsurface materials.

Characterization of the iron precipitates present at the adit show that it is hazardous only due to the total mercury content exceeding the TTLC. The threat to water quality from the precipitates was due to leachability of nickel at a concentration of 200 µg/L in a DI WET extract. The iron precipitates are, therefore, suitable for disposal in an on-site repository as discussed in detail in Appendix D.

If monitoring shows the necessity for additional treatment, a reactor containing a dispersed alkalinity source (DAS) where chemical reactions will further reduce the concentrations of arsenic, cobalt, copper, iron, manganese, mercury, and nickel would be installed (Appendix D). DAS reactor effluent would discharge via gravity to an infiltration system.

2. Install an infiltration gallery downstream of the adit drainage treatment system to minimize overland flow to the nearby tributary or to Upper Davis Creek.
3. Install surface run-on controls to direct runoff from the adjacent old mine road area away from the adit and waste rock and onto nearby native materials.

2.3.4 Remediation Area 4

Remediation Area 4 consists of waste rock forming the very steep northeast bank of Upper Davis Creek upstream from the former Engineers Office (Figure 10). Remediation activities at Remediation Area 4 will be coordinated with activities at Remediation Area 5, and will be subject to Clean Water Act (CWA) Section 404 water quality permit conditions.

Remediation Area 4 waste rock extends to Upper Davis Creek, and is readily eroded and transported into the creek. Figure 11 is a conceptual cross section of Remediation Area 4. Aluminum, cobalt, manganese, mercury, nickel, and thallium are potentially soluble from the waste rock at concentrations above water quality criteria. Thus, removing the waste rock and restoring the disturbed area are expected to improve water quality in Upper Davis Creek. In order to avoid severe environmental degradation associated with creek bank disturbance, the project does not intend to excavate in the creek channel any lower than bankfull.

The goal of remediation is to prevent erosion and transport of waste rock to Upper Davis Creek, and to remove the waste rock source for elevated aluminum, cobalt, manganese, mercury, nickel, and thallium to surface water. Waste rock consists of rock that did not contain economically recoverable mercury during mining. Waste rock contains cinnabar and other pyrite. While cinnabar is relatively stable under ambient surface conditions, in an aquatic stream environment pyrite readily reacts with oxygen and water to create sulphuric acid. The resulting acidic solution is capable of reacting with cinnabar to mobilize mercury. While not as reactive as the mercury species present in calcine tailings, waste rock should be removed from the creek banks to prevent the introduction of cinnabar and pyrite into the aquatic environment where mercury could be mobilized. The interaction of such drainage with calcines has been shown to contribute to increased bioavailability of mercury in downstream waters (Rytuba 2000).

Remediation tasks for waste rock are:

1) Temporarily divert water from Upper Davis Creek around the construction area if necessary.

   For example, diversion may consist of a plastic membrane-lined pit, excavated about two to three feet into the channel of Upper Davis Creek to divert water from the creek into a plastic pipe (actual method is subject to permit conditions). The pipe will be routed around construction areas along the channel edge across the creek from ongoing remediation activities. Water will be returned to Upper Davis Creek from the pipe at a location downstream from the remediation areas.

   The area will be restored in accordance with the channel restoration design, Appendix C currently in development, following remediation activities.

2) Excavate about 430 cubic yards of waste rock from the northeast bank (above bankfull channel level) of Upper Davis Creek. Excavated waste rock will be transported to the Group B repository at the Andalusia Pit.

   The material will be removed using appropriate mechanized excavation equipment, moving material from the top of the pile downward. This is intended to minimize spreading of material into the adjacent creek and clean areas, mixing of native material with the waste rock, or over-excavation of material. To the extent possible, work will proceed from the furthest upstream location of the waste rock and progress in the downstream direction.

   Waste rock will be loaded directly into bulk transporters or into on-site trucks where access is limited. Materials that are loaded into on-site trucks will be stockpiled in the staging area for loading into bulk carriers for transport to the repository.

   The extent of excavation will be determined in the field as excavation progresses. Excavation will stop where native materials are encountered or the creek bankfull level is reached, whichever is encountered first. The rationale for excavation above the bankfull level is discussed under Remediation Area 5.

   Trained personnel familiar with the local geology and mine waste will evaluate the extent of excavation based on color changes, textural changes, stratification, soil horizons, bedrock, and topography as described in Section 3.0 of this Work Plan. These lines of evidence will be used to determine when excavation should stop due to encountering native soil and/or rock.

3) Restore Upper Davis Creek margin.

   Creek restoration will be conducted in accordance with the design that is currently being developed (Appendix C). Creek restoration will be implemented after remediation tasks are completed at Remediation Areas 4 and 5.

   Appropriate materials that may include native spoils from grading and supplementary fill from an acceptable borrow area, will be used to restore the bank of the creek by placing and wheel-rolling the material in one-foot lifts until the bank height matches the adjacent undisturbed bank height consistent with design and applicable permit requirements. The restoration design will require that the channel bed be left undisturbed below the bankfull flood stage.

4) Install erosion controls consistent with the project SWPPP and Erosion Control Plan (Appendix A).

   Slopes will be stabilized by benching if feasible, will comply with storm water BMPs in accordance with the Construction General Permit, Erosion Control Plan (Appendix A), and will

be finished with hydroseeding per the Revegetation Plan (Appendix B). For areas requiring fill along slopes, material will be keyed in and compacted. The disturbed steep slope above Upper Davis Creek may require installation of run on controls at the top of the slope, and slope protection using Jute erosion control cloth or similar material in accordance with the SWPPP.

5) Revegetate using a locally sourced native seed mix.

   Revegetation will be initiated via hydroseeding the disturbed area using a seed mix consistent with the Revegetation Plan (Appendix B).

   Where appropriate, vegetation filter strips may be employed to facilitate stabilization and mitigate sediment transport. A vegetation filter strip is essentially a vegetated buffer zone lying on the flat to gently sloping terrace surface between the toe of the excavated slope and the top of the nearby channel bank. Vegetation slows the velocity of sediment-laden runoff causing the sediment to deposit on the surface within the limits of the vegetation coverage before reaching the edge of the stream bank. It relies on a high cover density of grass or grass-like vegetation. The vegetation filter can be formed either by preserving an existing stand of dense vegetative cover (i.e., leaving a buffer zone) or by re-establishing a dense vegetative cover on a newly disturbed surface.

Remediation performance in the short term will be assessed by documenting removal of waste rock from the bank of Upper Davis Creek, the final grade of the excavated area, installation of erosion controls, and restoration of the disturbed area along the Upper Davis Creek channel. Photographs will be taken from defined locations for comparison with future monitoring inspections. Pre-remediation photographs are included in Attachment 1, along with a figure showing photo viewpoint locations and coordinates.

Long-term performance will be documented through routine inspections during monitoring of the remediation area. As described in Section 4.0 of this Work Plan, inspections will entail photography and visual assessment of surface features and vegetation at the excavated area. Annual inspections will occur for five years after remediation.

2.3.5 Remediation Area 5

Remediation Area 5 comprises tailings and bricks on slopes below three old furnaces used to recover mercury at the southwest bank of Upper Davis Creek (Figure 10). Tailings and bricks cover the bank of Upper Davis Creek and extend into the creek channel. The tailings are erodible and readily transported into the adjacent creek via sheet flow, rills, and brick falls. The tailings were emplaced over the pre-existing bank of the creek. In order to avoid severe environmental degradation associated with creek bank disturbance, the project does not intend to excavate in the creek channel any lower than bankfull.

Remediation activities at Remediation Area 5 will be coordinated with activities at Remediation Area 4, and will be subject to CWA Section 404 water quality permit conditions.

The goal of remediation activities at Remediation Area 5 is to remove calcine tailings and bricks from the bank of Upper Davis Creek so that the tailings are no longer eroded and deposited into the tributary. Calcine tailings contain many mercury compounds that are readily mobilized in an aquatic environment. During roasting, cinnabar is oxidized and the liberated mercury is vaporized. Under roasting conditions oxidized species of mercury including mercury chloride and other mercury compounds are formed that are much more readily soluble than cinnabar (Kim et. Al., 2005). These mercury-containing oxidation products present in the tailings are more available to participate in

biochemical reactions within the aquatic environment than mercury bound in cinnabar. For these reasons, removing tailings from the banks of Upper Davis Creek is necessary to minimize the food web impacts of this mercury caused by erosion and transport to the creek channel.

At Upper Davis Creek, calcine tailings and waste rock are present above the bankfull channel along the reach of the stream at Remediation Areas 4 and 5. Calcine tailings above the bank likely contain soluble mercury species that are readily solubilized and readily participate in biochemical reactions when the tailings are introduced into an aquatic environment such as the channel of Upper Davis Creek. Waste rock contains pyrite and cinnabar that could react within the stream channel to form drainage that enhances mercury methylation. Mercury from tailings and waste rock already in the creek channel has most likely reacted in the environment through dissolution and biological interactions and any remaining mercury is not likely to pose a significant threat so long as it remains undisturbed. Removal of the calcine tailings and waste rock from the stream banks would minimize the continued and future erosion and transport of mercury containing mine waste to Upper Davis Creek, reducing the mercury available to impact the food web.

Calcine tailings are present along about 350 feet of the west bank of Upper Davis Creek, waste rock is present along about 200 feet of the same reach of the eastern creek bank (Figure 10). Waste rock and tailings piles cover in-place rock of the Knoxville formation, therefore, the entire length of the reach will not be excavated. Excavation will be restricted to areas above the bankfull channel containing waste rock or tailings. The riparian area was burned during the 2015 Rocky Fire, and all of the mature trees were killed. Since the fire, a vigorous stand of willows, berries, and aquatic vegetation has grown up along the banks and channel of the stream reach to be excavated.

Downstream from the remediation area, the stream channel becomes wider due to lower gradients and sediment deposition as Upper Davis Creek enters Davis Creek Reservoir. The wider channel is not vegetated as thickly as the reach to be excavated with the vegetation restricted to channel banks and isolated longitudinal bars above the bankfull level. These observations suggest that mercury liberated from mine waste may be more readily methylated within the narrower, vegetated reach of the remediation area during low flow conditions, than in the unvegetated and better drained sediment deposits downstream. Further, excavation below the bankfull level of the channel risks destabilizing the channel and contributing to increased erosion of the bed sediment load. This would result in transport of additional mercury to Davis Creek Reservoir. To minimize the likelihood for destabilizing the channel of Upper Davis Creek, excavation activities will be restricted to above the bankfull channel.

Remediation tasks are:

1) Temporarily divert water from Upper Davis Creek around the construction area in accordance with permit requirements.

2) Excavate about 730 cubic yards of tailings and bricks from the bank (above bankfull channel level) of Upper Davis Creek, to native soil/rock. Excavated tailings and bricks will be transported to an off-site hazardous waste disposal facility under hazardous waste manifests. The material will be removed using a straight edge bucket and through moving material away from the channel of the creek and onto the bank, from upstream to downstream. Excavation will minimize mixing of native material with tailings, over-excavation of material, and spreading of material into the adjacent creek and clean areas.

   Tailings will be loaded directly into bulk transporters or into on-site trucks where access is limited. Materials that are loaded into on-site trucks will then be stockpiled in the staging area for loading into bulk carriers for transport to the permitted off-site disposal facility.

The extent of excavation will be determined in the field as excavation progresses. Excavation will stop when native materials are encountered or the creek bankfull level is reached. Sediment characterization will be conducted to delineate the extent of excavation.

Trained personnel familiar with the local geology and mine waste will evaluate the extent of excavation based on color changes, textural changes, stratification, soil horizons, bedrock, and topography as described in Section 3.0 of this Work Plan. These lines of evidence will be used to determine when excavation should stop due to encountering native soil and/or rock.

3) Restore Upper Davis Creek margin. Creek restoration will be conducted in accordance with the design that is currently being developed (Appendix C). Creek restoration will be implemented after remediation tasks are completed at Remediation Areas 4 and 5.

   Appropriate materials that may include native spoils from grading, and supplementary fill from an acceptable borrow area, will be used to restore the bank of the creek by placing and wheel-rolling the material in one-foot lifts until the bank height matches the adjacent undisturbed bank height consistent with design and applicable permit requirements.

4) Install erosion controls consistent with the project SWPPP and Erosion Control Plan (Appendix A).

   Slopes above the creek channel will be stabilized by track rolling with a dozer, comply with storm water BMPs, and finished with hydroseeding per the Revegetation Plan (Appendix A).

5) Revegetate using a locally sourced native seed mix.

   Revegetation will be initiated via hydroseeding using a seed mix consistent with the Revegetation Plan (Appendix B).

   Where appropriate, vegetation filter strips may be employed to facilitate stabilization and mitigate sediment transport. A vegetation filter is essentially a vegetated buffer zone lying on a flat to gently sloping surface between the toe of the excavated slope and the top of the nearby channel bank. Vegetation slows the velocity of sediment-laden runoff causing the sediment to deposit on the surface within the limits of the vegetation coverage before reaching the edge of the stream bank. It relies on a high cover density of grass or grass-like vegetation. The vegetation filter can be formed either by preserving an existing stand of dense vegetative cover (i.e., leaving a buffer zone) or by re-establishing a dense vegetative cover on a newly disturbed surface.

Remediation performance in the short term will be assessed by documenting removal of tailings from the bank of Upper Davis Creek, the final grade of the excavated area, installation of erosion controls, and restoration of the project impacted areas of Upper Davis Creek. Photographs will be taken from defined locations for comparison with future monitoring inspections. Pre-remediation photographs are included in Attachment 1, along with a figure showing photo viewpoint locations and coordinates.

Longer-term performance will be documented through routine inspections during monitoring of the remediation area. As described in Section 4.0 of this Work Plan, inspections will entail photography and visual assessment of surface features and vegetation at the excavated area. Inspections will occur for five years after remediation.

2.3.6 Remediation Area 6

Remediation Area 6 comprises the former ore processing facilities on the slope northeast of Upper Davis Creek. Figure 12 shows access to the former process facilities, which include an ore bin

foundation, concrete pads and walls, rotary furnace, condenser tubes, collapsed cyclone, and soot bin (Figure 13). The condenser channels, rotary furnace, and soot bin contain residual materials and bricks with elevated mercury. Remnants of spilled ore are present on the slope above the former process facilities. Condenser tubes contain ACM used to seal joints. Ore contains elevated concentrations of aluminum, cobalt, copper, manganese, mercury, nickel, thallium, and zinc that are potentially soluble at concentrations above water quality criteria. Goals of remediation activities at Area 6 are to remove residual materials and bricks from process equipment for off-site disposal; demolish and remove the rotary furnace, condenser tubes, collapsed cyclone, and soot bin for off-site disposal at a hazardous waste disposal facility under hazardous waste manifests. Residual ore would be removed from Area 6 for consolidation in the on-site Group B repository. Concrete pads and walls will remain in place. Remediation tasks are:

1) Remove residual ore from the vicinity of the former ore-bin and adjacent slopes, and from the concrete pad at the south end of the rotary furnace (Figure 13). The ore will be transported to the on-site Group B repository for long term storage. About 50 cubic yards of ore are estimated to require removal.

2) Inspect condenser tubes and associated equipment for ACM. Remove ACM from the condenser tubes and associated equipment, and properly dispose of ACM at a permitted off-site facility.

3) Crush and remove condenser tubes and containerize for disposal off-site disposal at a hazardous waste disposal facility.

4) Remove about two cubic yards of granular material from condenser channels. Containerize this material and transport for off-site disposal at a hazardous waste disposal facility.

5) Remove and containerize about 10 cubic yards of bricks and soot from the bin at the north end of the rotary furnace. Containerize and transport bricks and soot to a permitted off-site disposal facility. Crush the emptied bin and containerize for off-site disposal at a hazardous waste disposal facility.

6) Remove and containerize about one-half cubic yard of powdery material from the north end of the rotary furnace. This material readily generates dust and should be handled in a manner that prevents creation of dust or other fugitive emissions. Transport this material for off-site disposal at a hazardous waste disposal facility.

7) Demolish the rotary furnace. Remove loose material from inside the rotary furnace to a manageable distance from one end, cut a manageable length of the furnace, crush and containerize the length of furnace, taking care to collect all of the brick furnace lining (about 65 cubic yards of brick lining and slag). Transport the containerized furnace and lining to a permitted hazardous waste off-site disposal facility.

8) Remove all remaining loose iron equipment for off-site disposal or recycling.

9) Remove any remaining loose processing residuals from the concrete pads at the Site, containerize, and transport for off-site disposal at a hazardous waste disposal facility.

10) Install erosion controls consistent with the project SWPPP and Erosion Control Plan (Appendix A).

    Slopes around the former ore bin will be stabilized by track rolling with a dozer, will comply with storm water BMPs, and will be finished with hydroseeding per the Revegetation Plan (Appendix B).

11) Revegetate using a locally sourced native seed mix.

    Revegetation will be initiated via hydroseeding using a seed mix consistent with the Revegetation Plan (Appendix B).

    Where appropriate, vegetation filter strips may be employed to facilitate stabilization and mitigate sediment transport. A vegetation filter is essentially a vegetated buffer zone lying on a flat to gently sloping surface between the toe of the excavated slope and the top of the nearby channel bank. Vegetation slows the velocity of sediment-laden runoff, causing the sediment to deposit on the surface within the limits of the vegetation coverage before reaching the edge of the stream bank. It relies on a high cover density of grass or grass-like vegetation. The vegetation filter can be formed either by preserving an existing stand of dense vegetative cover (i.e., leaving a buffer zone) or by re-establishing a dense vegetative cover on a newly disturbed surface.

Remediation performance in the short term will be assessed by documenting removal of ore and processing residuals, and processing equipment from the former processing area. Final grade of the excavated area near the former ore bin will be documented, as will installation of erosion controls. Photographs will be taken from defined locations for comparison with future monitoring inspections. Pre-remediation photographs are included in Attachment 1, along with a figure showing photo viewpoint locations and coordinates.

Long-term performance will be documented through routine inspections during monitoring of the remediation area as described in Section 4.0 of this Work Plan. Inspections will entail photography and visual assessment of surface features and vegetation at the excavated area. Inspections will be conducted for five years after remediation.

2.3.7 Repository

The repository will be constructed to isolate about 2,500 cubic yards of excavated Group B and C waste rock and ore from water and the environment (Appendix E in progress). The placement of material from each remediation area will be documented. Closure will consist of emplacing a cover and associated BMPs to prevent erosion and protect the cover until vegetation is established.

The on-site Group B repository will be located in a cut that provides access to the former Andalusia open pit (Figure 14). This location is on serpentinite and silica carbonate bedrock at least 230 feet above the elevation of any known groundwater (based on the elevation difference between the repository location and drainage at the Upper Reed Adit No. 2 shown on Figure 2).

Chapter 7 Subchapter 1, Article 1 §22470 describes exemptions from certain provisions of Article 1 requiring liners, leachate control systems, and monitoring systems, based on no/little/poor groundwater:

(c) Exemptions Based On No/Little/Poor Groundwater — The RWQCB can exempt a Group A or B (see §22480 of Article 7) Mining Unit from certain provisions of this article if a comprehensive hydrogeologic investigation demonstrates that:

(1) there are only very minor amounts of groundwater underlying the area; or

(2) the discharge is in compliance with the applicable water quality control plan; and

(3) either natural conditions or containment structures will prevent lateral hydraulic interconnection with natural geologic materials containing ground water suitable for

agricultural, domestic, or municipal beneficial uses. There is no detectable vertical hydraulic interconnection between the natural geologic materials underlying the Unit and natural geologic materials containing such ground water.

The Reed Mine is not located within a groundwater basin (DWR, 2003 and 2016). The Capay Subbasin of the Sacramento Valley Groundwater Basin occurs about 10 miles east of Reed Mine. Groundwater in the Capay Valley Subbasin occurs mostly in Pliocene to Holocene continental sedimentary deposits. Older and deeper Cretaceous deposits underlying the Pliocene water bearing formation have been found to contain saline water (DWR, 2003). The Reed Mine is located on serpentinite and sandstone bedrock. Local groundwater within these geologic units was encountered during mining. This groundwater is expected to flow from high points to low points at the Site (Freeze and Cherry, 1979, page 195). Because the Reed Mine is located on a steep northeast sloping canyon wall, groundwater underlying the repository location is expected to flow from the southwest to the northeast toward Davis Creek.

Drainage is encountered at only two of the ten adits located at the Site. The drainage is circumneutral (Burleson, 2017), and the background samples from serpentinite and silica carbonate rock yielded an acid neutralization potential of 26 to 42 pounds calcium carbonate per 1,000 pounds of rock, and did not have measurable acid producing potential (Burleson, 2017). Based on these observations, the bedrock underlying the proposed repository location has a net neutralizing capacity. This inherent neutralizing capacity would assist in preventing migration of metals away from the repository should any leachate form. In addition, the waste rock and ore have no measurable acid production potential (Burleson, 2017). Thus, metal mobility associated with any leachate at the repository is expected to be very low and similar to background.

During the dry season, the bed of Davis Creek is dry upstream from the vicinity of the former Reed Mine Processing Area. This is interpreted herein as evidence that only very small quantities of groundwater are present within the watershed because the presence of significant groundwater resources would result in continuous discharge to Davis Creek.

Based on the discussion above, groundwater at the Reed Mine is considered to be of limited quantity and extent. The Group B repository recommended at the Andalusia Pit is eligible for the Title 27 §22470 (c) exemptions based on the occurrence of little groundwater, and the fact that groundwater is not in lateral hydraulic interconnection with natural geologic materials containing groundwater suitable for agricultural, domestic, or municipal beneficial uses. In addition, the repository bottom is separated from the shallowest known groundwater in the area by about 230 feet of acid neutralizing bedrock and the mine waste to be placed in the repository has no acid producing potential and is net acid neutralizing.

Figure 15 is a conceptual repository section. The repository design is in progress and will incorporate the Title 27 §22470 (c) exemptions from requirements for a leachate control and liner system.

The repository area will be prepared by clearing and grubbing to remove vegetation, and the bottom of the repository will be graded and compacted if necessary to provide a stable base and to key into the surrounding rock/soil. Material will be placed into the repository in lifts, moistened for dust control, and wheel rolled for compaction. After the final grade of waste material is documented, the repository will be covered with loose material removed during initial grading, supplemented as needed with material from the borrow area. The cover will be moistened for dust control and wheel rolled for compaction. Run-on will be directed to the southwest along the northwest and southeast sides of the repository through armored channels to prevent erosion and infiltration. The final cover will be graded to ensure positive drainage, and revegetated in accordance with the Revegetation Plan (Appendix B).

3.0 Construction Quality Assurance

Construction quality assurance (CQA) provides for quality assurance and quality control monitoring necessary to document that the remediation activities are completed using methods and materials that achieve the project objectives. CQA will include monitoring during construction to confirm that the correct equipment and materials are used appropriately to remove mine waste, restore disturbed areas, and protect the environment. CQA will include both protection and performance monitoring:

- **Protection monitoring** to confirm that human health and the environment are adequately protected during construction.
- **Performance monitoring** to confirm that the remediation has attained performance standards presented in this document.

Routine inspections described in Section 4.0 include confirmation monitoring and maintenance activities to confirm and sustain the long-term remediation performance.

3.1 Construction Quality Assurance Team

The CQA team consists of RWQCB staff, Homestake, Remediation Contractor, Design Engineer, and CQA firm (Consultant).

California Regional Water Quality Control Board—Central Valley Region. The RWQCB is the regulatory authority and responsible agency for overseeing and authorizing the remedial action. In this capacity, RWQCB will review monitoring plans in the design phase and the Contractor's Construction Quality Control (CQC) Plan to ensure that monitoring is consistent with the remedial design. An environmental monitor will be designated to exercise project oversight for the agency and to coordinate with Homestake. The RWQCB will make final determinations with participation from Homestake to resolve unforeseen conditions that may require modifying the planned project components or the manner in which remediation is executed.

Homestake. Homestake is voluntarily undertaking this project to address water quality concerns associated with the Reed Mine expressed by the RWQCB (2014). After completing Site characterization at the Reed Mine, Homestake requested, and the RWQCB prepared, a Cleanup and Abatement Order directing activities at the Reed Mine (Order No. R5-2017-0710).

Homestake is responsible for conducting remediation in accordance with this Remediation Work Plan. Homestake will hire a contractor to complete remediation activities at Reed Mine. Homestake's Project Director is the primary Owner representative sponsoring the project. The Project Director defines the overall project scope and has the authority to make changes to that scope, if needed (with proper regulatory coordination). Homestake's Project Director is also the key point for regulatory contact. Homestake's Construction Manager is the Owner's representative on Site that will be responsible for contract administration, budget, schedule, and coordination between parties. Homestake' s Construction Manager will request assistance from the Design Engineer, as needed, to address technical, construction, and regulatory issues.

Homestake will be responsible for ensuring implementation of the CQA Plan, including required monitoring, sampling, testing, and reporting. Included within this responsibility is monitoring of the

Contractor's quality control activities to ensure that project construction is conducted in accordance with contract plans and specifications. These activities may be assigned to subordinate inspectors or conducted by consultants with the requisite expertise and experience.

Consultant. During the course of construction, the owner will retain a Consultant (Burleson Consulting, Inc.) to act as CQA Officer and Monitor. The CQA Officer and Monitor will ensure remediation objectives are realized and that the project is constructed in accordance with the specifications. The CQA Officer acts as a liaison between the Owner, Remediation Contractor, and Design Engineer and as an auditor to verify and document the proper and complete implementation of the quality assurance program. The CQA Officer will prepare a schedule of CQA inspection activities and coordinate personnel to conduct inspections. The CQA Officer will be responsible for documenting construction and preparing the final construction report, which will include a statement by the CQA Officer as to whether the construction was performed in general conformance with approved plans and specifications. The CQA Officer, in cooperation with the Design Engineer, must approve all design changes and clarifications to design questions. The CQA Officer will communicate with Homestake on a regular basis in carrying out his or her responsibilities.

The CQA Monitor represents the Owner in observing and testing the Contractor's work activities, and documents Contractor activities in sufficient detail and with continuity to provide a high level of confidence that the work product follows the intent of construction documents. The Monitor also performs tests, when appropriate, to provide a high level of confidence that the characteristics of the materials and services meet requirements of the construction documents.

Whenever a monitor performs visual observations or performs tests, he or she is responsible for timely preparation and processing of all required documentation and reports. Accurate and concise reports must be prepared for all monitoring activities and for each test performed. Section 3.3 of this document describes documentation requirements.

Remediation Contractor. The Contractor will be selected through a competitive bidding process. The remediation Contractor will be required to perform the construction activities of excavation and disposal of waste rock, tailings, soil and fill; demolition; on- and off-site disposal as described herein, construction operation and closure of a Group B repository as described herein; and Site restoration in accordance with the approved project plans and specifications. These documents contain specific, detailed requirements to achieve overall quality of the remediation project.

The Contractor is responsible for coordinating with subcontractors, scheduling and performing the work within the time frame and budget agreed to in the contract, and performing the work in accordance with the approved project plans and specifications. The Contractor is expected to cooperate with the CQA Monitor to achieve a quality product.

Specifications will require the Contractor to develop and implement a CQC Plan, through which the Contractor ensures compliance with the requirements of the contract. The CQC Plan will identify personnel, procedures, methods, instructions, inspections, records, and formats to be used in the CQC system. The CQC Plan must be reviewed and approved by Homestake. The Contractor's CQC Manager will have written CQC duties and responsibilities delegated by an officer of the firm. The Contractor will also employ a Health and Safety Manager to implement the Contractor's site-specific HASP as required by the contract specifications. The HASP specifies the minimum health and safety requirements for job site activities, and the measures and procedures to be employed for protection

of on-site personnel as well as visitors. Details on documentation required will be presented in the specifications.

The Contractor may employ subcontractors to perform selected phases of the work for which they have special expertise. The subcontractors are responsible to their prime Contractor for the quality of their work and health and safety of their project personnel in accordance with the Contractor's CQC Plan and HASP. The subcontractors' principals will designate a job site superintendent or foreman with responsibility to see that the work is conducted in accordance with the contract requirements.

3.1.1 Meetings

To facilitate construction and to clearly define construction goals and activities, close coordination between the Owner, Design Engineer, CQA personnel, and Contractor is essential. To meet this objective, preconstruction, progress, and weekly meetings will be held.

Preconstruction Meeting. A preconstruction meeting shall be held at the Site within two weeks of commencing construction and be attended by the Owner, Project Director, Contractor, Design Engineer, CQA Officer, CQA Monitor, and others designated by the Owner. The purposes will be to:

- Identify key personnel
- Review construction drawings, specifications, CQA program, work area security, health safety and security procedures, and related issues
- Define lines of communication and authority
- Establish reporting and documentation procedures
- Review testing equipment and procedures
- Establish testing protocols and procedures for correcting and documenting construction or nonconformance
- Review procedures to protect construction materials from adverse effects of weather during the project
- Conduct a site inspection to discuss work areas, staging areas, access roads, haul roads, and related items
- Identify changes, if any, to the CQA Plan that are needed to meet or exceed the specified design
- Review the project schedule

The meeting will be documented by the CQA Officer or representative. Copies of the minutes and relevant documents will be prepared and provided to all parties.

Progress Meetings. A progress meeting will be held at appropriate intervals during the project either on site or via conference call depending on project factors and conditions. At a minimum, this meeting will be attended by the CQA Monitor and Contractor. The purpose of this meeting is to:

- Review project activities and progress
- Discuss current and future work
- Address current or potential future construction problems

Problem or Work Deficiency Meetings. When a problem or deficiency is occurring or may occur, special meetings will be held at the Site or by conference call as soon as practicable to address the deficiency. The purpose of these meetings is to identify the problem or deficiency in the construction work, review alternative solutions, and select and implement a plan to resolve the problem or deficiency. Corrective action reporting, Work Plan deviations, and request for information items, if necessary, will also be addressed.

3.1.2 Communications

Figure 16 presents an organization and communication chart depicting relationships of the Owner, Contractor, Design Engineer, and CQA consultant. The purpose of this organization chart is to define reporting and communication responsibilities for the project. Responsibilities of each party are described in Section 3.1.

Only individuals assigned to this project, as defined in the CQA Plan, will communicate with the Contractor. When written communications are required, they must be documented on the appropriate forms. Formal letters to the Contractor should normally be signed by the Project Director.

Only those individuals assigned to this project, as defined in the CQA Plan, will communicate with the Owner. All communications must be through the Homestake Construction Manager. Communications of an official nature must be written.

3.2 Inspection Activities

Sufficient inspections and monitoring activities will be performed to ensure compliance with the terms and conditions of the contract. The results of these inspections and monitoring activities will be documented as specified in Section 3.3. Any work found not to be in accordance with contract requirements will be immediately brought to the attention of the Contractor for correction and annotated on the "Quality Assurance Report," (see Section 3.3) with the corrective action taken. Any work found not to be in accordance with the approved remedial design plans, specifications, work plans, and/or contract documents shall be brought to the immediate attention of the CQA Manager and Homestake. Homestake will be notified of any changes to the approved contract documents before being implemented. The following inspection activities will be performed

Preconstruction

- Review design criteria, drawings, and specifications associated with remediation and construction activities and report any inconsistencies to the Design Engineer responsible for the project for adjustment, if necessary.
- Inspect stockpile, waste rock, tailings, and erosional feature areas as appropriate.
- Review applicable existing reports that pertain to construction of the final remediation design.
- Verify that imported materials (including but not limited to: backfilling, capping, and habitat substrate materials, steel, concrete, wood, installed habitat elements, and other construction materials) comply with all contract requirements prior to delivery to the job Site.

Construction

- Review submittals and daily documentation.

- Observe all phases of construction and document compliance or noncompliance with the approved plans, specifications, and directions of the Design Engineer.
- Document types and placement of different mine wastes into repository.
- Document erosion on Site and potential areas where erosion may occur.
- Observe that cracks, depressions, and irregularities are filled in to the specified design criteria.
- Observe/review earth materials for clod size, organic material, gradation, and other characteristics that may not meet the final repository reclamation specifications.
- Inspect for and verify the removal of any sticks, litter, scrap, or other material that would affect remediation activities.
- Monitor water quality as necessary during construction to ensure that water quality is protected in Upper Davis Creek and tributaries.
- Observe that seeding is uniform and consistent with design specifications and that seasonal conditions are considered before seeding.
- Verify the location control (stationing, offset, and elevation) during excavation, repository construction operation and closure, and revegetation construction activities will be completed through independent means or verification of the Contractor's CQC checks. These checks are critical to ensure that mine waste is removed, cap materials placed, and habitat elements installed to the limits and depths specified.

Post-Construction

- Review final documentation associated with remediation activities and report any inconsistencies to the design engineer for potential adjustments
- Inspect stabilized repository and former waste rock areas quarterly for revegetation during the first year following construction activities
- Document erosion on site and potential areas where erosion may occur. Plan and implement erosion mitigation measures
- Prepare quarterly memo documenting site conditions and any needed mitigation measures for the first year after construction

Final Inspection

- Check for low spots or depressions that may cause water to pond on the repository
- Check for areas that may be damaged by erosion or other root causes
- Check for areas that have been excessively eroded by rainfall during the construction period or as a result of construction activities

3.3 Documentation and Reporting

Prior to beginning work on the project, the Contractor will be required to submit various work plans for approval by Homestake and the CQA Manager. Submittals required of the Contractor prior to, during, and at the completion of different tasks are summarized below.

3.3.1 Pre-Construction Submittals

Construction Plan and Schedule. For construction activities, the Contractor(s) will be required to submit a Construction Plan and Schedule for approval by Homestake and the CQA Manager, and RWQCB. No physical work is to be performed at the Site until the plan is reviewed and specific authorization to start the work is obtained. The plan will cover potential environmental degradation as a result of the Contractor's operations. The plan will contain separate sections for contamination prevention, closure, cleanup, and erosion and turbidity control as they pertain to remediation activities. The Contractor will obtain a General Permit for Storm Water Discharges Associated with Construction and prepare the SWPPP for this work.

Construction Quality Control Plan. The Contractor's CQC Plan will present the system that will ensure the Contractor will meet the requirements of the contract. The CQC Plan will identify personnel, procedures, methods, instructions, inspections, potential remedies, records, and forms to be used in the CQC system.

The Plan will also include a description of procedures for maintaining and updating activity logs, laboratory records, procedures for reporting emergencies, potential remedies, records for personnel and maintenance, and monthly reports to agencies. The CQC Plan will include a description of how change orders will be reviewed for consistency with specifications.

The Contractor will prepare and maintain a Daily CQC Report which includes results of all inspections, surveys, and monitoring activities and supporting documentation.

Contractor's Health and Safety Plan. The Contractor will submit a HASP that will present the minimum health and safety requirements for job site activities, and the measures and procedures to be employed for protection of on-site personnel, including visitors. The plan will cover the controls, work practices, personal protective equipment, and other health and safety requirements that will be implemented by the Contractor in connection with the remedial action activities.

3.3.2 Construction Documentation

The Contractor(s) is responsible for Quality Control, including daily checks and testing, as documented in the Daily CQC Reports. The CQA Manager will provide Quality Assurance, which is oversight of the Contractor's Quality Control procedures.

Construction documents are controlled by the Design Engineer. The CQA Officer maintains one or more copies of the most current set of construction documents for use by the CQA Monitor. Upon issuance of new copies or revisions, it is the responsibility of the Owner to notify the Contractor and CQA staffs of the revisions, provide revised construction documents, and order the recall of all unrevised copies of the construction documents.

As-built information is controlled by the CQA Monitor and Surveyor. During work progress, the CQA Officer and Design Engineer obtain as-built information from the Contractor, CQA Monitor, Surveyor, or others. At the completion of the project, this information is presented to the CQA Consultant. The Contractor will use this information to prepare Record Drawings of the construction. Final as-built drawings will be included with the Construction Certification Report.

Daily report forms, test report forms, and other project forms are controlled by the CQA Monitor, who maintains a master of each form. Upon issuance of a new form, the CQA Monitor must recall and remove all superseded copies along with the master.

Each CQA Monitor writes a daily record of work progress. Daily reports are reviewed by the CQA Officer, who maintains a complete file of daily reports. These daily reports contain supporting

inspection data sheets and records of any problems that have occurred or corrective measures that were implemented throughout the day. These reports shall include, at a minimum:

- Date, name of project, and location.
- General weather and Site conditions.
- Summary of any meetings conducted and the results of the meetings other than formal periodic meetings.
- Summary of the location of daily construction activities and progress.
- Record of equipment and personnel working in a particular area.
- Locations of work being reviewed and areas passing final inspection.
- Description and conditions of construction materials received at the Site.
- Documentation of erosion and erosion potential.
- Site visits by others.
- Documentation of remediation construction activities and repository construction and materials received.
- Identification of construction problems and their solution of disposition.
- Signature of the CQA personnel.

The CQA Officer will document results of the quality assurance inspections and testing and monitoring activities on a weekly basis in a Quality Assurance (QA) Report, which will include that week's Daily CQC Reports (prepared by the Contractor). These reports will be transmitted weekly from the CQA Officer to Homestake. An Executive Summary, which summarizes the significant construction activity for the period, will be submitted monthly to RWQCB.

Where QA inspections utilize results of the Contractor's surveys, these results will be summarized and included in the QA Report. If the QA results reveal out-of-specification conditions, the CQA Manager will immediately contact the Contractor's Superintendent to determine what action will be taken to modify the construction operation and correct the condition. A written memo will follow up this personal contact to the Contractor confirming any oral instructions given. Instructions to the Contractor for any work that does not comply with specifications will be confirmed with the Contractor in writing. Results of these discussions and follow-up corrective actions will be included in the weekly QA report.

3.3.3 Inspection Data Sheets

All field observations and field testing will be recorded on an inspection data sheet. These sheets will be used to formulate the daily summary reports. Observations in the field may take the form of notes, charts, drawings or sketches, photographs, or any combination of the above. The inspection data sheets will contain the following information:

- Identification of construction problems and their solution of disposition.
- Signature of the CQA personnel.
- Date, name of project, and location.
- Description and title of the inspection activity.
- Time the activity was performed.
- Location of the inspection activity.

- Type of inspection.
- Test equipment used.
- Record of observation with all calculations completed and checked.
- A record of any material or workmanship that does not meet specified designs and all corrective action measures results.

3.3.4 Nonconformance

Whenever a nonconformance is discovered or observed in the construction process, product, job related materials, documentation, or elsewhere, the CQA Monitor must notify the Homestake Construction Manager, Contractor, and CQA Officer as soon as possible. Additionally a nonconformance must be noted in the daily report. The extent of the deficiency may be determined by additional sampling, testing, observations, review of records, or any other means deemed appropriate.

Upon notification by the Contractor that corrective measures are complete, the CQA Monitor verifies completion. Verification must be accomplished by observations or retesting and photographs. Written documentation of the corrective measures must be made by the CQA Monitor on daily reports and logs and forms. Verification of corrective measures is reviewed by the CQA Officer.

3.4 Remedial Action Construction Elements

The Contractor will be required to perform the following activities necessary to implement remedial actions identified in the Remediation Work Plan:

- Establish Site access
- Excavate mine waste and complete Site grading
- Construct, operate, and close the on-site repository
- Demolish processing equipment
- Remove excavated hazardous materials from the Site and transport to permitted off-site disposal facility
- Complete Site restoration

All related work will be conducted in strict accordance with project plans and specifications, which contain specific detailed requirements to achieve the project objectives including permit compliance. The following sections present a brief description of each construction element, including discussions of associated CQA monitoring and testing requirements.

3.4.1 Establish Site Access

Access to each remediation area is necessary for safe equipment and materials delivery. Remediation Areas 1 and 3 are adjacent to County Road 40 and will require minor grading to gain equipment access; Remediation Areas 4, 5, and 6 will require vegetation removal and grading to gain access.

The purpose for QA during establishment of site access is to ensure that appropriate areas are addressed, permit conditions are maintained, and proper techniques and procedures are used in accordance with project drawings and specifications.

Performance will be monitored by construction observation that will consist of confirming appropriate locations prior to beginning site work, and visual inspection of the completed site access prior to starting other tasks.

3.4.2 Excavate Mine Waste

Mine waste will be excavated at Remediation Areas 1, 3, 4, 5, and 6. The purpose for QA during mine waste excavation is to ensure that sufficient material is removed to meet project objectives, minimize disturbance of native materials, confirm that erosion control measures are properly emplaced during the work, and confirm that excavated material is managed appropriately. Waste rock at Remediation Areas 1, 3, and 4, and ore at Remediation Area 6 will be placed at the on-site repository; tailings at Remediation Area 5 and process residuals at Remediation Area 6 will be transported off site for disposal.

Performance will be monitored through construction observation, review of Contractor daily reports, and visual inspection of the excavation extent when the Contractor determines that excavation is complete and prior to the start of final grading.

Pre-construction surveys of each remediation area will be conducted by Homestake. The Contractor is responsible for conducting surveys during construction and completing post-construction surveys. The Contractor will also maintain a record of the number of fully and partially loaded trucks used to transport material from excavation areas to the on-site repository.

The CQA Monitor will be familiar with the local geology and mine waste, and will evaluate the extent of excavation based on color changes, textural changes, stratification, soil horizons, bedrock, and topography. These lines of evidence will be used to determine when excavation should stop.

3.4.3 Repository Construction, Operation, and Closure

The repository will be constructed to isolate excavated Group B and C waste rock from water and the environment. During operation, placement of material from each remediation area will be documented. Closure will consist of emplacing a cover and associated BMPs to prevent erosion and protect the cover until vegetation is established.

The purpose for monitoring repository construction, operation, and closure is to ensure that the repository is built, operated, and closed in accordance with design specifications. Homestake will conduct a survey of the repository location prior to construction and stake the limits of the repository bottom. The Contractor will conduct surveys to document the dimensions and final grade of the repository prior to accepting any excavated waste rock, location and dimensions after waste rock from each of the remediation areas is placed, and final grade and dimensions after the final cover is emplaced.

The CQA Monitor will inspect the repository during construction by visual observation and conducting various tests including:

ASTM D422 Particle-size analysis of soils

ASTM D2487 Standard practice for classification of soils for engineering properties (unified soil classification system)

ASTM D2488 Standard practice for description and identification of soils (visual-manual method)

Tests will be conducted daily during repository base layer construction. No fewer than 10 locations distributed evenly across the base layer will be tested.

Construction monitoring will occur during each phase of repository construction including:

Stripping Subgrade

- Verify that stripping is complete
- Verify that construction staking is performed before work
- Review survey with Design Engineer

Base Layer

- Verify subgrade is scarified to design requirements
- Verify removal and stockpiling of oversized material
- Verify that source of material is suitable for base layer
- Verify lift thickness
- Test compaction and moisture content at required frequencies
- Sample and perform classification testing at required frequencies
- Verify that completed grades meet slope requirements
- Verify that final grading meets tolerance requirements

Waste Rock Placement

- Verify lift thickness
- Verify that completed grades meet slope requirements
- Verify that final grading meets tolerance requirements
- Verify that location of material from each remediation area is documented
- Verify that completed grades meet slope requirements
- Verify that final grading meets tolerance requirements

Soil Cover Borrow Area

- Visually monitor borrow area excavation to identify soil types
- Confirm soil types by sampling and visual classification
- Notify Contractor of visual classification

Soil Cover Engineering Fill Placement

- Verify subgrade is scarified to design requirements
- Verify removal and stockpiling of oversized material
- Verify that source of material is suitable for soil cover fill
- Verify lift thickness
- Test compaction and moisture content at required frequencies
- Sample and perform classification testing at required frequencies
- Verify that completed grades meet slope requirements
- Verify that final grading meets tolerance requirements

Construction surveys completed by the Contractor will be determined by a surveyor on minimum 25-foot centers for the final cover placement at the following locations:

- Top of subgrade
- Top of final cover
- Flow line elevations of drainage ditches and storm water conveyance structures
- Elevations along major grade breaks

The tolerances applicable in setting survey stakes will be as specified in the design.

3.4.4 Demolition of Processing Equipment at Remediation Area 6

Demolition of process equipment will reduce Site physical hazards and be integrated with removal of process residuals for off-site disposal. Demolition will consist of disassembly of metal equipment and containerizing the resulting metal debris for transport to an off-site disposal facility.

Process residuals will be removed prior to demolition to the extent possible and containerized for transport and off-site disposal. CQA monitoring will consist of visual observation to confirm that process residuals and demolition debris are removed from the Site, containerized, and transported off site for disposal.

During demolition, the CQA Monitor will conduct visual inspections to confirm that material such as soot, bricks, and slag are removed from the metal components. The CQA Monitor will also visually confirm that any ACM is appropriately segregated and containerized for off-site disposal by appropriately certified professionals as it is encountered.

3.4.5 Removal of Excavated Materials from the Site and Transport to Permitted Off-Site Disposal Facility

The Contractor is responsible for proper containerization of materials for transport to the off-site disposal facility. The CQA monitor will visually confirm the contents of each container, and the Homestake Construction Manager will confirm that the appropriate manifest and other documentation accompanies each container during transport to the off-site disposal facility. After confirmation of the appropriate documentation, the Contractor will transport the material to the off-site disposal facility.

3.4.6 Site Restoration

Site restoration consists of installation of erosion control BMPs and initial revegetation efforts at each remediation area disturbed by excavation; and restoration of the disturbed channel of Upper Davis Creek at Remediation Areas 4 and 5.

CQA monitoring of Site restoration will consist of visual observation to ascertain that BMPs are properly emplaced, and confirmation that initial revegetation efforts are completed in accordance with the Revegetation Plan at each excavation location.

CQA monitoring of the stream restoration will include inspecting the materials to be used for conformance with specifications, and visual observation to ensure that materials are emplaced in accordance with the design.

4.0 Post Remediation Performance Monitoring and Annual Inspection and Maintenance

Post-remediation performance monitoring and annual inspection and maintenance requirements are identified for the disturbed parts of each remediation area in the General Permit for Storm Water Associated with Construction Activity (General Permit) (Order No. 2009-0009-DWQ as amended). Detection Monitoring and Post-Closure Maintenance for the Group B repository at the Andalusia Pit are identified in CCR Title 27. Monitoring requirements for the OLRA semi-passive treatment system may be identified in waste discharge requirements to be issued by the RWQCB in accordance with the California Water Code.

4.1 Disturbed Parts of Each Remediation Area

The General Permit is implemented through a SWPPP that identifies site-specific monitoring requirements based on the risk level of the Site (level 1, 2, or 3 with 3 being the highest water quality risk). Monitoring requirements described herein are based on Risk Level 2, assumed for the remediation areas.

Level 2 Monitoring comprises visual inspections and sample collection. When a Risk Level 2 construction site is active, the visual monitoring consists of quarterly non-storm water discharge inspections, daily site BMP inspections, pre-storm event inspections, daily inspections during storm events, and post storm inspections. Risk Level 2 sampling is necessary if storm water discharges from the site and consists of measuring the pH and turbidity levels in the discharged water.

With respect to monitoring disturbed parts of each remediation area, coverage under the General Permit is terminated in part by installing post-construction storm water management measures and establishing a long-term (5-year) maintenance plan (Section II D of the General Permit). One purpose of the long-term (5-year) monitoring is to demonstrate that final stabilization conditions are satisfied. After making this demonstration, the site is withdrawn from the General Permit.

Homestake expects that meeting the monitoring requirements of the General Permit for disturbed portions in each remediation area will demonstrate that remediation goals were attained. This is because monitoring is intended to demonstrate that the site does not pose any sediment discharge risk beyond that presented before construction, and the project goal is to remove mine waste from locations where it is subject to erosion and leave native materials stabilized by vegetation in place. Thus, demonstrating stabilization of native materials and mine waste by vegetation would also demonstrate a reduction in the erosion and transport of metal containing mine waste to adjacent water ways.

Post Remediation Monitoring. Post remediation monitoring will consist of two visual inspections per year, one in September before the onset of seasonal rains, and one in April after the seasonal rains cease. Visual inspections will consist of assessing vegetation coverage, BMP performance, and looking for evidence of erosion such as rills and gullies. Visual inspections will be documented on inspection forms and through photography.

Post Remediation Maintenance. Post remediation maintenance will consist of repairing damaged BMPs, removing BMPs (for example straw wattles) determined to be no longer necessary (for example where vegetation is established), and installing additional BMPs as necessary to mitigate erosion. Vegetation will also be maintained in accordance with the Revegetation Plan.

4.2 Group B Repository at Andalusia Pit

The repository will accept material from the remediation areas for a few months during remediation and will then be closed in accordance with CCR Title 27 §21410. Immediately after closure, Homestake will implement a 5-year detection monitoring program.

Closure will consist of installing a final cover consistent with design specifications to minimize infiltration of water into the waste, thereby minimizing leachate production, and installing run-on and runoff controls to prevent entry of water to the repository, and facilitate positive drainage of direct precipitation.

After closure, a five-year compliance period will begin that will include a detection monitoring program (including inspections) and maintenance program.

Detection Monitoring and Inspection. Detection monitoring will consist of quarterly visual inspections of the repository cover and associated drainage controls to detect any cracking or depressions caused by settling, formation of rills, or obstructions to flow paths. Annual vegetation surveys will also be completed as part of monitoring at the repository. Detection monitoring may also include storm water sampling (e.g., at one background location uphill from the repository, and at one location where drainage from the cover flows off the repository) as necessary to comply with permits.

Post-Closure Maintenance. Maintenance will be conducted to correct any issues identified during quarterly visual inspections. The goal of post-closure maintenance at such units is to assure that the unit continues to comply with performance standards of §20950 (a)(2)(A)1 until such time as the waste in the unit no longer constitutes a potential threat to water quality. Homestake considers that after five years, assuming the cover is vegetated in accordance with the Revegetation Plan, no slope failures have occurred, and no erosional features have exposed waste rock at the repository, that the repository will have ceased to pose a threat to water quality and routine “formal” detection monitoring may cease. This is because the waste will have been isolated high above groundwater, and kept dry by virtue of run-on controls and infiltration control (via vegetation and positive drainage), thus, no leachate capable of mobilizing metals from the isolated waste rock, would be generated.

4.3 Old Lower Reed Adit Semi-Passive Drainage Treatment System

The semi-passive drainage treatment at the OLRA will be designed to operate via gravity requiring minimal maintenance. The system will be installed to minimize the potential for surface exposure of the water, so that treated water will infiltrate to the subsurface, and overland flow to surface water will be avoided. After construction, commissioning, and start of regular operations, the treatment system will require periodic monitoring and maintenance that will be conducted in accordance with any issued permits. After five years, the monitoring and maintenance requirements would be updated based on performance.

Monitoring: After start of regular operations, the semi-passive treatment system will be monitored as specified in any issued permits. Routine monitoring may consist of measuring influent and effluent water quality parameters (pH, specific conductance, oxidation-reduction potential, and temperature), collecting samples of influent and effluent for laboratory analysis for chemicals of concern, flow measurement, and visible inspection and observation of the treatment system,

infiltration area, surrounding vegetation and soils, BMPs, and the bank of the tributary to Upper Davis Creek.

Maintenance: Routine maintenance will coincide with monitoring events and consist of clearing any observed flow obstructions and repairing BMPs to prevent run-on, as needed.

Periodic maintenance would occur in response to detection of increasing concentrations of metals in effluent and would entail replacing the reactive matrix in the treatment cell with new matrix to reestablish treatment effectiveness to comply with discharge requirements. Removed material would be sampled to confirm metal contents and managed as a Group C waste by placing it on the surface of waste rock at the Andalusia Pit.

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Tables

(2 Pages)

Table 1: Alternatives Analysis Summary At Reed Mine

Area	Location	Material Type	Waste Classification [1]	Estimated Volume[2] (cubic yards in-place)	Recommended Action[3]	Rationale
Andalusia Mine	Andalusia Pit	Waste Rock	C	5,350	No Action	No threat to water quality from existing mine unit, established vegetation, disturbing material on the steep slope would result in increased likelihood for erosion of pre-mining soils naturally enriched in mercury and other metals.
	Andalusia North	Waste Rock	C	1,330	No Action	No threat to water quality from existing mine unit, established vegetation, disturbing material on the steep slope would result in increased likelihood for erosion of pre-mining soils naturally enriched in mercury and other metals.
	Andalusia Main	Waste Rock	C	4,250	No Action	No threat to water quality from existing mine unit, established vegetation, disturbing material on the steep slope would result in increased likelihood for erosion of pre-mining soils naturally enriched in mercury and other metals.
Fusiyama Mine	Fusiyama Adit	Waste Rock	B	575	Remediation Area 1: Excavate Waste Rock	Waste rock poses threat to water quality and extends to adjacent drainage that is tributary to Upper Davis Creek.
	Fusiyama Pit	Waste Rock	C	1,460	No Action	No threat to water quality from existing mine unit, established vegetation, disturbing material on the steep slope would result in increased likelihood for erosion of pre-mining soils naturally enriched in mercury and other metals.
	Fusiyama Shaft	Waste Rock	C	285	No Action	No threat to water quality from existing mine unit, established vegetation, disturbing material on the steep slope would result in increased likelihood for erosion of pre-mining soils naturally enriched in mercury and other metals.
Reed Mine	Reed North	Waste Rock	C	840	Remediation Area 2: Stabilize Gully in Waste Rock	Continued erosion of waste rock would result in transport of mercury containing rock to tributary to Upper Davis Creek.
	Reed Main	Waste Rock	B	760	No Action	Waste rock is located remote from surface water such that attenuation is sufficient to protect water quality from existing mine unit, established vegetation, disturbing material on the steep slope would result in increased likelihood for erosion of pre-mining soils naturally enriched in mercury and other metals.
	Reed South 1	Waste Rock	B	400	No Action	Waste rock is located remote from surface water such that attenuation is sufficient to protect water quality from existing mine unit, established vegetation, disturbing material on the steep slope would result in increased likelihood for erosion of pre-mining soils naturally enriched in mercury and other metals.
	Reed South 2	Waste Rock	C	580	No Action	No threat to water quality from existing mine unit, established vegetation, disturbing material on the steep slope would result in increased likelihood for erosion of pre-mining soils naturally enriched in mercury and other metals.
	Reed South 3	Waste Rock	C	855	Remediation Area 3: Remove Waste Rock at Old Lower Reed Adit, Passively Treat and Infiltrate Adit Drainage	Waste rock forms north bank of tributary to Upper Davis Creek, drainage contains metals (arsenic, cobalt, copper, iron, manganese, mercury, and nickel) that are elevated in surface water in the drainage and in Upper Davis Creek.
Davis Creek	East Bank Slope	Waste Rock	B	430	Remediation Area 4: Excavate Waste Rock	Waste rock forms east bank of Upper Davis Creek, and is visibly eroding into creek.
	West Bank Furnace 1	Tailings, Brick, Sandstone blocks	A	230	Remediation Area 5: Excavate Tailings	Tailings extend to west bank of Upper Davis Creek and are visible eroding into creek.
	West Bank Furnace 2	Tailings, Brick, Loose Sandstone blocks	A	320	Remediation Area 5: Excavate Tailings	Tailings extend to west bank of Upper Davis Creek and are visible eroding into creek.
	West Bank Furnace 3	Tailings, Brick, Loose Sandstone blocks	A	180	Remediation Area 5: Excavate Tailings	Tailings extend to west bank of Upper Davis Creek and are visible eroding into creek.

Notes:

1 = California Code of Regulations, Division 2, Title 27, Chapter 7 Subchapter 1, Article 1 SWRCB – Mining Waste Management Regulations

2 = Volume Group A is about 730 cubic yards, Volume Group B is about 2,165 cubic yards, Volume Group C is about 14,950 cubic yards

3 = No Action locations are shown in blue on Figure 2.

Table 2: Remediation Area Activities for Reed Mine

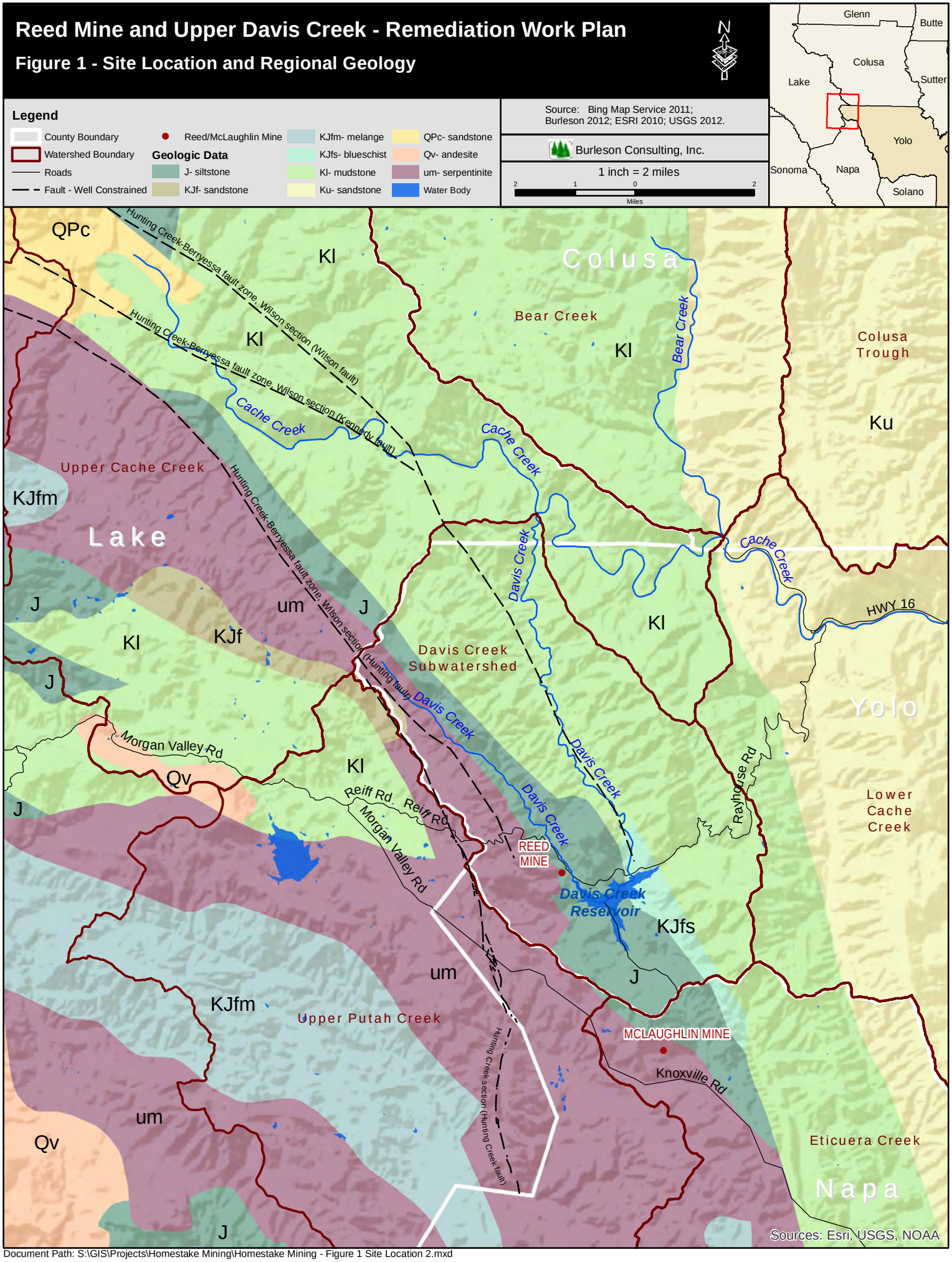
Location	Material to be Removed	Access Preparation Steps	Frequency	Post Construction
County Road 40 (from Andalusia Mine to Lower Reed Mine)	Not Any (grading of road surface soils)	• Inspect Road • Grade to ensure safe personnel and equipment travel	• Before mobilization • Weekly inspection during project • Grade as needed	• Restore any interrupted roadside ditches or culverts • Remove berms as necessary to allow appropriate drainage of the road surface • Install water bars/dips with armored outlets
Remediation Area 1	575 cubic yards Group B Waste Rock	• Inspect area • Remove brush as necessary for safe access. • Minor grading to provide safe access	• One time at beginning of area work	• None, site restoration will occur in accordance with the revegetation plan
Remediation Area 2	Not any (stabilize gully in Group C Waste Rock)	• Inspect route to area • Trim vegetation if needed • Emplace temporary walk ways to cross wash-outs if needed	• One time at beginning of area work	• Remove temporary walk-ways if used
Remediation Areas 3 and 4	• RA 3: 1400 cubic yards Group C Waste Rock. • RA 4: 430 cubic yards Group B Waste Rock	• Remove existing fence along both sides of road • Remove brush as necessary for safe access • Rough grade site entrance to ensure safe personnel and equipment access	• One time at beginning of area work	• Install fences along both sides of road
Remediation Area 5	730 cubic yards Group A Tailings	• Establish access to existing old road along southwest bank of creek at Remediation Area 3. • Remove trees and brush as necessary for safe access and safe work space • Remove metal, wood and other debris (***not*** bricks) as necessary for safe work space	• One time at beginning of area work	None, site restoration will occur in accordance with the revegetation plan
Remediation Area 6	• 75 cubic yards of Group A process residuals • 50 cubic yards of Group B ore	• Inspect former access road • Regrade former access road while taking care to avoid disturbing the existing vegetated cover on tailings	• One time at beginning of area work	None, site restoration will occur in accordance with the revegetation plan
Borrow Area	Native material as needed	• Remove vegetation as necessary for safe access	• One time at beginning of area work	None, site restoration will occur in accordance with the revegetation plan
Repository	To be determined in design	• Inspect route from road to repository • Remove brush as necessary from route • Grade route to ensure safe equipment and personnel access	• One time at beginning of area work	Place boulders and roughen access road surface to prevent vehicle access

Figures

(16 Pages)

Reed Mine and Upper Davis Creek - Remediation Work Plan

Figure 1 - Site Location and Regional Geology



Document Path: S:\GIS\Projects\Homestake Mining\Homestake Mining - Figure 1 Site Location 2.mxd

Reed Mine and Upper Davis Creek- Remediation Work Plan

Figure 2 - Remediation Areas

Legend

- Reference Soil Sample
- Mine Waste Sample
- Adit
- Decline
- Waste Rock Group B
- Waste Rock Group C
- Remediation Area Waste Rock
- Remediation Area Waste Rock Slope
- Tailings Top
- Tailings Slope
- Davis Creek
- Davis Creek tributary
- County Roads
- Old Mine Road
- Cut
- Former Rail Bed
- Road Reference Sample
- Road Waste Sample

Burleson Consulting, Inc.

Source: USGS 2012; ESRI Data Server 2010; Burleson 2014; Trans-Pacific Metals, Inc. 1959.

Locations are Approximate

Remediation Area 1: Fusiyama Adit

Remove Waste Rock

Andalusia North

Andalusia Main

Andalusia Pit

Andalucia Pit Decline

Sky High Adit

Upper Reed Adit No. 2

Upper Reed Adit

Proposed Future On-Site Repository

Willow Adit

Fusiyama Adit

Lower Fusiyama Adit

Fusiyama Pit

Davis Creek

Remove Tailings and Bricks

Remediation Area 4: East Bank of Davis Creek

Remediation Area 5: West Bank Davis Creek Furnace Area 1, 2, 3

Remove Waste Rock

Fusiyama Shaft

Fusiyama Shaft

Remediation Area 2: Reed North

Big Adit

Reed North

North Reed Decline

Reed Main

Old Caved Adit

Main Reed Decline

Lower Reed Adit

East Bank Davis Creek Slope

West Bank Davis Creek Furnace Area 1, 2, 3

Former Reed Mine Processing Area

Stabilize Gully

Reed South 1

Reed South 2

Old Adit

Old Lower 3 Reed Adit

Reed South

Remediation Area 3: OLRA Waste Rock & Drainage

Old Adit

Old Lower Reed Adit

Treat Mine Drainage

Install Water Bars

Remove Waste Rock From Tributary to Davis Creek

Remove/Stabilize Rotary Furnace and Bin Residue

Remove/Stabilize Condenser Channel Residue

Remove/Stabilize Rotary Furnace Brick Lining

Recycle Iron

Remove/Stabilize Ore

Remediation Area 6: Former Reed Mine Processing Area

550 275 0 550 Feet

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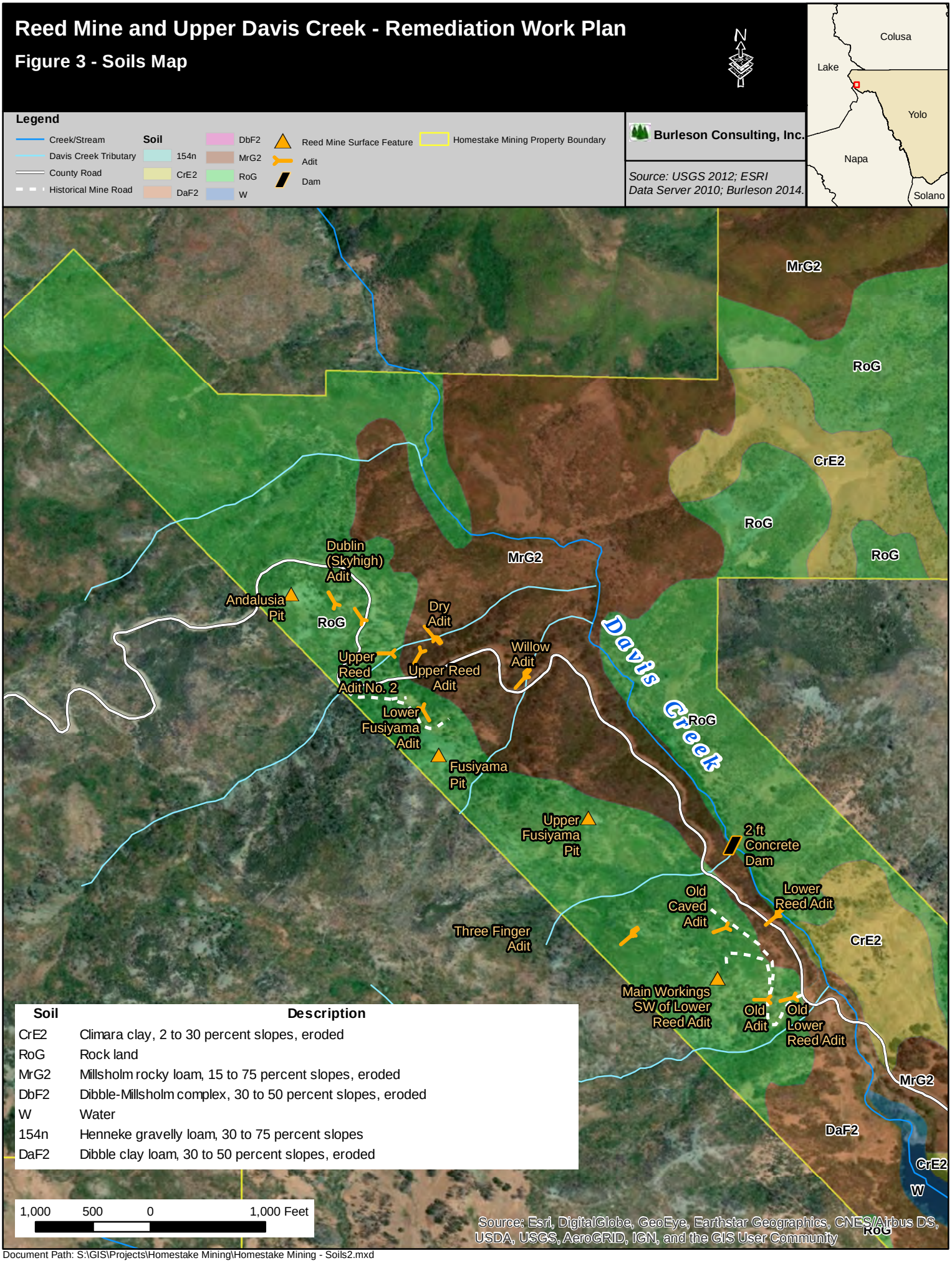
Reed Mine and Upper Davis Creek - Remediation Work Plan

Figure 3 - Soils Map



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Reed Mine and Upper Davis Creek - Remediation Work Plan

Figure 4 - Vicinity, Command Post, and Staging Areas

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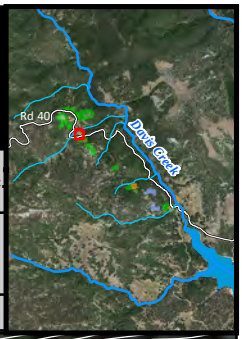
Reed Mine and Upper Davis Creek - Remediation Work Plan

Figure 5 - Remediation Area 1



Legend

- Vegetated Strip
- Fiber Rolls
- Remediation Area Waste Rock
- Remediation Area Waste Rock Slope
- Davis Creek tributary
- County Roads
- Current 1 foot contour

Burleson Consulting, Inc.

Source: USGS 2012; ESRI Data Server 2010; Burleson 2014; Trans-Pacific Metals, Inc. 1959.

Locations are Approximate

Revegetation seeding will occur on all remediation area surfaces.

40 20 0 40 Feet

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Document Path: S:\GIS\Projects\Homestake Mining\Erosion_Control_MXDs\Figure 1 - Fusiyama Adit.mxd

Reed Mine and Upper Davis Creek - Remediation Work Plan

Figure 6 - Remediation Area 1 Conceptual Cross Section (View to the North)

LEGEND

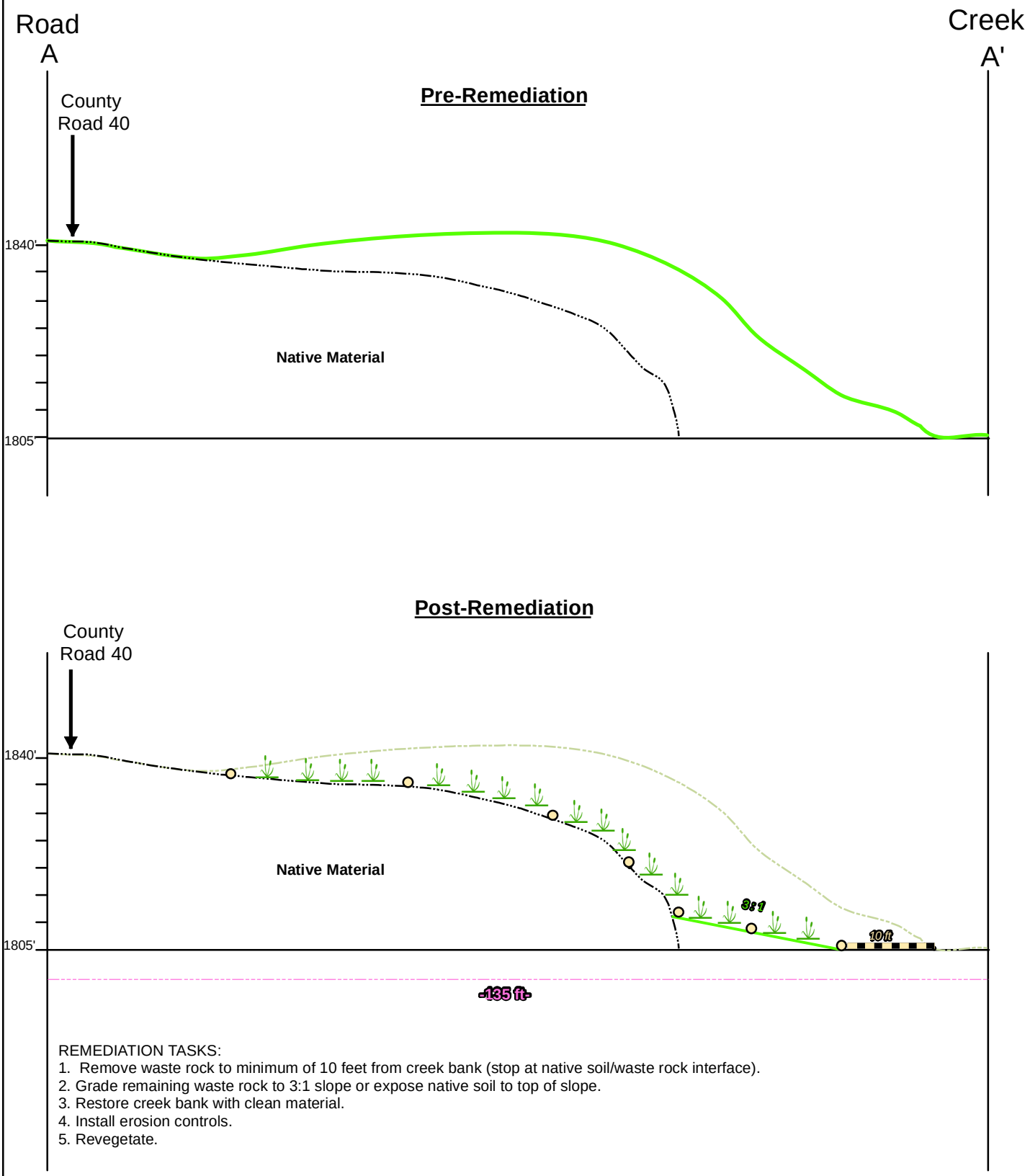
Revegetate
Straw Wattle
Native Material
Waste Rock
Removed Waste Rock
Compacted Fill

SCALE

Vertical: 1 inch = 25 ft
Horizontal: 1 inch = 15 ft
1 inch

Burleson Consulting, Inc.

Elevation is Relative



REMEDIATION TASKS:

1. Remove waste rock to minimum of 10 feet from creek bank (stop at native soil/waste rock interface).
2. Grade remaining waste rock to 3:1 slope or expose native soil to top of slope.
3. Restore creek bank with clean material.
4. Install erosion controls.
5. Revegetate.

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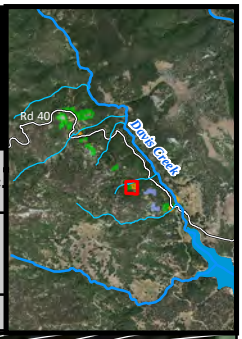
Reed Mine and Upper Davis Creek - Remediation Work Plan

Figure 7 - Remediation Area 2



Legend

- Adit
- Gully
- Gully Revegetation
- Brush Check Dam
- Earthen Berm
- Water Bars
- Remediation Area Waste Rock
- Remediation Area Waste Rock Slope
- Waste Rock Group C
- Davis Creek tributary
- Old Mine Road
- Current 1 foot contour

Burleson Consulting, Inc.

Source: USGS 2012; ESRI Data Server 2010; Burleson 2014; Trans-Pacific Metals, Inc. 1959.

Locations are Approximate

Revegetation seeding will only occur within the "Gully Revegetation" area.

Big Adit

Reed North

North Reed Decline

50 25 0 50 Feet

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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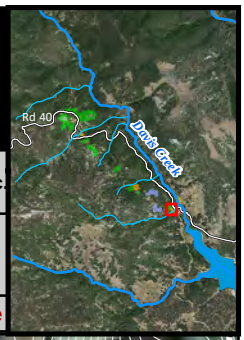
Reed Mine and Upper Davis Creek - Remediation Work Plan

Figure 8 - Remediation Area 3



Legend

- Concrete Channel
- Concrete Basin
- Gravel Infiltration Gallery
- Vegetated Strip
- Fiber Rolls
- Water Bars
- Adit
- Remediation Area Waste Rock
- Remediation Area Waste Rock Slope
- Waste Rock Group C
- Davis Creek tributary
- County Road
- Old Mine Road
- Current 1 foot contour

Burleson Consulting, Inc.

Source: USGS 2012; ESRI Data Server 2010; Burleson 2014; Trans-Pacific Metals, Inc. 1959.

Locations are Approximate

Revegetation seeding will occur on all non-concrete remediation area surfaces.

Old Lower Reed Adit

Reed South 3

50 25 0 50 Feet

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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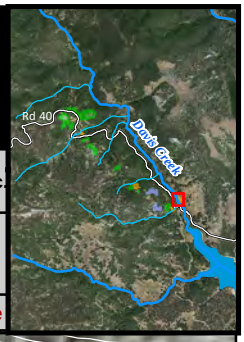
Reed Mine and Upper Davis Creek - Remediation Work Plan

Figure 10 - Remediation Areas 4 & 5



Legend

- rock wall
- Upper Davis Creek Diversion Pipeline
- Upper Davis Creek Diversion
- Jute Mat
- Jute Mat with Gravel Toe
- Fiber Rolls
- Remediation Area Waste Rock
- Remediation Area Waste Rock Slope
- Waste Rock Group C
- Tailings & Bricks Slope
- Tailings & Bricks Top
- Davis Creek
- Davis Creek tributary
- County Roads
- Old Mine Road
- Current 1 foot contour

Burleson Consulting, Inc.

Source: USGS 2012; ESRI Data Server 2010; Burleson 2014; Trans-Pacific Metals, Inc. 1959.

Locations are Approximate

Revegetation seeding will occur on all remediation area surfaces.

Remediation Area 4

Remediation Area 5

Engineer's Office

Old Furnace

50 25 0 50 Feet

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Document Path: S:\GIS\Projects\Homestake Mining\Erosion_Control_MXDs\Figure 4 - Davis Creek Slope2.mxd

Reed Mine and Upper Davis Creek - Remediation Work Plan

Figure 11 - Remediation Areas 4 & 5 Conceptual Cross Section (View to the Northwest)

LEGEND

- Revegetate
- Straw Wattle
- Gravel Toe
- Native Material
- Waste Rock
- Removed Waste Rock
- Mine Tailings & Bricks
- Removed Tailings & Bricks
- Jute Mat or Similar

SCALE

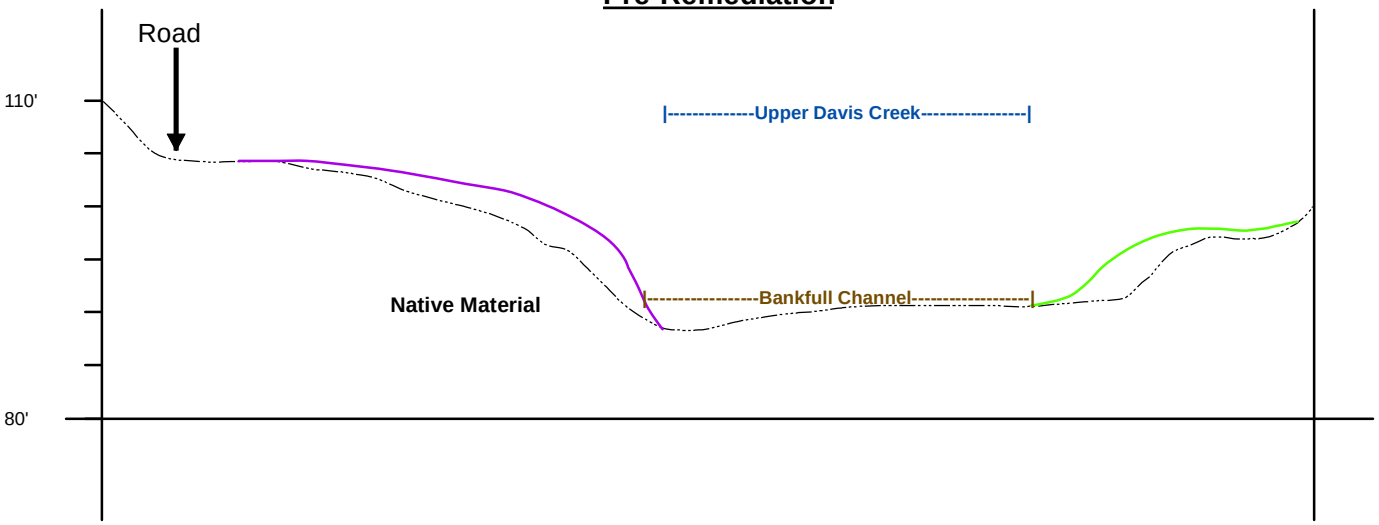
Vertical: 1 inch = 18 ft
Horizontal: 1 inch = 30 ft

1 inch

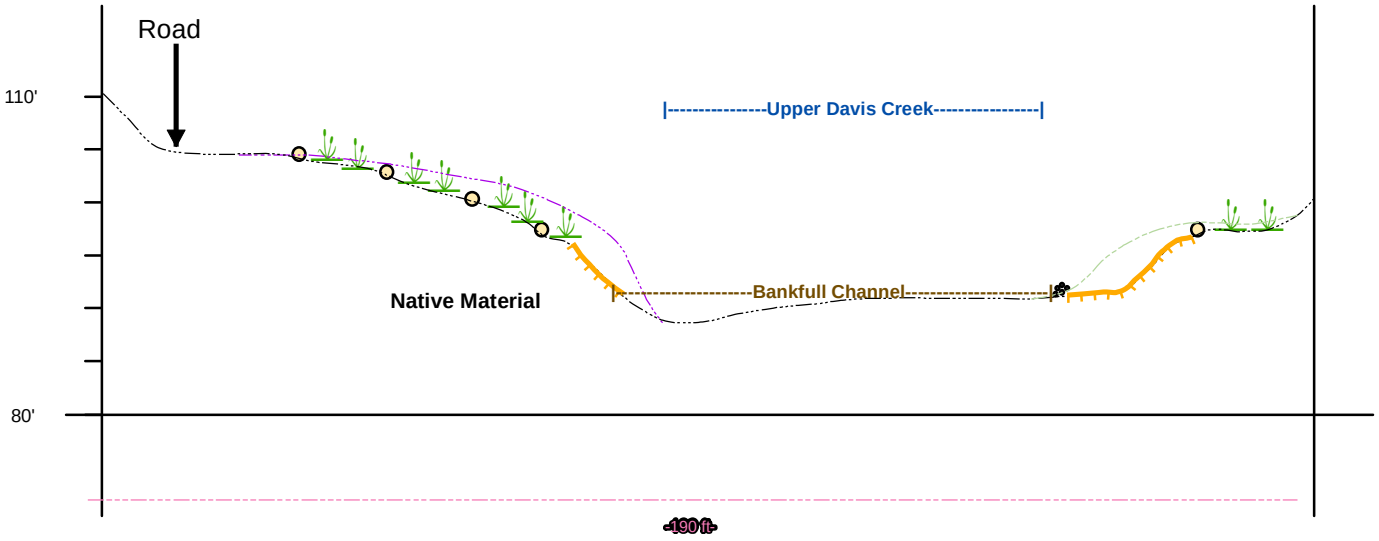
Burleson Consulting, Inc.

Elevation is Relative

Pre-Remediation



Post-Remediation



REMEDIATION TASKS:

1. Remove waste rock to minimum of 10 feet from creek bank (stop at native soil/waste rock interface).
2. Grade remaining waste rock to 3:1 slope or expose native soil to top of slope.
3. Restore creek bank with clean material.
4. Install erosion controls.
5. Revegetate.
6. Extent of excavation at creek margins will be determined by results of channel sediment characterization.

NOTE: Remediation activities will not occur within the bankfull channel.

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Reed Mine and Upper Davis Creek

Figure 12 - Remediation Area 6 Access

Legend

- Creeks
- Old Mine Road
- Private Road (unpaved)
- County Road 40 (unpaved)
- Access to be Graded
- Staging Area

Burleson Consulting, Inc.

Source: ESRI Data Server 2010; Burleson 2015; USDA NAIP 2012; Trans-Pacific Metals, Inc. 1959.

Locations are Approximate

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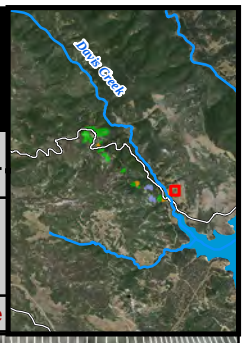
Reed Mine and Upper Davis Creek - Remediation Work Plan

Figure 13 - Remediation Area 6



Legend

- Ore Pile Revegetation
- Old Mine Road
- Fiber Rolls
- Current 1 foot contour

Burleson Consulting, Inc.

Source: ESRI Data Server 2010; Burleson 2015; USDA NAIP 2012; Trans-Pacific Metals, Inc. 1959.

Locations are Approximate

Revegetation seeding will occur on "Ore Pile Revegetation" areas.

Soot Bin

Rotary Furnace

Condensers

Small Ore Pile

Ore on Slope

50 25 0 50 Feet

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Document Path: S:\GIS\Projects\Homestake Mining\Erosion_Control_MXDs\Figure 13 - Remediation Area 6 Details.mxd

Reed Mine and Upper Davis Creek - Remediation Work Plan

Figure 14 - Repository Location

Legend

- Adit
- Decline
- Access to be Graded
- Repository
- Waste Rock Group C
- Depression
- Cut
- Old Mine Road
- County Road 40 (unpaved)

Burleson Consulting, Inc.

Source: ESRI Data Server 2010; Burleson 2015; USDA NAIP 2012; Trans-Pacific Metals, Inc. 1959.

Locations are Approximate

Andalusia North

Andalusia Pit

Andalucia Pit Decline

Sky High Adit

100 50 0 100 Feet

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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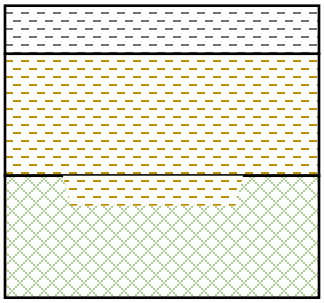


12” compacted cover of native material

Compacted mine waste keyed into serpentinite bedrock (per design)

Serpentinite Bedrock (Depth to groundwater about 230 + feet)

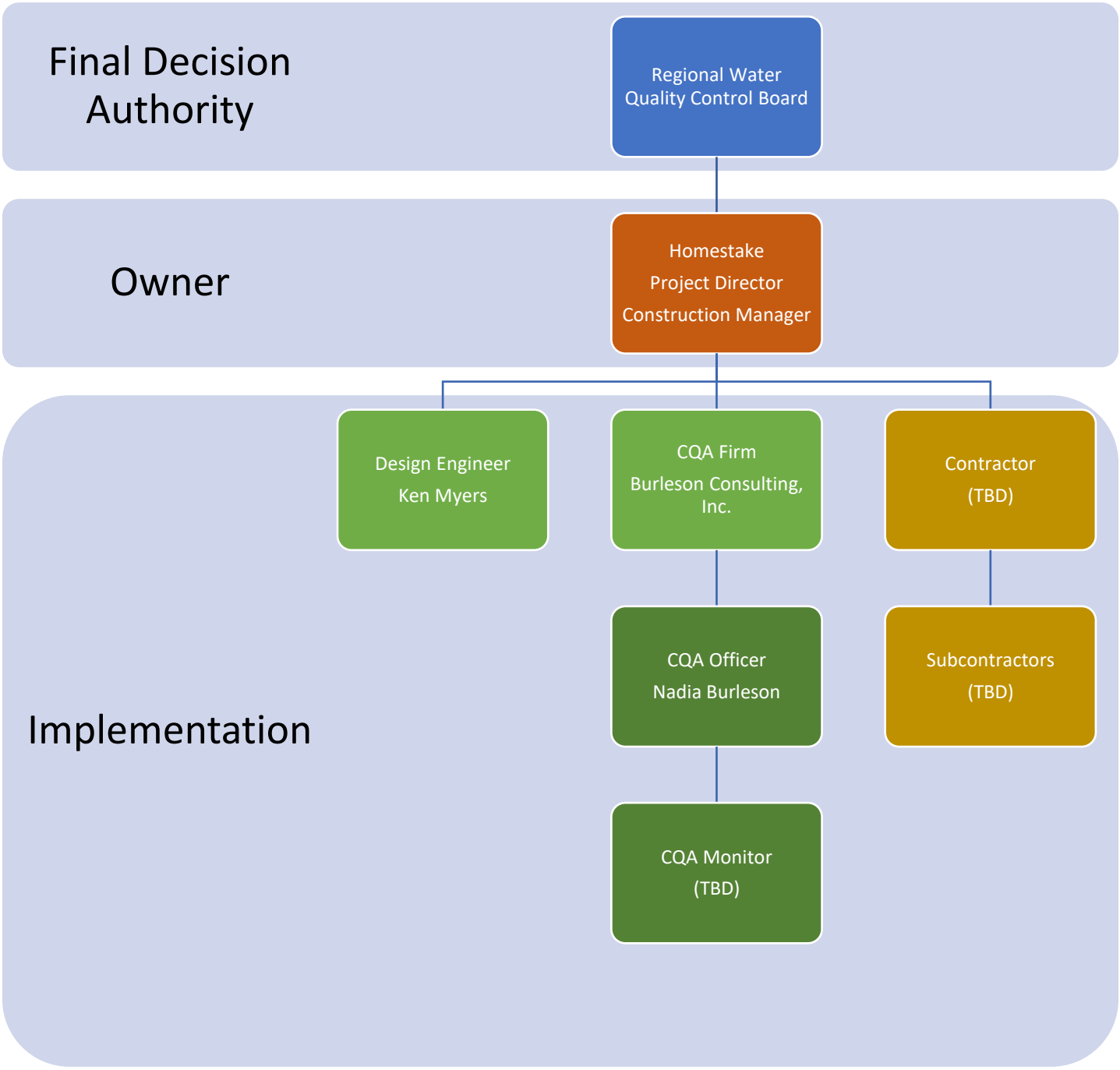
Notes:

Material to be placed in lifts, moistened for dust control and wheel or track rolled for compaction.

Uphill edge of repository to be protected from erosion by diversion ditch designed to accept 50-year runoff flows.

Cover to be compacted and stabilized using best management practices (straw wattles, straw mulch, degradable fabric, hydroseed with tackifier) in accordance with the storm water pollution protection plan, and revegetated in accordance with the revegetation plan.

Incorporates Title 27 §22470 (c) exemptions from requirements for a leachate control and liner system


Final Decision Authority
Regional Water Quality Control Board
Owner
Homestake
Project Director
Construction Manager
Design Engineer
Ken Myers
CQA Firm
Burleson Consulting, Inc.
Contractor
(TBD)
Implementation
CQA Officer
Nadia Burleson
Subcontractors
(TBD)
CQA Monitor
(TBD)

Appendices

A Erosion Control Plan

B Revegetation Plan

C Channel Restoration Design (in progress)

D OLRA Drainage Treatment Design

E Repository Design (in progress)

Appendix A

Erosion Control Plan

Erosion Control Plan for Reed Mercury Mine and Upper Davis Creek Remediation Project

Prepared by

Burleson Consulting, Inc.
950 Glenn Drive
Suite 245
Folsom, CA 95630
(916) 984-4651

Prepared for
Homestake Mining Company

February 2019

1.0 Remediation Areas Control Measures

This Erosion Control Plan details erosion control measures that have been developed for each of the six remediation areas of Reed Mine and will be implemented on site. Table 1 provides a summary of the erosion control measures that will be used at each remediation area. Additionally, fact sheets for proposed BMPs are included in this plan following remediation area descriptions.

The erosion control measures identified herein are based on the slopes and materials anticipated prior to implementing remediation. Actual erosion control measures should be tailored to the site based on actual site conditions after excavation and any associated backfill is emplaced. If site conditions require significant variation from the erosion control measures identified herein, the project engineer should be consulted prior to implementing suggested changes.

Table 1. Summary of Erosion Control Measures by Remediation Area

Erosion Control Measure (CASQA)	Remediation Area 1	Remediation Area 2	Remediation Area 3	Remediation Area 4	Remediation Area 5	Remediation Area 6
Hydraulic Mulch (EC-3)[1]	✓		✓	✓	✓	✓
Hydroseeding (EC-4)[1]	✓		✓	✓	✓	✓
Geotextiles & Mats (EC-7)				✓	✓	
Earthen Dikes (EC-9)[2]		✓	✓			
Check Dam (SE-4)		✓				
Fiber Rolls (SE-5)	✓		✓	✓	✓	✓

[1] Will be used together and ollectively referred to as hydroseeding in this plan.
[2] Referred to as berms and water bars in this plan.

1.1 Remediation Area 1

Remediation activities at this location consist of removing waste rock from the slope between County Road 40 and a tributary to Upper Davis Creek at Fusiyama Adit, and regrading any remaining waste rock to a 3:1 slope or matching the adjoining topography. Erosion control measures for Remediation Area 1 are illustrated in Figure 1 of this plan. Waste rock nearest the tributary will be removed to create a 10-foot wide low-gradient vegetation filter strip at the toe of the slope. The resurfaced slope will be revegetated with a native seed mx. Additional erosion control will be employed:

- Track walk site perpendicular to the slope prior to reseeding.
- Trench for fiber roll placement after track walking.
- Install fiber rolls at the upslope boundary of the area disturbed by remediation and on the slope. The installation of fiber rolls will be parallel to the contour of the regraded slope, and space fiber rolls each 15 linear feet along slope, and install fiber rolls at the toe of the slope.
- Hydroseed with native erosion control seed mix.
- Seed an approximately 10-foot wide vegetated buffer strip at the toe of the remediation area slope with native erosion control seed mix.

1.2 Remediation Area 2

Remediation activities at this location consist of redirecting water from the historic mine road south of the waste rock slope away from the gully through the waste rock pile. Erosion control measures for Remediation Area 2 are illustrated in Figure 2 of this plan. With run-on water directed away from the gully and other mine waste piles by emplacing an earthen berm, the following erosion control measures will be employed:

- Install water bars along the historical road to direct water to the existing depression south of the mine waste pile.
- Install an earthen berm in a semi-circular shape on the road at the head of the gully.
- Stabilize gully.
    - Check dams of local brush will be entrenched and spaced approximately 15 feet apart.
    - Hand broadcast seed in gully with native erosion control seed mix.

1.3 Remediation Area 3

Remediation activities at this location consist of removing waste rock downslope of the lower Reed adit and east of County Road 40, constructing an aeration channel that conveys adit drainage from the adit to a treatment system, placing clean fill as necessary to install a semi passive drainage treatment system, and installation of a semi-passive drainage treatment system with infiltration gallery. Erosion control measures for Remediation Area 3 are illustrated in Figure 3 of this plan. Any remaining waste rock will be graded to a 3:1 slope or graded to match adjoining native topography. Waste rock nearest the tributary will be removed to create a 10-foot wide low gradient vegetation filter strip. The resurfaced slope will be revegetated with a native seed mix. Additional erosion control measures will be employed:

- Track walk site perpendicular to the slope prior to reseeding.
- Trench for fiber roll placement after track walking.
- Install fiber rolls at the upslope boundary of the area disturbed by remediation and on the slope. The installation of fiber rolls will be parallel to the contour of the regraded slope, and space fiber rolls each 20 linear feet along slope, and install fiber rolls at the toe of the slope and at the closest edge to the Davis Creek tributary.
- Install water bars on the upslope historical road to prevent offsite run-on.
- Hydroseed with native erosion control seed mix.
- Seed an approximately 10-foot wide vegetated buffer strip at the toe of the remediation area slope with native erosion control seed mix.

1.4 Remediation Area 4

Remediation activities at this location consist of removing mine waste along the eastern bank of Upper Davis Creek. This area is downslope of the former Reed Mine processing area. Erosion control measures for Remediation Area 4 are illustrated in Figure 4 of this plan. Removal will not occur in the creek bed below bankfull width. The slope will be benched in areas where feasible (see Appendix C) and will be reseeded with native seed mix. Additional erosion control measures will be employed:

- Track walk site perpendicular to the slope prior to reseeding.

- Trench for fiber roll placement after track walking.
- Install fiber rolls at the upslope boundary of the area disturbed by remediation and on the slope. The installation of fiber rolls will be parallel to the contour of the regraded slope, and space fiber rolls each 15 linear feet along slope, and install fiber rolls at the toe of the slope.
- Hydroseed with native erosion control seed mix.
- Install jute mat with a gravel toe will be employed at the toe of the remediation area slope.

1.5 Remediation Area 5

Remediation activities at this location consist of removing tailings and bricks along the western bank of Upper Davis Creek and downslope for former furnaces used to recover mercury. Removal will not occur below the bankfull width of the creek bed. Erosion control measures for Remediation Area 5 are illustrated in Figure 4 of this plan. Tailings nearest the tributary will be removed to create an approximate 10-foot wide low gradient strip. The slope will be tracked and reseeded with native seed mix. Additional erosion control measures will be employed:

- Track walk site perpendicular to the slope prior to reseeding.
- Trench for fiber roll placement after track walking.
- Install fiber rolls at the upslope boundary of the area disturbed by remediation and on the slope. The installation of fiber rolls will be parallel to the contour of the regraded slope, and space fiber rolls each 15 linear feet along slope, and install fiber rolls at the toe of the slope.
- Hydroseed with native erosion control seed mix.
- Seed an approximately 10-foot wide vegetated buffer strip at the toe of the remediation area slope with native erosion control seed mix.
- Install jute mat with a gravel toe will be employed at the toe of the remediation area slope.

1.6 Remediation Area 6

Remediation activities at this location consist of removing ore along the south and southwest edge of the former Reed Mine Processing Area, removing condenser channel residue, Rotary furnace and bin residue, and rotary furnace brick lining, and stabilizing all of these areas. Additionally, iron equipment will be removed and recycled. Erosion control measures for Remediation Area 6 are illustrated in Figure 5 of this plan. Additional erosion control measures will be employed:

- Install fiber rolls directly upgradient and downgradient of the removal area, and across the slope at 15-foot intervals
- Hydroseed slope with native plant seed mix

2.0 Monitoring

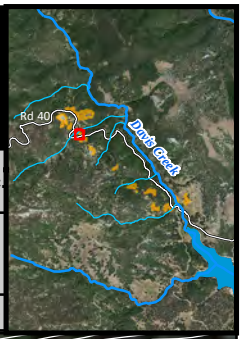
Remediation areas will require maintenance monitoring to ensure that erosion is minimized at the remediation areas. Erosion monitoring will occur during revegetation monitoring. Indications of erosion include formation of rills, significant accumulation of sediment behind fiber rolls, undercutting of fiber rolls, and offsite transport of sediment.

3.0 Corrective Measures

If during the course of erosion control measure monitoring there is evidence that erosion is occurring at a remediation area, corrective measures will be assessed and employed. Corrective measures may include additional broadcasting of seed, soil or additional soil amendments, installation of new or additional fiber rolls, check dams, geotextile mats, silt fencing, or mulch. Monitoring and corrective measures will be employed until vegetation is established. Any corrective action will be documented and the appropriate team members notified.

Reed Mine and Upper Davis Creek - Erosion Control Plan

Figure 1 - Remediation Area 1



Legend

- Vegetated Strip
- Fiber Rolls
- Remediation Area Waste Rock
- Remediation Area Waste Rock Slope
- Davis Creek tributary
- County Roads
- Current 1 foot contour

Burleson Consulting, Inc.

Source: USGS 2012; ESRI Data Server 2010; Burleson 2014; Trans-Pacific Metals, Inc. 1959.

Locations are Approximate

Revegetation seeding will occur on all remediation area surfaces.

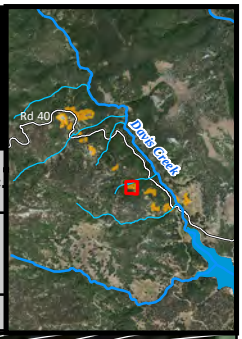
40 20 0 40 Feet

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Document Path: S:\GIS\Projects\Homestake Mining\Erosion_Control_MXDs\Figure 1 - Fusiyama Adit.mxd

Reed Mine and Upper Davis Creek - Erosion Control Plan

Figure 2 - Remediation Area 2



Legend

- Adit
- Gully
- Gully Revegetation
- Brush Check Dam
- Earthen Berm
- Water Bars
- Remediation Area Waste Rock
- Remediation Area Waste Rock Slope
- Waste Rock Group C
- Davis Creek tributary
- Old Mine Road
- Current 1 foot contour

Burleson Consulting, Inc.

Source: USGS 2012; ESRI Data Server 2010; Burleson 2014; Trans-Pacific Metals, Inc. 1959.

Locations are Approximate

Revegetation seeding will only occur within the "Gully Revegetation" area.

Big Adit

Reed North

North Reed Decline

50 25 0 50 Feet

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Document Path: S:\GIS\Projects\Homestake Mining\Erosion_Control_MXDs\Figure 2 - Reed North.mxd

Reed Mine and Upper Davis Creek - Erosion Control Plan

Figure 3 - Remediation Area 3

Legend

- Concrete Channel
- Concrete Basin
- Gravel Infiltration Gallery
- Vegetated Strip
- Fiber Rolls
- Water Bars
- Adit
- Remediation Area Waste Rock
- Remediation Area Waste Rock Slope
- Waste Rock Group C
- Davis Creek tributary
- County Road
- Old Mine Road
- Current 1 foot contour

Burleson Consulting, Inc.

Source: USGS 2012; ESRI Data Server 2010; Burleson 2014; Trans-Pacific Metals, Inc. 1959.

Locations are Approximate

Revegetation seeding will occur on all non-concrete remediation area surfaces.

Old Lower Reed Adit

Reed South 3

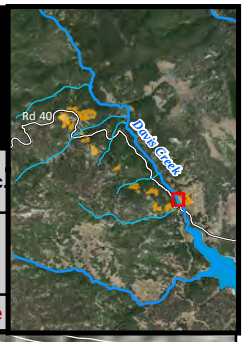
50 25 0 50 Feet

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Document Path: S:\GIS\Projects\Homestake Mining\Erosion_Control_MXDs\Figure 3 - Reed South.mxd

Reed Mine and Upper Davis Creek - Erosion Control Plan

Figure 4 - Remediation Areas 4 & 5



Legend

- rock wall
- Upper Davis Creek Diversion Pipeline
- Upper Davis Creek Diversion
- Jute Mat
- Jute Mat with Gravel Toe
- Fiber Rolls
- Remediation Area Waste Rock
- Remediation Area Waste Rock Slope
- Waste Rock Group C
- Tailings & Bricks Slope
- Tailings & Bricks Top
- Davis Creek
- Davis Creek tributary
- County Roads
- Old Mine Road
- Current 1 foot contour

Burleson Consulting, Inc.

Source: USGS 2012; ESRI Data Server 2010; Burleson 2014; Trans-Pacific Metals, Inc. 1959.

Locations are Approximate

Revegetation seeding will occur on all remediation area surfaces.

Upper Davis Creek

Remediation Area 4

Remediation Area 5

Engineer's Office

Old Furnace

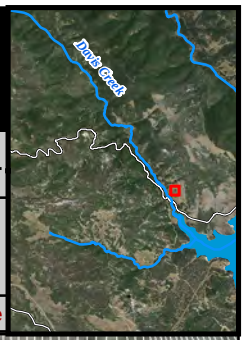
50 25 0 50 Feet

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Document Path: S:\GIS\Projects\Homestake Mining\Erosion_Control_MXDs\Figure 4 - Davis Creek Slope2.mxd

Reed Mine and Upper Davis Creek - Erosion Control Plan

Figure 5 - Remediation Area 6



Legend

- Ore Pile Revegetation
- Old Mine Road
- Fiber Rolls
- Current 1 foot contour

Burleson Consulting, Inc.

Source: ESRI Data Server 2010; Burleson 2015; USDA NAIP 2012; Trans-Pacific Metals, Inc. 1959.

Locations are Approximate

Revegetation seeding will occur on "Ore Pile Revegetation" areas.

Soot Bin

Rotary Furnace

Condensers

Small Ore Pile

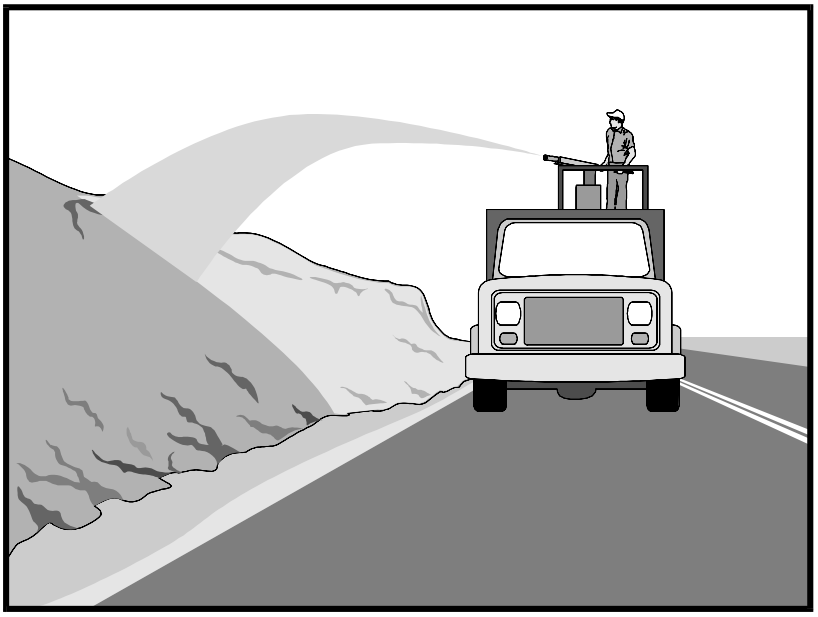
Ore on Slope

50 25 0 50 Feet

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Document Path: S:\GIS\Projects\Homestake Mining\Erosion_Control_MXDs\Figure 13 - Remediation Area 6 Details.mxd

Hydraulic Mulch EC-3



Objectives

EC	Erosion Control	☑
SE	Sediment Control	
TR	Tracking Control	
WE	Wind Erosion Control	☒
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

EC-4 Hydroseeding

EC-5 Soil Binders

EC-6 Straw Mulch

EC-7 Geotextiles and Mats

EC-8 Wood Mulching

Description and Purpose

Hydraulic mulch consists of applying a mixture of shredded wood fiber or a hydraulic matrix, and a stabilizing emulsion or tackifier with hydro-mulching equipment, which temporarily protects exposed soil from erosion by raindrop impact or wind.

Suitable Applications

Hydraulic mulch is suitable for soil disturbed areas requiring temporary protection until permanent stabilization is established, and disturbed areas that will be re-disturbed following an extended period of inactivity.

Limitations

Wood fiber hydraulic mulches are generally short lived and need 24 hours to dry before rainfall occurs to be effective. May require a second application in order to remain effective for an entire rainy season.

Implementation

- Prior to application, roughen embankment and fill areas by rolling with a crimping or punching type roller or by track walking. Track walking shall only be used where other methods are impractical.
- To be effective, hydraulic matrices require 24 hours to dry before rainfall occurs.
- Avoid mulch over spray onto roads, sidewalks, drainage channels, existing vegetation, etc.

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- Paper based hydraulic mulches alone shall not be used for erosion control.

Hydraulic Mulches

Wood fiber mulch can be applied alone or as a component of hydraulic matrices. Wood fiber applied alone is typically applied at the rate of 2,000 to 4,000 lb/acre. Wood fiber mulch is manufactured from wood or wood waste from lumber mills or from urban sources.

Hydraulic Matrices

Hydraulic matrices include a mixture of wood fiber and acrylic polymer or other tackifier as binder. Apply as a liquid slurry using a hydraulic application machine (i.e., hydro seeder) at the following minimum rates, or as specified by the manufacturer to achieve complete coverage of the target area: 2,000 to 4,000 lb/acre wood fiber mulch, and 5 to 10% (by weight) of tackifier (acrylic copolymer, guar, psyllium, etc.)

Bonded Fiber Matrix

Bonded fiber matrix (BFM) is a hydraulically applied system of fibers and adhesives that upon drying forms an erosion resistant blanket that promotes vegetation, and prevents soil erosion. BFMs are typically applied at rates from 3,000 lb/acre to 4,000 lb/acre based on the manufacturer's recommendation. A biodegradable BFM is composed of materials that are 100% biodegradable. The binder in the BFM should also be biodegradable and should not dissolve or disperse upon re-wetting. Typically, biodegradable BFMs should not be applied immediately before, during or immediately after rainfall if the soil is saturated. Depending on the product, BFMs typically require 12 to 24 hours to dry and become effective.

Costs

Average cost for installation of wood fiber mulch is $900/acre. Average cost for installation of BFM is $5,500/acre.

Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- Areas where erosion is evident shall be repaired and BMPs re-applied as soon as possible. Care should be exercised to minimize the damage to protected areas while making repairs, as any area damaged will require re-application of BMPs.
- Maintain an unbroken, temporary mulched ground cover throughout the period of construction when the soils are not being reworked.

References

Controlling Erosion of Construction Sites Agricultural Information #347, U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) (formerly Soil Conservation Service – SCS).

Guides for Erosion and Sediment Control in California, USDA Soils Conservation Service, January 1991.

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

Sedimentation and Erosion Control, An Inventory of Current Practices Draft, US EPA, April 1990.

Soil Erosion by Water, Agriculture Information Bulletin #513, U.S. Department of Agriculture, Soil Conservation Service.

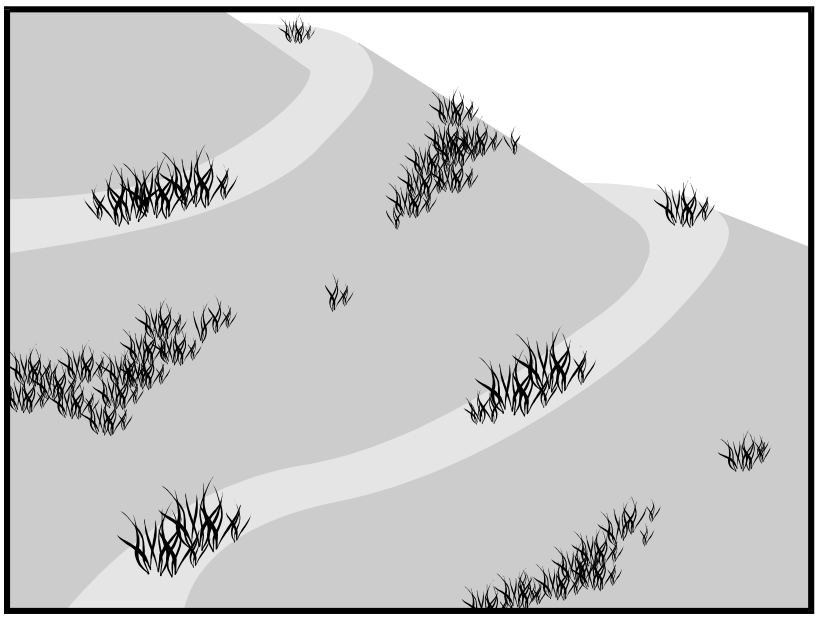
Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Guidance Document: Soil Stabilization for Temporary Slopes, State of California Department of Transportation (Caltrans), November 1999

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.

Hydroseeding EC-4



Objectives

EC	Erosion Control	☑
SE	Sediment Control	
TR	Tracking Control	
WE	Wind Erosion Control	☒
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:
☑ **Primary Objective**
☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

EC-3 Hydraulic Mulch
EC-5 Soil Binders
EC-6 Straw Mulch
EC-7 Geotextiles and Mats
EC-8 Wood Mulching

Description and Purpose

Hydroseeding typically consists of applying a mixture of wood fiber, seed, fertilizer, and stabilizing emulsion with hydro-mulch equipment, to temporarily protect exposed soils from erosion by water and wind.

Suitable Applications

Hydroseeding is suitable for soil disturbed areas requiring temporary protection until permanent stabilization is established, and disturbed areas that will be re-disturbed following an extended period of inactivity.

Limitations

- Hydroseeding may be used alone only when there is sufficient time in the season to ensure adequate vegetation establishment and coverage to provide adequate erosion control. Otherwise, hydroseeding must be used in conjunction with mulching (i.e., straw mulch).
- Steep slopes are difficult to protect with temporary seeding.
- Temporary seeding may not be appropriate in dry periods without supplemental irrigation.
- Temporary vegetation may have to be removed before permanent vegetation is applied.
- Temporary vegetation is not appropriate for short term inactivity.

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Implementation

In order to select appropriate hydroseeding mixtures, an evaluation of site conditions shall be performed with respect to:

- Soil conditions
- Site topography
- Season and climate
- Vegetation types
- Maintenance requirements
- Sensitive adjacent areas
- Water availability
- Plans for permanent vegetation

The local office of the U.S.D.A. Natural Resources Conservation Service (NRCS) is an excellent source of information on appropriate seed mixes.

The following steps shall be followed for implementation:

- Avoid use of hydroseeding in areas where the BMP would be incompatible with future earthwork activities and would have to be removed.
- Hydroseeding can be accomplished using a multiple step or one step process. The multiple step process ensures maximum direct contact of the seeds to soil. When the one step process is used to apply the mixture of fiber, seed, etc., the seed rate shall be increased to compensate for all seeds not having direct contact with the soil.
- Prior to application, roughen the area to be seeded with the furrows trending along the contours.
- Apply a straw mulch to keep seeds in place and to moderate soil moisture and temperature until the seeds germinate and grow.
- All seeds shall be in conformance with the California State Seed Law of the Department of Agriculture. Each seed bag shall be delivered to the site sealed and clearly marked as to species, purity, percent germination, dealer's guarantee, and dates of test. The container shall be labeled to clearly reflect the amount of Pure Live Seed (PLS) contained. All legume seed shall be pellet inoculated. Inoculant sources shall be species specific and shall be applied at a rate of 2 lb of inoculant per 100 lb seed.
- Commercial fertilizer shall conform to the requirements of the California Food and Agricultural Code. Fertilizer shall be pelleted or granular form.
- Follow up applications shall be made as needed to cover weak spots and to maintain adequate soil protection.
- Avoid over spray onto roads, sidewalks, drainage channels, existing vegetation, etc.

Costs

Average cost for installation and maintenance may vary from as low as $300 per acre for flat slopes and stable soils, to $1600 per acre for moderate to steep slopes and/or erosive soils.

Hydroseeding		Installed Cost per Acre
High Density	Ornamentals	$400 - $1600
	Turf Species	$350
	Bunch Grasses	$300 - $1300
Fast Growing	Annual	$350 - $650
	Perennial	$300 - $800
Non-Competing	Native	$300 - $1600
	Non-Native	$400 - $500
Sterile	Cereal Grain	$500

Source: Caltrans Guidance for Soil Stabilization for Temporary Slopes, Nov. 1999

Inspection and Maintenance

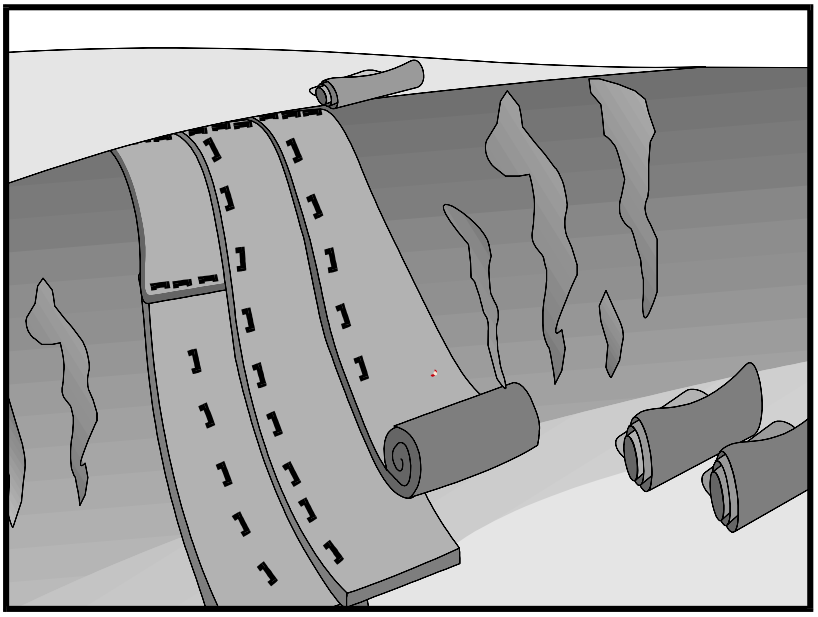
- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- Areas where erosion is evident shall be repaired and BMPs re-applied as soon as possible. Care should be exercised to minimize the damage to protected areas while making repairs, as any area damaged will require re-application of BMPs.
- Where seeds fail to germinate, or they germinate and die, the area must be re-seeded, fertilized, and mulched within the planting season, using not less than half the original application rates.
- Irrigation systems, if applicable, should be inspected daily while in use to identify system malfunctions and line breaks. When line breaks are detected, the system must be shut down immediately and breaks repaired before the system is put back into operation.
- Irrigation systems shall be inspected for complete coverage and adjusted as needed to maintain complete coverage.

References

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Guidance Document: Soil Stabilization for Temporary Slopes, State of California Department of Transportation (Caltrans), November 1999.

Geotextiles and Mats EC-7



Objectives

EC	Erosion Control	☑
SE	Sediment Control	
TR	Tracking Control	
WE	Wind Erosion Control	3
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

EC-3 Hydraulic Mulch

EC-4 Hydroseeding

EC-5 Soil Binders

EC-6 Straw Mulch

EC-8 Wood Mulching

Description and Purpose

Mattings of natural materials are used to cover the soil surface to reduce erosion from rainfall impact, hold soil in place, and absorb and hold moisture near the soil surface. Additionally, matting may be used to stabilize soils until vegetation is established.

Suitable Applications

Mattings are commonly applied on short, steep slopes where erosion hazard is high and vegetation will be slow to establish. Mattings are also used on stream banks where moving water at velocities between 3 ft/s and 6 ft/s are likely to wash out new vegetation, and in areas where the soil surface is disturbed and where existing vegetation has been removed. Matting may also be used when seeding cannot occur (e.g., late season construction and/or the arrival of an early rain season). Erosion control matting should be considered when the soils are fine grained and potentially erosive. These measures should be considered in the following situations.

- Steep slopes, generally steeper than 3:1 (H:V)
- Slopes where the erosion potential is high
- Slopes and disturbed soils where mulch must be anchored
- Disturbed areas where plants are slow to develop
- Channels with flows exceeding 3.3 ft/s

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- Channels to be vegetated
- Stockpiles
- Slopes adjacent to water bodies of Environmentally Sensitive Areas (ESAs)

Limitations

- Properly installed mattings provide excellent erosion control but do so at relatively high cost. This high cost typically limits the use of mattings to areas of concentrated channel flow and steep slopes.
- Mattings are more costly than other BMP practices, limiting their use to areas where other BMPs are ineffective (e.g. channels, steep slopes).
- Installation is critical and requires experienced contractors. The contractor should install the matting material in such a manner that continuous contact between the material and the soil occurs.
- Geotextiles and Mats may delay seed germination, due to reduction in soil temperature.
- Blankets and mats are generally not suitable for excessively rocky sites or areas where the final vegetation will be mowed (since staples and netting can catch in mowers).
- Blankets and mats must be removed and disposed of prior to application of permanent soil stabilization measures.
- Plastic sheeting is easily vandalized, easily torn, photodegradable, and must be disposed of at a landfill.
- Plastic results in 100% runoff, which may cause serious erosion problems in the areas receiving the increased flow.
- The use of plastic should be limited to covering stockpiles or very small graded areas for short periods of time (such as through one imminent storm event) until alternative measures, such as seeding and mulching, may be installed.
- Geotextiles, mats, plastic covers, and erosion control covers have maximum flow rate limitations; consult the manufacturer for proper selection.
- Not suitable for areas that have heavy foot traffic (tripping hazard) – e.g., pad areas around buildings under construction.

Implementation

Material Selection

Organic matting materials have been found to be effective where re-vegetation will be provided by re-seeding. The choice of matting should be based on the size of area, side slopes, surface conditions such as hardness, moisture, weed growth, and availability of materials.

The following natural and synthetic mattings are commonly used:

Geotextiles

- Material should be a woven polypropylene fabric with minimum thickness of 0.06 in., minimum width of 12 ft and should have minimum tensile strength of 150 lbs (warp), 80 lbs (fill) in conformance with the requirements in ASTM Designation: D 4632. The permittivity of the fabric should be approximately 0.07 sec^{-1} in conformance with the requirements in ASTM Designation: D4491. The fabric should have an ultraviolet (UV) stability of 70 percent in conformance with the requirements in ASTM designation: D4355. Geotextile blankets must be secured in place with wire staples or sandbags and by keying into tops of slopes to prevent infiltration of surface waters under geotextile. Staples should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.

- Geotextiles may be reused if they are suitable for the use intended.

Plastic Covers

- Plastic sheeting should have a minimum thickness of 6 mils, and must be keyed in at the top of slope and firmly held in place with sandbags or other weights placed no more than 10 ft apart. Seams are typically taped or weighted down their entire length, and there should be at least a 12 in. to 24 in. overlap of all seams. Edges should be embedded a minimum of 6 in. in soil.

- All sheeting must be inspected periodically after installation and after significant rainstorms to check for erosion, undermining, and anchorage failure. Any failures must be repaired immediately. If washout or breakages occur, the material should be re-installed after repairing the damage to the slope.

Erosion Control Blankets/Mats

- Biodegradable rolled erosion control products (RECPs) are typically composed of jute fibers, curled wood fibers, straw, coconut fiber, or a combination of these materials. In order for an RECP to be considered 100% biodegradable, the netting, sewing or adhesive system that holds the biodegradable mulch fibers together must also be biodegradable.

  - **Jute** is a natural fiber that is made into a yarn that is loosely woven into a biodegradable mesh. It is designed to be used in conjunction with vegetation and has longevity of approximately one year. The material is supplied in rolled strips, which should be secured to the soil with U-shaped staples or stakes in accordance with manufacturers' recommendations.

  - **Excelsior** (curled wood fiber) blanket material should consist of machine produced mats of curled wood excelsior with 80 percent of the fiber 6 in. or longer. The excelsior blanket should be of consistent thickness. The wood fiber must be evenly distributed over the entire area of the blanket. The top surface of the blanket should be covered with a photodegradable extruded plastic mesh. The blanket should be smolder resistant without the use of chemical additives and should be non-toxic and non-injurious to plant and animal life. Excelsior blankets should be furnished in rolled strips, a minimum of 48 in. wide, and should have an average weight of 0.8 lb/yd^2, ±10 percent, at the time of manufacture. Excelsior blankets must be secured in place with wire staples. Staples

should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.

- **Straw blanket** should be machine produced mats of straw with a lightweight biodegradable netting top layer. The straw should be attached to the netting with biodegradable thread or glue strips. The straw blanket should be of consistent thickness. The straw should be evenly distributed over the entire area of the blanket. Straw blanket should be furnished in rolled strips a minimum of 6.5 ft wide, a minimum of 80 ft long and a minimum of 0.5 lb/yd^2. Straw blankets must be secured in place with wire staples. Staples should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.

- **Wood fiber blanket** is composed of biodegradable fiber mulch with extruded plastic netting held together with adhesives. The material is designed to enhance re-vegetation. The material is furnished in rolled strips, which must be secured to the ground with U-shaped staples or stakes in accordance with manufacturers' recommendations.

- **Coconut fiber blanket** should be a machine produced mat of 100 percent coconut fiber with biodegradable netting on the top and bottom. The coconut fiber should be attached to the netting with biodegradable thread or glue strips. The coconut fiber blanket should be of consistent thickness. The coconut fiber should be evenly distributed over the entire area of the blanket. Coconut fiber blanket should be furnished in rolled strips with a minimum of 6.5 ft wide, a minimum of 80 ft. long and a minimum of 0.5 lb/yd^2. Coconut fiber blankets must be secured in place with wire staples. Staples should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.

- **Coconut fiber mesh** is a thin permeable membrane made from coconut or corn fiber that is spun into a yarn and woven into a biodegradable mat. It is designed to be used in conjunction with vegetation and typically has longevity of several years. The material is supplied in rolled strips, which must be secured to the soil with U-shaped staples or stakes in accordance with manufacturers' recommendations.

- **Straw coconut fiber blanket** should be machine produced mats of 70 percent straw and 30 percent coconut fiber with a biodegradable netting top layer and a biodegradable bottom net. The straw and coconut fiber should be attached to the netting with biodegradable thread or glue strips. The straw coconut fiber blanket should be of consistent thickness. The straw and coconut fiber should be evenly distributed over the entire area of the blanket. Straw coconut fiber blanket should be furnished in rolled strips a minimum of 6.5 ft wide, a minimum of 80 ft long and a minimum of 0.5 lb/yd^2. Straw coconut fiber blankets must be secured in place with wire staples. Staples should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.

- Non-biodegradable RECPs are typically composed of polypropylene, polyethylene, nylon or other synthetic fibers. In some cases, a combination of biodegradable and synthetic fibers is used to construct the RECP. Netting used to hold these fibers together is typically non-biodegradable as well.

- **Plastic netting** is a lightweight biaxially oriented netting designed for securing loose mulches like straw or paper to soil surfaces to establish vegetation. The netting is photodegradable. The netting is supplied in rolled strips, which must be secured with U-shaped staples or stakes in accordance with manufacturers' recommendations.

- **Plastic mesh** is an open weave geotextile that is composed of an extruded synthetic fiber woven into a mesh with an opening size of less than ¼ in. It is used with re-vegetation or may be used to secure loose fiber such as straw to the ground. The material is supplied in rolled strips, which must be secured to the soil with U-shaped staples or stakes in accordance with manufacturers' recommendations.

- **Synthetic fiber with netting** is a mat that is composed of durable synthetic fibers treated to resist chemicals and ultraviolet light. The mat is a dense, three dimensional mesh of synthetic (typically polyolefin) fibers stitched between two polypropylene nets. The mats are designed to be re-vegetated and provide a permanent composite system of soil, roots, and geomatrix. The material is furnished in rolled strips, which must be secured with U-shaped staples or stakes in accordance with manufacturers' recommendations.

- **Bonded synthetic fibers** consist of a three dimensional geomatrix nylon (or other synthetic) matting. Typically it has more than 90 percent open area, which facilitates root growth. It's tough root reinforcing system anchors vegetation and protects against hydraulic lift and shear forces created by high volume discharges. It can be installed over prepared soil, followed by seeding into the mat. Once vegetated, it becomes an invisible composite system of soil, roots, and geomatrix. The material is furnished in rolled strips that must be secured with U-shaped staples or stakes in accordance with manufacturers' recommendations.

- **Combination synthetic and biodegradable RECPs** consist of biodegradable fibers, such as wood fiber or coconut fiber, with a heavy polypropylene net stitched to the top and a high strength continuous filament geomatrix or net stitched to the bottom. The material is designed to enhance re-vegetation. The material is furnished in rolled strips, which must be secured with U-shaped staples or stakes in accordance with manufacturers' recommendations.

Site Preparation

- Proper site preparation is essential to ensure complete contact of the blanket or matting with the soil.

- Grade and shape the area of installation.

- Remove all rocks, clods, vegetation or other obstructions so that the installed blankets or mats will have complete, direct contact with the soil.

- Prepare seedbed by loosening 2 to 3 in. of topsoil.

Seeding

Seed the area before blanket installation for erosion control and revegetation. Seeding after mat installation is often specified for turf reinforcement application. When seeding prior to blanket

installation, all check slots and other areas disturbed during installation must be re-seeded. Where soil filling is specified, seed the matting and the entire disturbed area after installation and prior to filling the mat with soil.

Fertilize and seed in accordance with seeding specifications or other types of landscaping plans. When using jute matting on a seeded area, apply approximately half the seed before laying the mat and the remainder after laying the mat. The protective matting can be laid over areas where grass has been planted and the seedlings have emerged. Where vines or other ground covers are to be planted, lay the protective matting first and then plant through matting according to design of planting.

Check Slots

Check slots are made of glass fiber strips, excelsior matting strips or tight folded jute matting blanket or strips for use on steep, highly erodible watercourses. The check slots are placed in narrow trenches 6 to 12 in. deep across the channel and left flush with the soil surface. They are to cover the full cross section of designed flow.

Laying and Securing Matting

- Before laying the matting, all check slots should be installed and the friable seedbed made free from clods, rocks, and roots. The surface should be compacted and finished according to the requirements of the manufacturer's recommendations.

- Mechanical or manual lay down equipment should be capable of handling full rolls of fabric and laying the fabric smoothly without wrinkles or folds. The equipment should meet the fabric manufacturer's recommendations or equivalent standards.

Anchoring

- U-shaped wire staples, metal geotextile stake pins, or triangular wooden stakes can be used to anchor mats and blankets to the ground surface.

- Wire staples should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.

- Metal stake pins should be 0.188 in. diameter steel with a 1.5 in. steel washer at the head of the pin, and 8 in. in length.

- Wire staples and metal stakes should be driven flush to the soil surface.

Installation on Slopes

Installation should be in accordance with the manufacturer's recommendations. In general, these will be as follows:

- Begin at the top of the slope and anchor the blanket in a 6 in. deep by 6 in. wide trench. Backfill trench and tamp earth firmly.

- Unroll blanket down slope in the direction of water flow.

- Overlap the edges of adjacent parallel rolls 2 to 3 in. and staple every 3 ft.

- When blankets must be spliced, place blankets end over end (shingle style) with 6 in. overlap. Staple through overlapped area, approximately 12 in. apart.
- Lay blankets loosely and maintain direct contact with the soil. Do not stretch.
- Staple blankets sufficiently to anchor blanket and maintain contact with the soil. Staples should be placed down the center and staggered with the staples placed along the edges. Steep slopes, 1:1 (H:V) to 2:1 (H:V), require a minimum of 2 staples/yd^2. Moderate slopes, 2:1 (H:V) to 3:1 (H:V), require a minimum of 1 ½ staples/yd^2.

Installation in Channels

Installation should be in accordance with the manufacturer's recommendations. In general, these will be as follows:

- Dig initial anchor trench 12 in. deep and 6 in. wide across the channel at the lower end of the project area.
- Excavate intermittent check slots, 6 in. deep and 6 in. wide across the channel at 25 to 30 ft intervals along the channels.
- Cut longitudinal channel anchor trenches 4 in. deep and 4 in. wide along each side of the installation to bury edges of matting, whenever possible extend matting 2 to 3 in. above the crest of the channel side slopes.
- Beginning at the downstream end and in the center of the channel, place the initial end of the first roll in the anchor trench and secure with fastening devices at 12 in. intervals. Note: matting will initially be upside down in anchor trench.
- In the same manner, position adjacent rolls in anchor trench, overlapping the preceding roll a minimum of 3 in.
- Secure these initial ends of mats with anchors at 12 in. intervals, backfill and compact soil.
- Unroll center strip of matting upstream. Stop at next check slot or terminal anchor trench. Unroll adjacent mats upstream in similar fashion, maintaining a 3 in. overlap.
- Fold and secure all rolls of matting snugly into all transverse check slots. Lay mat in the bottom of the slot then fold back against itself. Anchor through both layers of mat at 12 in. intervals, then backfill and compact soil. Continue rolling all mat widths upstream to the next check slot or terminal anchor trench.
- Alternate method for non-critical installations: Place two rows of anchors on 6 in. centers at 25 to 30 ft. intervals in lieu of excavated check slots.
- Staple shingled lap spliced ends a minimum of 12 in. apart on 12 in. intervals.
- Place edges of outside mats in previously excavated longitudinal slots; anchor using prescribed staple pattern, backfill, and compact soil.
- Anchor, fill, and compact upstream end of mat in a 12 in. by 6 in. terminal trench.

- Secure mat to ground surface using U-shaped wire staples, geotextile pins, or wooden stakes.
- Seed and fill turf reinforcement matting with soil, if specified.

Soil Filling (if specified for turf reinforcement)

- Always consult the manufacturer's recommendations for installation.
- Do not drive tracked or heavy equipment over mat.
- Avoid any traffic over matting if loose or wet soil conditions exist.
- Use shovels, rakes, or brooms for fine grading and touch up.
- Smooth out soil filling just exposing top netting of mat.

Temporary Soil Stabilization Removal

- Temporary soil stabilization removed from the site of the work must be disposed of if necessary.

Costs

Relatively high compared to other BMPs. Biodegradable materials: $0.50 - $0.57/yd^2. Permanent materials: $3.00 - $4.50/yd^2. Staples: $0.04 - $0.05/staple. Approximate costs for installed materials are shown below:

Rolled Erosion Control Products		Installed Cost per Acre
Biodegradable	Jute Mesh	$6,500
	Curled Wood Fiber	$10,500
	Straw	$8,900
	Wood Fiber	$8,900
	Coconut Fiber	$13,000
	Coconut Fiber Mesh	$31,200
	Straw Coconut Fiber	$10,900
Non-Biodegradable	Plastic Netting	$2,000
	Plastic Mesh	$3,200
	Synthetic Fiber with Netting	$34,800
	Bonded Synthetic Fibers	$50,000
	Combination with Biodegradable	$32,000

Source: Caltrans Guidance for Soil Stabilization for Temporary Slopes, Nov. 1999

Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season, and at two-week intervals during the non-rainy season.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.

- Areas where erosion is evident shall be repaired and BMPs reapplied as soon as possible. Care should be exercised to minimize the damage to protected areas while making repairs, as any area damaged will require reapplication of BMPs.
- If washout or breakage occurs, re-install the material after repairing the damage to the slope or channel.
- Make sure matting is uniformly in contact with the soil.
- Check that all the lap joints are secure.
- Check that staples are flush with the ground.
- Check that disturbed areas are seeded.

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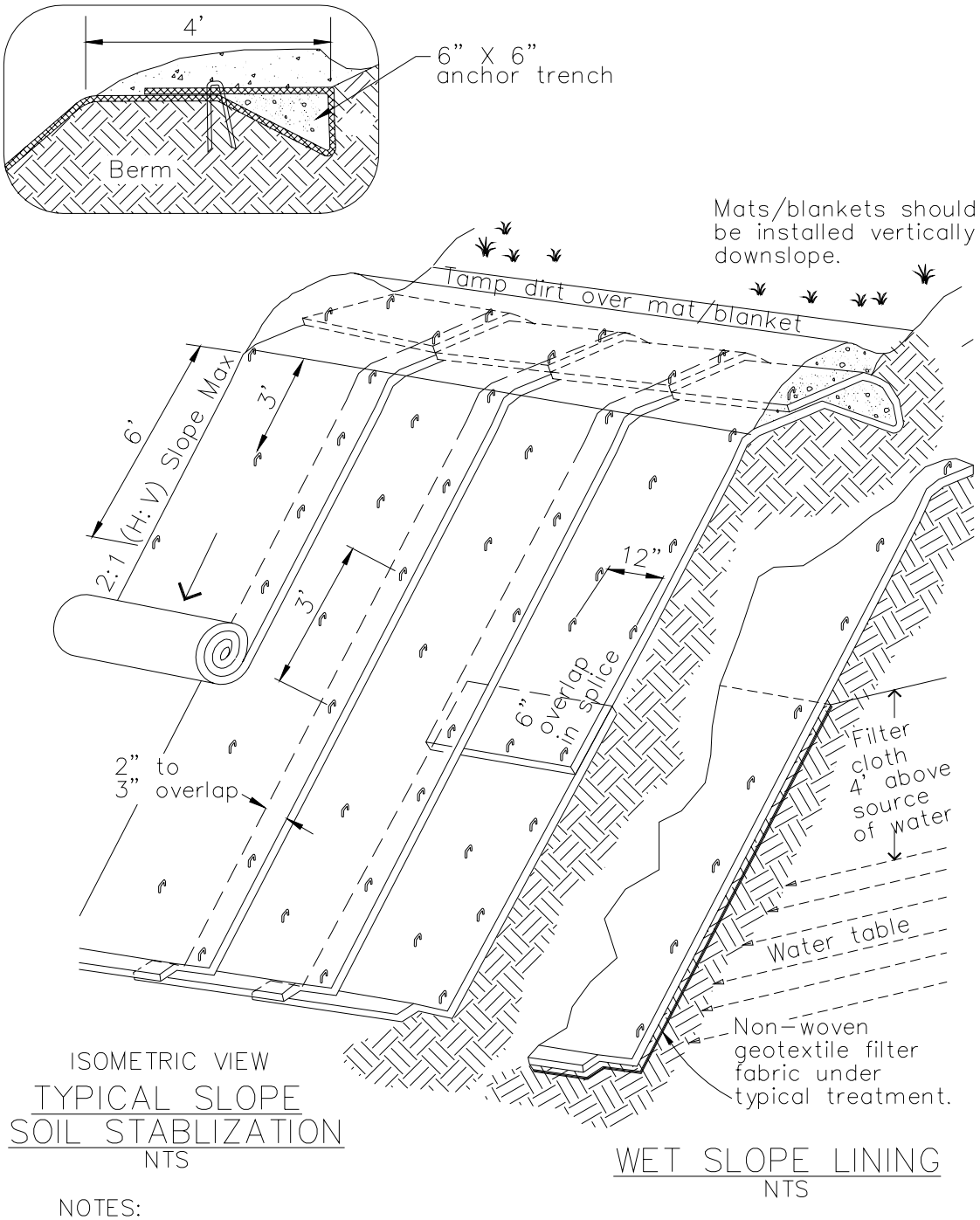


ISOMETRIC VIEW

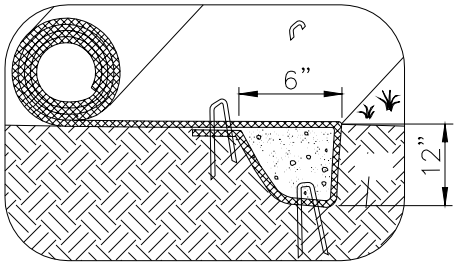
TYPICAL SLOPE
SOIL STABLIZATION
NTS

WET SLOPE LINING
NTS

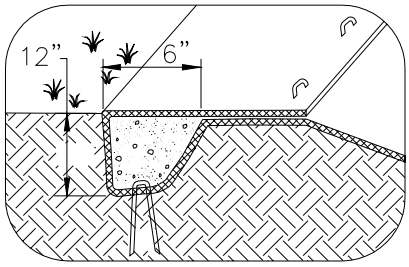
NOTES:

1. Slope surface shall be free of rocks, clods, sticks and grass. Mats/blankets shall have good soil contact.
2. Lay blankets loosely and stake or staple to maintain direct contact with the soil. Do not stretch.
3. Install per manufacturer's recommendations

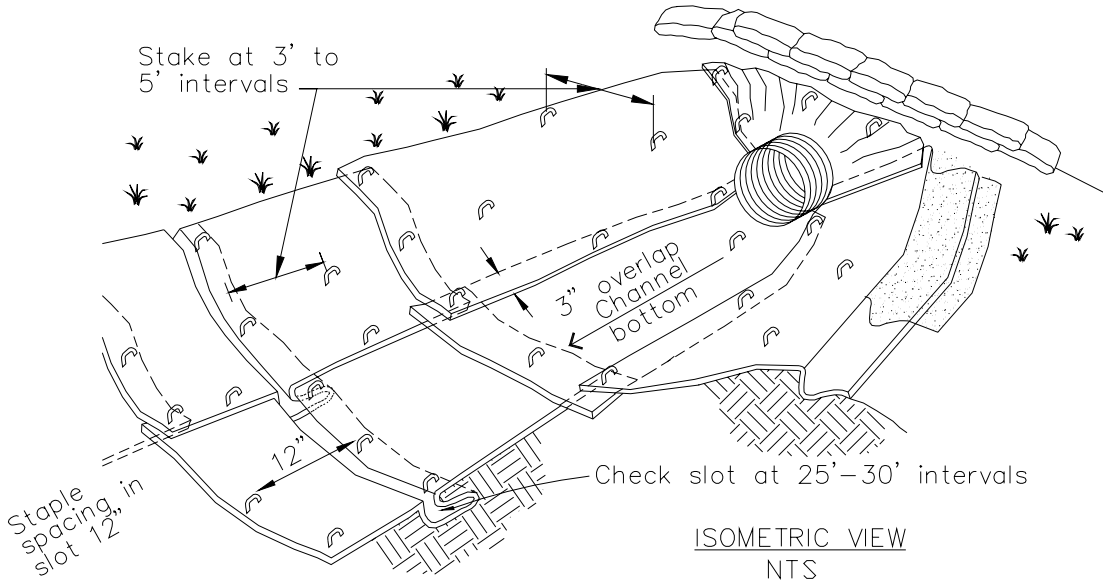
TYPICAL INSTALLATION DETAIL



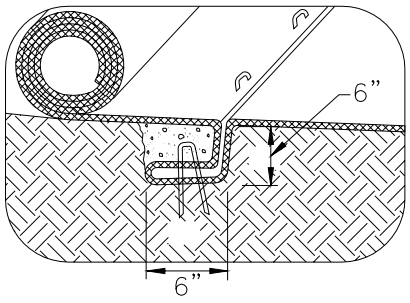
INITIAL CHANNEL ANCHOR TRENCH
NTS



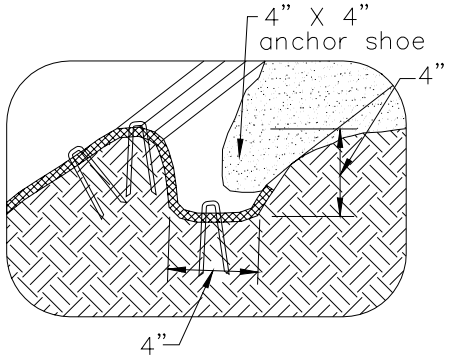
TERMINAL SLOPE AND CHANNEL ANCHOR TRENCH
NTS



ISOMETRIC VIEW
NTS



INTERMITTENT CHECK SLOT
NTS

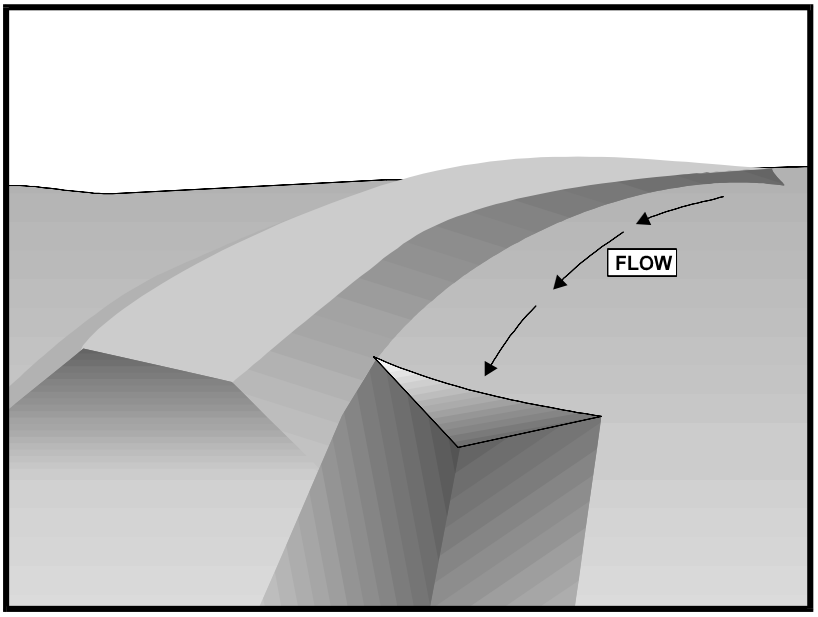


LONGITUDINAL ANCHOR TRENCH
NTS

NOTES:
1. Check slots to be constructed per manufacturers specifications.
2. Staking or stapling layout per manufacturers specifications.
3. Install per manufacturer's recommendations

TYPICAL INSTALLATION DETAIL

Earth Dikes and Drainage Swales EC-9



Objectives

EC	Erosion Control	☑
SE	Sediment Control	
TR	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

Description and Purpose

An earth dike is a temporary berm or ridge of compacted soil used to divert runoff or channel water to a desired location. A drainage swale is a shaped and sloped depression in the soil surface used to convey runoff to a desired location. Earth dikes and drainage swales are used to divert off site runoff around the construction site, divert runoff from stabilized areas and disturbed areas, and direct runoff into sediment basins or traps.

Suitable Applications

Earth dikes and drainage swales are suitable for use, individually or together, where runoff needs to be diverted from one area and conveyed to another.

- Earth dikes and drainage swales may be used:
  - To convey surface runoff down sloping land
  - To intercept and divert runoff to avoid sheet flow over sloped surfaces
  - To divert and direct runoff towards a stabilized watercourse, drainage pipe or channel
  - To intercept runoff from paved surfaces
  - Below steep grades where runoff begins to concentrate
  - Along roadways and facility improvements subject to flood drainage

- At the top of slopes to divert runon from adjacent or undisturbed slopes
- At bottom and mid slope locations to intercept sheet flow and convey concentrated flows
- Divert sediment laden runoff into sediment basins or traps

Limitations

Dikes should not be used for drainage areas greater than 10 acres or along slopes greater than 10 percent. For larger areas more permanent drainage structures should be built. All drainage structures should be built in compliance with local municipal requirements.

- Earth dikes may create more disturbed area on site and become barriers to construction equipment.
- Earth dikes must be stabilized immediately, which adds cost and maintenance concerns.
- Diverted stormwater may cause downstream flood damage.
- Dikes should not be constructed of soils that may be easily eroded.
- Regrading the site to remove the dike may add additional cost.
- Temporary drains and swales or any other diversion of runoff should not adversely impact upstream or downstream properties.
- Temporary drains and swales must conform to local floodplain management requirements.
- Earth dikes/drainage swales are not suitable as sediment trapping devices.
- It may be necessary to use other soil stabilization and sediment controls such as check dams, plastics, and blankets, to prevent scour and erosion in newly graded dikes, swales, and ditches.

Implementation

The temporary earth dike is a berm or ridge of compacted soil, located in such a manner as to divert stormwater to a sediment trapping device or a stabilized outlet, thereby reducing the potential for erosion and offsite sedimentation. Earth dikes can also be used to divert runoff from off site and from undisturbed areas away from disturbed areas and to divert sheet flows away from unprotected slopes.

An earth dike does not itself control erosion or remove sediment from runoff. A dike prevents erosion by directing runoff to an erosion control device such as a sediment trap or directing runoff away from an erodible area. Temporary diversion dikes should not adversely impact adjacent properties and must conform to local floodplain management regulations, and should not be used in areas with slopes steeper than 10%.

Slopes that are formed during cut and fill operations should be protected from erosion by runoff. A combination of a temporary drainage swale and an earth dike at the top of a slope can divert runoff to a location where it can be brought to the bottom of the slope (see EC-11, Slope Drains). A combination dike and swale is easily constructed by a single pass of a bulldozer or grader and

compacted by a second pass of the tracks or wheels over the ridge. Diversion structures should be installed when the site is initially graded and remain in place until post construction BMPs are installed and the slopes are stabilized.

Diversion practices concentrate surface runoff, increasing its velocity and erosive force. Thus, the flow out of the drain or swale must be directed onto a stabilized area or into a grade stabilization structure. If significant erosion will occur, a swale should be stabilized using vegetation, chemical treatment, rock rip-rap, matting, or other physical means of stabilization. Any drain or swale that conveys sediment laden runoff must be diverted into a sediment basin or trap before it is discharged from the site.

General

- Care must be applied to correctly size and locate earth dikes, drainage swales. Excessively steep, unlined dikes, and swales are subject to erosion and gully formation.
- Conveyances should be stabilized.
- Use a lined ditch for high flow velocities.
- Select flow velocity based on careful evaluation of the risks due to erosion of the measure, soil types, overtopping, flow backups, washout, and drainage flow patterns for each project site.
- Compact any fills to prevent unequal settlement.
- Do not divert runoff onto other property without securing written authorization from the property owner.
- When possible, install and utilize permanent dikes, swales, and ditches early in the construction process.
- Provide stabilized outlets.

Earth Dikes

Temporary earth dikes are a practical, inexpensive BMP used to divert stormwater runoff. Temporary diversion dikes should be installed in the following manner:

- All dikes should be compacted by earth moving equipment.
- All dikes should have positive drainage to an outlet.
- All dikes should have 2:1 or flatter side slopes, 18 in. minimum height, and a minimum top width of 24 in. Wide top widths and flat slopes are usually needed at crossings for construction traffic.
- The outlet from the earth dike must function with a minimum of erosion. Runoff should be conveyed to a sediment trapping device such as a Sediment Trap (SE-3) or Sediment Basin (SE-2) when either the dike channel or the drainage area above the dike are not adequately stabilized.

- Temporary stabilization may be achieved using seed and mulching for slopes less than 5% and either rip-rap or sod for slopes in excess of 5%. In either case, stabilization of the earth dike should be completed immediately after construction or prior to the first rain.
- If riprap is used to stabilize the channel formed along the toe of the dike, the following typical specifications apply:

Channel Grade	Riprap Stabilization
0.5-1.0%	4 in. Rock
1.1-2.0%	6 in. Rock
2.1-4.0%	8 in. Rock
4.1-5.0%	8 in. -12 in. Riprap

- The stone riprap, recycled concrete, etc. used for stabilization should be pressed into the soil with construction equipment.
- Filter cloth may be used to cover dikes in use for long periods.
- Construction activity on the earth dike should be kept to a minimum.

Drainage Swales

Drainage swales are only effective if they are properly installed. Swales are more effective than dikes because they tend to be more stable. The combination of a swale with a dike on the downhill side is the most cost effective diversion.

Standard engineering design criteria for small open channel and closed conveyance systems should be used (see the local drainage design manual). Unless local drainage design criteria state otherwise, drainage swales should be designed as follows:

- No more than 5 acres may drain to a temporary drainage swale.
- Place drainage swales above or below, not on, a cut or fill slope.
- Swale bottom width should be at least 2 ft
- Depth of the swale should be at least 18 in.
- Side slopes should be 2:1 or flatter.
- Drainage or swales should be laid at a grade of at least 1 percent, but not more than 15 percent.
- The swale must not be overtopped by the peak discharge from a 10-year storm, irrespective of the design criteria stated above.
- Remove all trees, stumps, obstructions, and other objectionable material from the swale when it is built.
- Compact any fill material along the path of the swale.

- Stabilize all swales immediately. Seed and mulch swales at a slope of less than 5 percent, and use rip-rap or sod for swales with a slope between 5 and 15 percent. For temporary swales, geotextiles and mats (EC-7) may provide immediate stabilization.
- Irrigation may be required to establish sufficient vegetation to prevent erosion.
- Do not operate construction vehicles across a swale unless a stabilized crossing is provided.
- Permanent drainage facilities must be designed by a professional engineer (see the local drainage design criteria for proper design).
- At a minimum, the drainage swale should conform to predevelopment drainage patterns and capacities.
- Construct the drainage swale with a positive grade to a stabilized outlet.
- Provide erosion protection or energy dissipation measures if the flow out of the drainage swale can reach an erosive velocity.

Costs

- Cost ranges from $15 to $55 per ft for both earthwork and stabilization and depends on availability of material, site location, and access.
- Small dikes: $2.50 - $6.50/linear ft; Large dikes: $2.50/$yd^3$.
- The cost of a drainage swale increases with drainage area and slope. Typical swales for controlling internal erosion are inexpensive, as they are quickly formed during routine earthwork.

Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.
- Inspect ditches and berms for washouts. Replace lost riprap, damaged linings or soil stabilizers as needed.
- Inspect channel linings, embankments, and beds of ditches and berms for erosion and accumulation of debris and sediment. Remove debris and sediment and repair linings and embankments as needed.
- Temporary conveyances should be completely removed as soon as the surrounding drainage area has been stabilized or at the completion of construction

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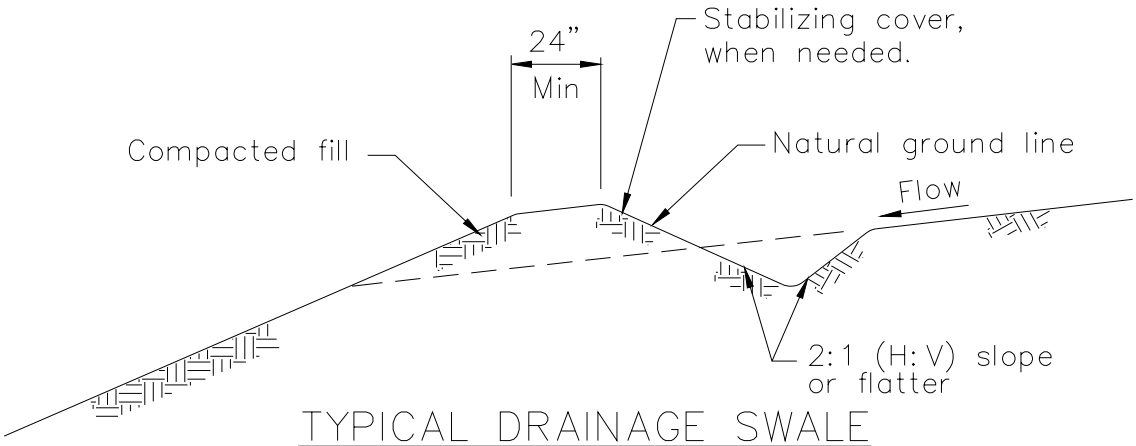
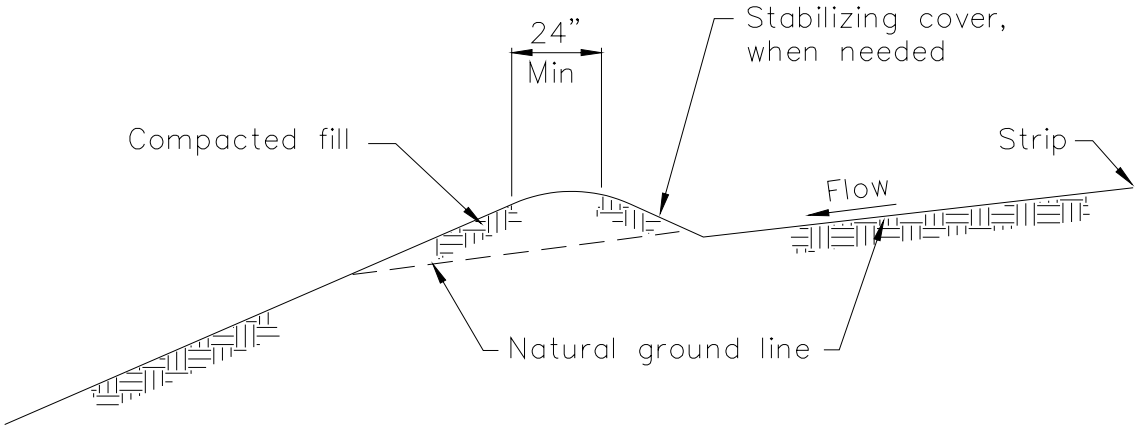


TYPICAL DRAINAGE SWALE
NOT TO SCALE

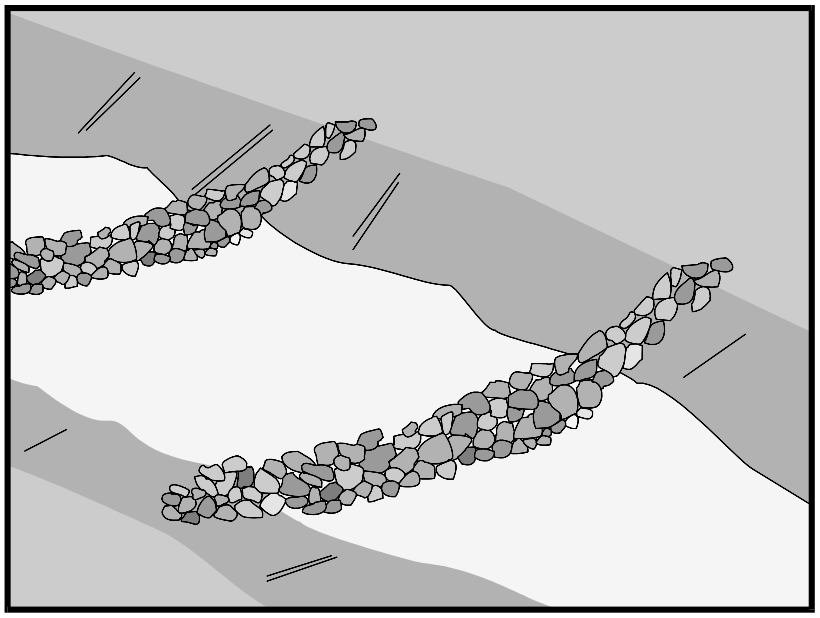
NOTES:

1. Stabilize inlet, outlets and slopes.
2. Properly compact the subgrade.



TYPICAL EARTH DIKE
NOT TO SCALE

Check Dams SE-4



Objectives

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Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

SE-5 Fiber Rolls

SE-6 Gravel Bag Berm

SE-8 Sandbag Barrier

Description and Purpose

A check dam is a small barrier constructed of rock, gravel bags, sandbags, fiber rolls, or reusable products, placed across a constructed swale or drainage ditch. Check dams reduce the effective slope of the channel, thereby reducing the velocity of flowing water, allowing sediment to settle and reducing erosion.

Suitable Applications

Check dams may be appropriate in the following situations:

- To promote sedimentation behind the dam.
- To prevent erosion by reducing the velocity of channel flow in small intermittent channels and temporary swales.
- In small open channels that drain 10 acres or less.
- In steep channels where stormwater runoff velocities exceed 5 ft/s.
- During the establishment of grass linings in drainage ditches or channels.
- In temporary ditches where the short length of service does not warrant establishment of erosion-resistant linings.

Limitations

- Not to be used in live streams or in channels with extended base flows.

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- Not appropriate in channels that drain areas greater than 10 acres.
- Not appropriate in channels that are already grass-lined unless erosion is expected, as installation may damage vegetation.
- Require extensive maintenance following high velocity flows.
- Promotes sediment trapping which can be re-suspended during subsequent storms or removal of the check dam.

Implementation

General

Check dams reduce the effective slope and create small pools in swales and ditches that drain 10 acres or less. Reduced slopes reduce the velocity of stormwater flows, thus reducing erosion of the swale or ditch and promoting sedimentation. Use of check dams for sedimentation will likely result in little net removal of sediment because of the small detention time and probable scour during longer storms. Using a series of check dams will generally increase their effectiveness. A sediment trap (SE-3) may be placed immediately upstream of the check dam to increase sediment removal efficiency.

Design and Layout

Check dams work by decreasing the effective slope in ditches and swales. An important consequence of the reduced slope is a reduction in capacity of the ditch or swale. This reduction in capacity must be considered when using this BMP, as reduced capacity can result in overtopping of the ditch or swale and resultant consequences. In some cases, such as a "permanent" ditch or swale being constructed early and used as a "temporary" conveyance for construction flows, the ditch or swale may have sufficient capacity such that the temporary reduction in capacity due to check dams is acceptable. When check dams reduce capacities beyond acceptable limits, there are several options:

- Don't use check dams. Consider alternative BMPs.
- Increase the size of the ditch or swale to restore capacity.

Maximum slope and velocity reduction is achieved when the toe of the upstream dam is at the same elevation as the top of the downstream dam. The center section of the dam should be lower than the edge sections so that the check dam will direct flows to the center of the ditch or swale.

Check dams are usually constructed of rock, gravel bags, sandbags, and fiber rolls. A number of products manufactured specifically for use as check dams are also being used, and some of these products can be removed and reused. Check dams can also be constructed of logs or lumber, and have the advantage of a longer lifespan when compared to gravel bags, sandbags, and fiber rolls. Straw bales can also be used for check dams and can work if correctly installed; but in practice, straw bale check dams have a high failure rate. Check dams should not be constructed from straw bales or silt fences, since concentrated flows quickly wash out these materials.

Rock check dams are usually constructed of 8 to 12 in. rock. The rock is placed either by hand or mechanically, but never just dumped into the channel. The dam must completely span the ditch

or swale to prevent washout. The rock used must be large enough to stay in place given the expected design flow through the channel.

Log check dams are usually constructed of 4 to 6 in. diameter logs. The logs should be embedded into the soil at least 18 in. Logs can be bolted or wired to vertical support logs that have been driven or buried into the soil.

Gravel bag and sandbag check dams are constructed by stacking bags across the ditch or swale, shaped as shown in the drawings at the end of this fact sheet.

Manufactured products should be installed in accordance with the manufacturer's instructions.

If grass is planted to stabilize the ditch or swale, the check dam should be removed when the grass has matured (unless the slope of the swales is greater than 4%).

The following guidance should be followed for the design and layout of check dams:

- Install the first check dam approximately 16 ft from the outfall device and at regular intervals based on slope gradient and soil type.
- Check dams should be placed at a distance and height to allow small pools to form between each check dam.
- Backwater from a downstream check dam should reach the toes of the upstream check dam.
- A sediment trap provided immediately upstream of the check dam will help capture sediment. Due to the potential for this sediment to be resuspended in subsequent storms, the sediment trap must be cleaned following each storm event.
- High flows (typically a 2-year storm or larger) should safely flow over the check dam without an increase in upstream flooding or damage to the check dam.
- Where grass is used to line ditches, check dams should be removed when grass has matured sufficiently to protect the ditch or swale.
- Gravel bags may be used as check dams with the following specifications:

Materials

Gravel bags used for check dams should conform to the requirements of SE-6, Gravel Bag Berms. Sandbags used for check dams should conform to SE-8, Sandbag Barrier. Fiber rolls used for check dams should conform to SE-5, Fiber Rolls. Straw bales used for check dams should conform to SE-9, Straw Bale Barrier.

Installation

- Rock should be placed individually by hand or by mechanical methods (no dumping of rock) to achieve complete ditch or swale coverage.
- Tightly abut bags and stack according to detail shown in the figure at the end of this section. Gravel bags and sandbags should not be stacked any higher than 3 ft.
- Fiber rolls and straw bales must be trenched in and firmly staked in place.

Costs

Cost consists of only installation costs if materials are readily available. If material must be imported, costs may increase. For material costs, see SE-5, SE-6, SE-8 and SE-9.

Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- Replace missing rock, bags, bales, etc. Replace bags or bales that have degraded or have become damaged.
- If the check dam is used as a sediment capture device, sediment that accumulates in the BMP must be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the barrier height. Sediment removed during maintenance may be incorporated into earthwork on the site or disposed at an appropriate location.
- If the check dam is used as a grade control structure, sediment removal is not required as long as the system continues to control the grade.
- Remove accumulated sediment prior to permanent seeding or soil stabilization.
- Remove check dam and accumulated sediment when check dams are no longer needed.

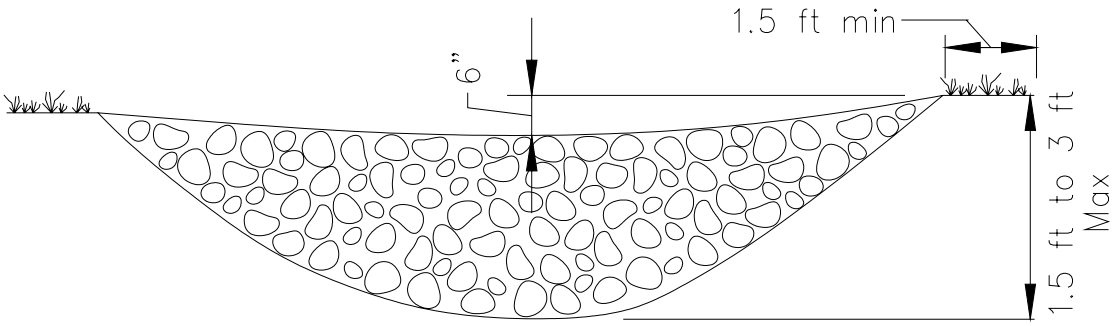
References

Draft – Sedimentation and Erosion Control, and Inventory of Current Practices, USEPA, April 1990.

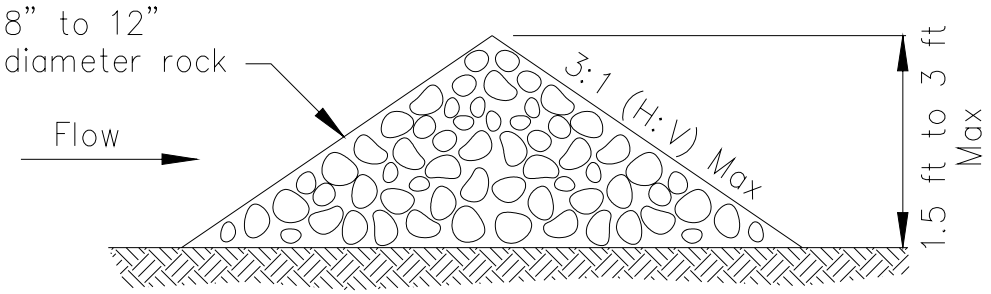
Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

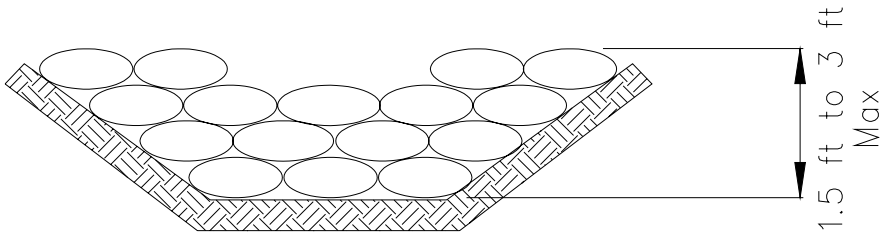


ELEVATION



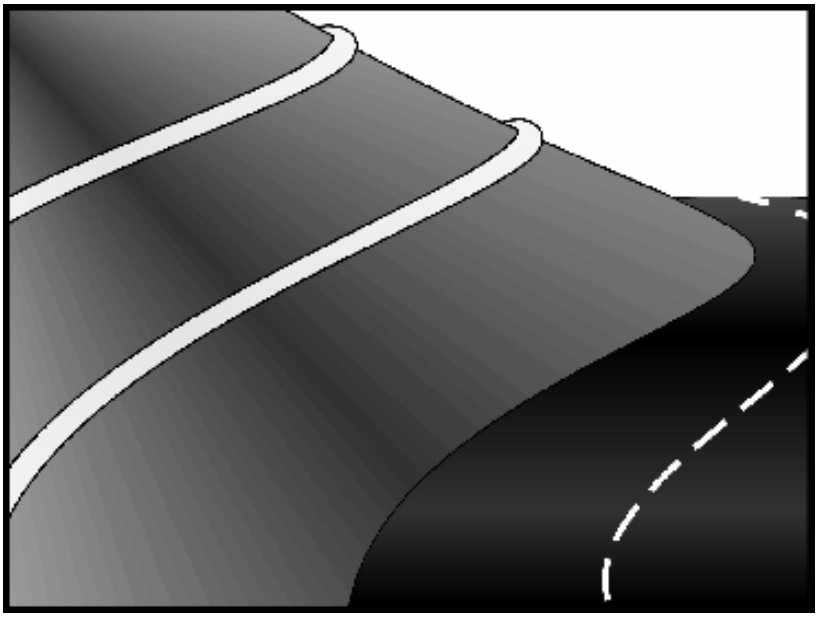
TYPICAL ROCK CHECK DAM SECTION

ROCK CHECK DAM
NOT TO SCALE



GRAVEL BAG CHECK DAM ELEVATION
NOT TO SCALE

Fiber Rolls SE-5



Objectives

EC	Erosion Control	☒
SE	Sediment Control	☑
TR	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

SE-1 Silt Fence

SE-6 Gravel Bag Berm

SE-8 Sandbag Barrier

SE-9 Straw Bale Barrier

Description and Purpose

A fiber roll consists of straw, flax, or other similar materials bound into a tight tubular roll. When fiber rolls are placed at the toe and on the face of slopes, they intercept runoff, reduce its flow velocity, release the runoff as sheet flow, and provide removal of sediment from the runoff. By interrupting the length of a slope, fiber rolls can also reduce erosion.

Suitable Applications

Fiber rolls may be suitable:

- Along the toe, top, face, and at grade breaks of exposed and erodible slopes to shorten slope length and spread runoff as sheet flow
- At the end of a downward slope where it transitions to a steeper slope
- Along the perimeter of a project
- As check dams in unlined ditches
- Down-slope of exposed soil areas
- Around temporary stockpiles

Limitations

- Fiber rolls are not effective unless trenched

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- Fiber rolls at the toe of slopes greater than 5:1 (H:V) should be a minimum of 20 in. diameter or installations achieving the same protection (i.e. stacked smaller diameter fiber rolls, etc.).
- Difficult to move once saturated.
- If not properly staked and trenched in, fiber rolls could be transported by high flows.
- Fiber rolls have a very limited sediment capture zone.
- Fiber rolls should not be used on slopes subject to creep, slumping, or landslide.

Implementation

Fiber Roll Materials

- Fiber rolls should be either prefabricated rolls or rolled tubes of erosion control blanket.

Assembly of Field Rolled Fiber Roll

- Roll length of erosion control blanket into a tube of minimum 8 in. diameter.
- Bind roll at each end and every 4 ft along length of roll with jute-type twine.

Installation

- Locate fiber rolls on level contours spaced as follows:
  - Slope inclination of 4:1 (H:V) or flatter: Fiber rolls should be placed at a maximum interval of 20 ft.
  - Slope inclination between 4:1 and 2:1 (H:V): Fiber Rolls should be placed at a maximum interval of 15 ft. (a closer spacing is more effective).
  - Slope inclination 2:1 (H:V) or greater: Fiber Rolls should be placed at a maximum interval of 10 ft. (a closer spacing is more effective).
- Turn the ends of the fiber roll up slope to prevent runoff from going around the roll.
- Stake fiber rolls into a 2 to 4 in. deep trench with a width equal to the diameter of the fiber roll.
  - Drive stakes at the end of each fiber roll and spaced 4 ft maximum on center.
  - Use wood stakes with a nominal classification of 0.75 by 0.75 in. and minimum length of 24 in.
- If more than one fiber roll is placed in a row, the rolls should be overlapped, not abutted.

Removal

- Fiber rolls are typically left in place.

- If fiber rolls are removed, collect and dispose of sediment accumulation, and fill and compact holes, trenches, depressions or any other ground disturbance to blend with adjacent ground.

Costs

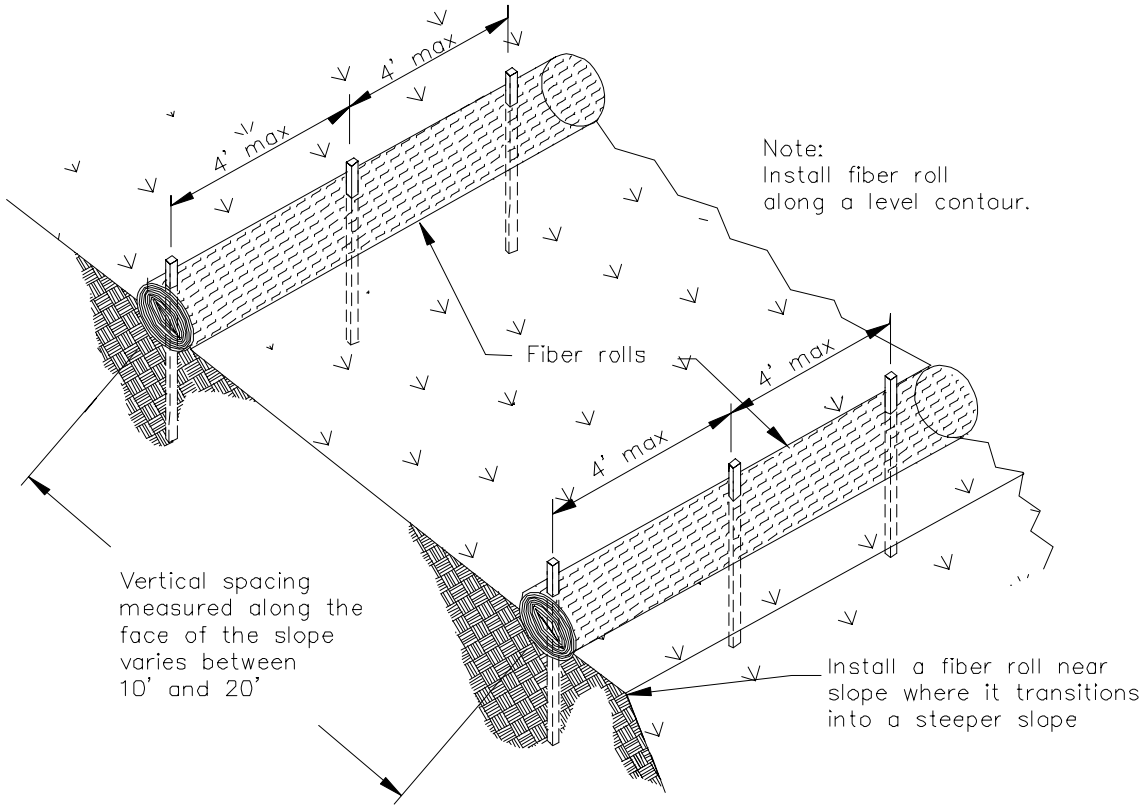
Material costs for fiber rolls range from $20 - $30 per 25 ft roll.

Inspection and Maintenance

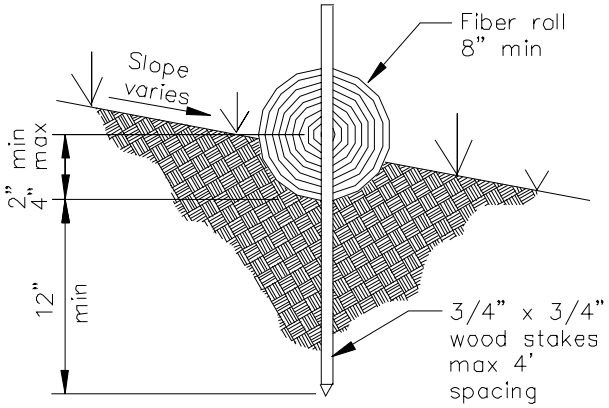
- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- Repair or replace split, torn, unraveling, or slumping fiber rolls.
- If the fiber roll is used as a sediment capture device, or as an erosion control device to maintain sheet flows, sediment that accumulates in the BMP must be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when sediment accumulation reaches one-half the designated sediment storage depth, usually one-half the distance between the top of the fiber roll and the adjacent ground surface. Sediment removed during maintenance may be incorporated into earthwork on the site of disposed at an appropriate location.
- If fiber rolls are used for erosion control, such as in a mini check dam, sediment removal should not be required as long as the system continues to control the grade. Sediment control BMPs will likely be required in conjunction with this type of application.

References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.



TYPICAL FIBER ROLL INSTALLATION
N.T.S.



ENTRENCHMENT DETAIL
N.T.S.

Appendix B

Revegetation Plan

Revegetation Plan for Reed Mercury Mine and Upper Davis Creek Remediation Project

Prepared by

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Prepared for
Homestake Mining Company

February 2019

1.0 REVEGETATION STRATEGY

This Revegetation Plan (plan) details revegetation of about 0.95 acre of disturbed habitat at the Reed Mine and Upper Davis Creek Remediation Project (Reed Mine). This plan provides guidelines for revegetating Reed Mine after remediation activities are completed. This plan also contains success criteria and monitoring protocols. After project activities are complete, the goal is to establish native vegetation cover at the disturbed areas within the site to enhance habitat and stabilize soils/slopes. Revegetation will include the purchase of native plant seeds and hydroseeding.

The success of revegetation depends on proper timing of seeding and weed control. Native plants in the region are specifically adapted to dry summers and mild, wet winters. Native plant communities in the region usually germinate after the first soaking rains and flower and seed in the dryer portions of the year. As a result, seeding will occur during or shortly before the rainy season.

2.0 GOALS AND OBJECTIVES

The remediation goals for Reed Mine remediation areas are to reduce the potential risk of water quality degradation posed by mining wastes. These goals will be achieved through completion of the following tasks:

- Remove mine waste from banks of Upper Davis Creek and tributaries.
- Minimize erosion of mine waste at Reed Mine North.
- Prevent contact of mine drainage with mine waste at the Old Lower Reed Adit (OLRA).
- Minimize, to the extent practical, the concentration of arsenic, cobalt, copper, mercury, and nickel in drainage at the OLRA (Remediation Area 3).

The goal of revegetation is to establish self-sustaining areas of native vegetation communities where clean up activities occurred. The specific objective for this plan is to revegetate disturbed areas by hand at Remediation Area 2 and through hydroseeding at all other remediation areas.

3.0 EXISTING SITE CONDITIONS

Reed Mine occupies about 370 acres of private property in Sections 23, 24, 25, and 26 of Township 12N, Range 5W (Mount Diablo Base and Meridian). The mine is located in northwestern Yolo County, CA about 12.4 miles southeast of Lower Lake, California (Figure 1).

Reed Mine is located in a portion of the California Coast Ranges that generally is characterized as a Mediterranean climate with arid, warm summers; relatively wet winters; and moderate temperatures (38 to 93.4 °F). However, the area can be subject to freezing temperatures during winter months (Western Regional Climate Center, 2012). Precipitation in the area generally occurs as rainfall, but the high elevation areas may receive some snowfall annually.

Reed Mine is located along the canyon of Upper Davis Creek approximately 0.5 mile upstream of Davis Creek Reservoir which is approximately 267.5 acres. The mine consists of the Andalusia Mine, Fusiyama Mine, and Reed Mine, associated underground workings (including 13 adits), historical waste rock and tailings piles, and the former Reed Mine processing area. Features associated with the Reed Mine extend about 1.3 miles along the Upper Davis Creek Canyon from the vicinity of the Andalusia Pit to the former Reed Mine processing area upstream from the DCR. The remediation areas are located on predominantly steep slopes and three of the six remediation

areas are upslope of tributaries draining to Upper Davis Creek. Remediation areas can be accessed from County Road 40 or historic mine roads off of County Road 40. Areas where remediation activities will take place are shown on Figure 2.

Dominant vegetation communities that occur at the site include non-native valley and foothill grassland, serpentine mixed chaparral, non-serpentine mixed chaparral, serpentine mixed chaparral and gray pine woodland, and mixed evergreen (UC Davis, 2003). Fires in 2015 burned through the area; tree survey of remediation areas conducted in 2018 recorded many trees as dead resulting from fire. The results of plant and tree surveys are presented in Appendix B: Biological Survey Reports of the Initial Study/Mitigated Negative Declaration for Reed Mine.

In the immediate vicinity of most remediation areas where construction activity is to take place, vegetation is sparse and is dominated by non-native grasses. Remediation Areas 4 and 5 contained mostly native riparian vegetation nearest the creek and non-native grasses in upland areas.

Native vegetation immediately surrounding the project site will be flagged with all efforts made to avoid damaging this vegetation. Work near plants identified to remain in place will be restricted to hand work to prevent damage. However, some shrubs near remediation areas may need to be removed to facilitate remediation activities.

4.0 PROCEDURES

4.1 Revegetation

After the contractor has completed excavation, grading, and reconturing/stablizing of associated slopes, remediation areas will be revegated using a native seed mix and tree plantings where mature live trees require removal. The contactor will determine the planting boundary and locations and these areas will be flagged or marked.

Hydroseeding will be conducted over most of the disturbed areas. The seed mix will contain local native plants. Table 1 presents a recommended list of plants for use in this seed mix. Seeds will be broadcast by hand at Remediation Area 2 and through hydroseeding with an organic stabilizer/ tackifier at all other remediation areas. The organic stabilizer/tackifier will be an organic substance supplied in powder form and shall be psilium-based and packed in clearly marked bags stating the contents of each package.

Tree planting will only occur at remediation areas where removal of mature live trees are necessary to complete remediation activities. Additionally, it should be noted that natural succession and establishment of trees and shrubs is anticipated due to the surrounding habitat and the size of the remediation areas.

4.1.1 Site Seeding

Non-irrigated seeding will be used as the chief means of revegetating the site. The desired plant community will be characteristic of both the adjacent undisturbed habitat and the early seral recovery areas on the site, native grassland. The plant species used in the seed mix include those easily established from seed.

Recommended Seed Mix

Seeds will be purchased from reputable native seed suppliers that meet the pure live seed standards specified for each species. All seed will be in conformance with the California State Seed Law of the Department of Agriculture. Each seed bag will be delivered to the site sealed and clearly marked

as to species, purity, percent germination, dealer's guarantee, and dates of test. In addition, the container will be labeled to clearly reflect the amount of Pure Live Seed (PLS) contained. Table 1 presents a recommended seed mix for Reed Mine.

Table 1 – Recommended Seed Mix for Reed Mine

Native Erosion Control Mix (Pacific Coast Seed) 45 lbs/acre		
Botanical Name	**Common Name**	**Annual or Perennial**
Bromus carinatus	California brome	A
Elymus glaucus	Blue wild rye	A
Festuca microstachys	Small fescue	A
Trifolium willdenovii	Tomcat Clover	A

Seed Application

The seed mix will be applied to the site by hydroseeding (hand broadcast at Area 2). Application rates will be provided by the seed supplier. The general application rate for the seed mix shown in Table 1 is 45 pounds per acre. Procedures for hydroseed application are described below.

Hydroseeding

A. Preparation: Complete all slurry preparation at the job site:

1. Water, mulch, fertilizer, compost, binder and other ingredients will be added to the tank simultaneously so that the finished load is a homogenous mix of the specified ingredients.
2. Seed will be added last and shall be discharged within 2 hours. Loads held over 2 hours shall be recharged with ½ the seed rate before application.
3. Once fully loaded, the complete slurry will be agitated for 3-5 minutes to allow for uniform mixing.

B. Application:

1. General: Apply specified slurry in a sweeping motion to form a uniform application and form a mat at slurry applications of 800 lbs per 0.5 acre or more.
2. Protection: Contractor will stay off treated areas.

Unused Loads: If mixture remains in tank for more than 8 hours it will be removed from the job site at contractor's expense.

4.1.2 Tree Replacement

At remediation areas requiring the removal of live mature trees (diameter at breast height of 6 inches or greater) a similar native species of tree will be planted after remediation activities are completed and before seed broadcast. Table 2 presents a recommended list of trees appropriate for replacement. Trees shall be purchased from reputable native plant suppliers. Trees shall be purchased from

reputable native plant suppliers that meet phytosanitary certificate requirements for United States Department of Agriculture Animal and Plant Health Inspection Service Sudden Oak Death certification and *Epiphyas postvitanna* free certification. Tree planting is anticipated at Remediation Areas 1, 3, 4, 5, and 6.

Table 2 – Recommended Tree Species for Reed Mine

Botanical Name	Common Name	Container Size
Pinus sabiniana	Grey pine	5 gallon
Quercus douglassi	Blue oak	5 gallon
Sambucus caerulea	Blue elderberry	1 gallon

Tree Installation

Installation procedures:

1. Receiving holes will be dug to provide 1-2 feet of free space around each rootball. Depths will be slightly shallower than rootball height.
2. Trees will be planted with the root flare at grade. Root balls will be installed so that the first roots are level with the native grade to account for settling. Soil will be mounded to cover the first roots.
3. Holes will be backfilled with native soil. Excess soil from the hole will be used to construct a watering basin. Water basins will consist of a continuous berm that is 3-4 feet in diameter, measuring approximately 8 inches wide at the base and 6 inches high.
4. Each root ball will be watered-in and completely saturated to the depth of the hole immediately after planting.

4.1.3 Photograph Documentation

Photos will be taken during each monitoring event at established permanent photo points to document changes at the revegetated area.

4.1.4 Irrigation

No watering or irrigation practices are anticipated to occur for the hydroseeded area. Seeds used at Reed Mine are for indigenous species adapted to the anticipated weather conditions.

Hand watering will be required at each tree plantings during dry periods. During the dry season, watering will occur once per month.

5.0 SUCCESS CRITERIA

The success criteria are directly related to the project goals and objectives presented in Section 2.0 of this plan. Success should be measured by identifying when an area is self sustaining and on a clear trajectory towards the native vegetative cover found within naturally occurring and similar reference areas. Reed Mine will be considered to have been successfully revegetated when the following criteria have been met:

- Native seed is establishing within the remediated areas.
- Native tree plantings are establishing within the remediated areas.

6.0 MONITORING

Revegetated areas will require maintenance monitoring. The monitoring period will begin at the time of the initial seeding.

Maintenance and Revegetation Monitoring

After the seeding and planting are complete, maintenance and revegetation monitoring will begin. General observations will be documented regarding erosion, plant germination, and invasive weeds. Corrective actions will be recommended, if necessary. Monitoring will occur in accordance with the schedule in Section 4.0 of the Remediation Work Plan.

Assessing Effectiveness and Adaptive Management

After each monitoring event, the monitoring results will be compared to the success criteria. Areas that meet the success criteria will no longer be monitored. Areas that require corrective measures will continue to be monitored until they meet the success criterion. Specifically, monitoring will continue and corrective measures implemented, until the success criteria are met.

7.0 CORRECTIVE MEASURES

If during the course of the monitoring schedule, the revegetated sites are obviously not progressing toward the success criteria, then corrective measures may be employed. If, at the end of the monitoring schedule, an area has not reached the success criteria, the owner may employ corrective action measures, and continue monitoring until the success criteria are met. Measures will be based on results and observations from the adaptive management approach described above. Corrective action measures may include additional broadcasting of seeds or transplanting of container-grown plants and/or additional amendments (straw, mulch, mycorrhizal inoculates, etc.), and improved erosion controls. Monitoring and corrective measures should be employed until the success criteria are met.

8.0 REPORTING

Maintenance/ Vegetation Reports

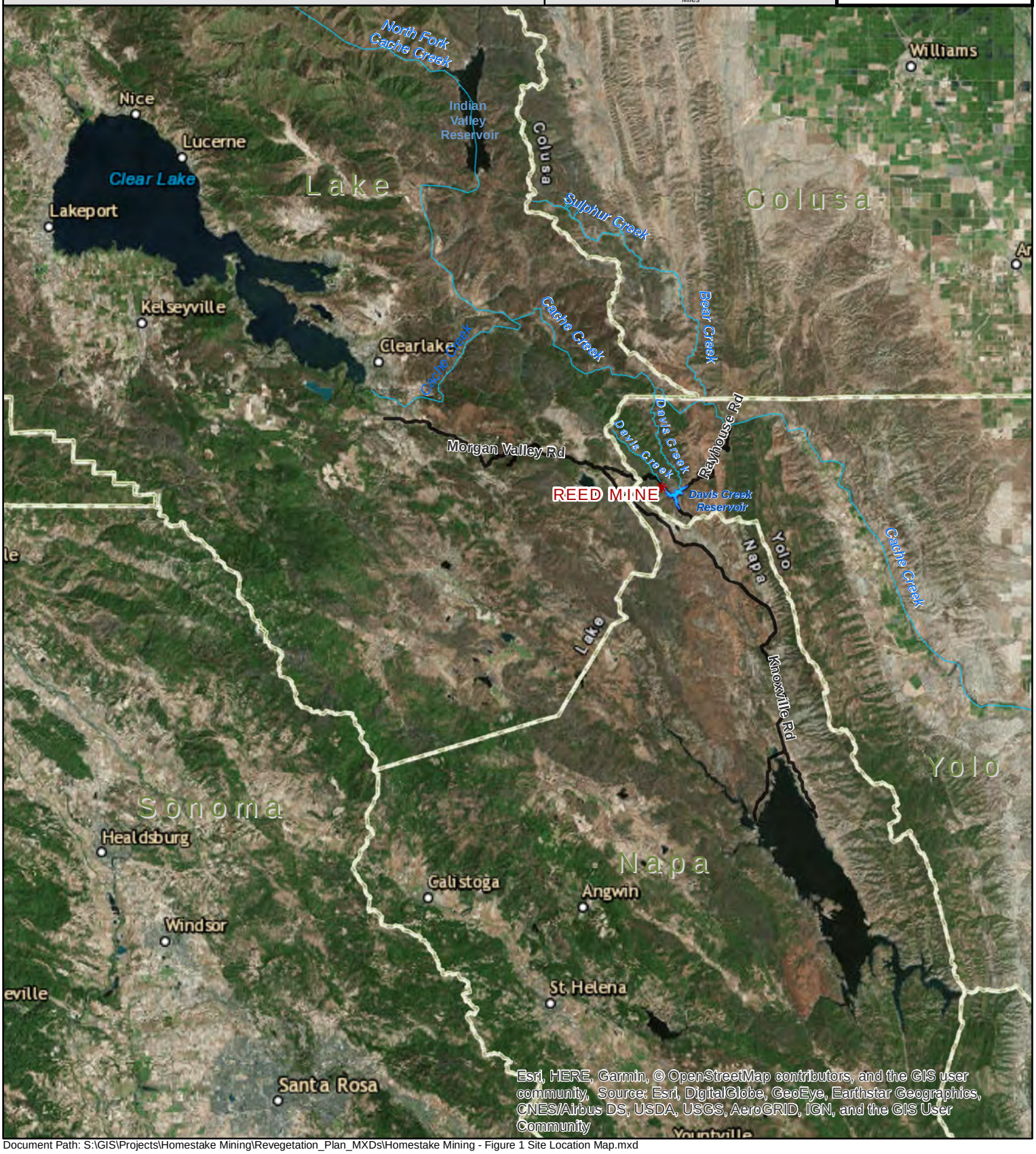
The post-installation monitoring maintenance period will occur after the end of each rainy season for the first two years after project installation. General observations will be made about the surface water drainage, erosion control, and the progress of the revegetation.

9.0 WEED MANAGEMENT

A determination of the need for weed removal will be conducted during each monitoring event. Removal of large perennial weeds will occur before seed set. No spraying of large weeds will occur before seed set of target annual species.

Reed Mine and Upper Davis Creek - Revegetation Plan

Figure 1 - Site Location Map



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Reed Mine and Upper Davis Creek- Revegetation Plan

Figure 2 - Remediation Areas & Acreage

Legend

- Adit
- Decline
- Targeted Revegetation Areas
- Waste Rock Group B
- Waste Rock Group C
- Remediation Area Waste Rock
- Remediation Area Waste Rock Slope
- Tailings Top
- Tailings Slope
- Davis Creek
- Davis Creek tributary
- County Roads
- Old Mine Road
- Cut
- Former Rail Bed

Burleson Consulting, Inc.

Source: USGS 2012; ESRI Data Server 2010; Burleson 2014; Trans-Pacific Metals, Inc. 1959.

Locations are Approximate

Remediation Area 1:
Fusiyama Adit
0.11 acre

Remove Waste Rock

Andalusia North
Andalusia Main
Andalusia Pit
Andalucia Pit Decline
Sky High Adit
Upper Reed Adit No. 2
Upper Reed Adit
Willow Adit
Fusiyama Adit
Lower Fusiyama Adit
Fusiyama Pit
Fusiyama Shaft
Fusiyama Shaft
Davis Creek

Proposed Future On-Site Repository

Remove Tailings and Bricks

Remediation Area 4:
East Bank of Davis Creek
0.18 acre

Remediation Area 5:
West Bank Davis Creek
Furnace Area 1, 2, 3
0.25 acre

Remove Waste Rock

Remediation Area 2:
Reed North
0.02 acre

Stabilize Gully

Big Adit
Reed North
North Reed Decline
Reed Main
Old Caved Adit
Main Reed Decline
Lower Reed Adit
West Bank Davis Creek Furnace Area 1, 2, 3
East Bank Davis Creek Slope
Former Reed Mine Processing Area
Reed South 1
Old Adit
Reed South 2
Old Lower 3 Reed Adit
Reed 5

Remediation Area 3:
OLRA Waste Rock & Drainage
0.36 acre

Old Adit
Old Lower Reed Adit

Treat Mine Drainage

Install Water Bars

Remove Waste Rock From Tributary to Davis Creek

Remove/Stabilize Rotary Furnace and Bin Residue

Remove/Stabilize Condenser Channel Residue

Remove/Stabilize Rotary Furnace Brick Lining

Recycle Iron

Remove/Stabilize Ore

Remediation Area 6:
Former Reed Mine Processing Area
0.02 acre

550 275 0 550 Feet

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Appendix C

Channel Restoration Design (in progress)

Appendix D

OLRA Drainage Treatment Design

(in development)

Appendix E

Repository Design (in progress)

Attachments

1 Pre-Remediation Photographs (in progress)