Environmental Evaluation

Grassy Mountain Gold Project

Malheur County, Oregon

APPENDIX A

BEST AVAILABLE, PRACTICABLE AND NECESSARY TECHNOLOGY

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A-1 INTRODUCTION

Chemical process mining regulations in Oregon, including extraction, processing, and reclamation, must be undertaken in a manner that minimizes environmental damage through the use of the best available, practicable, and necessary technology (BAPNT) to ensure compliance with environmental standards (Oregon Administrative Rule [OAR] 632-037-0118). These regulations require the Technical Review Team (TRT) to consult with Calico Resources USA Corp. (the Applicant) in determining the BAPNT for use in the proposed Grassy Mountain Gold Project (Project) mining operation.

The BAPNT review process first requires the TRT to determine the necessary technologies, if such technologies exist, and second to determine if necessary technologies are available and practicable. Per OAR 632-037-0010, the definitions for available, practicable, and necessary are as follows:

- “Available Technology” means technology that is obtainable and has been demonstrated to meet environmental standards at an existing mine or a demonstration project of similar size and scale, or is reasonably expected to meet or exceed environmental standards at the proposed mine.
- “Practicable Technology” means available and necessary technology whose costs are not significantly disproportionate to the potential environmental benefits. A technology is not practicable if the cost is so high it renders a mining operation infeasible.
- “Necessary Technology” means technology that is required to ensure compliance with environmental standards.

The TRT reviews the identified necessary, available, and practicable technologies to select the technologies with the most effective environmental benefits that becomes the BAPNT. The TRT then recommends the BAPNT to the Department of Geology and Mineral Industries (DOGAMI) to ensure compliance with environmental standards, which the Applicant must use. In the event that the TRT and DOGAMI are unable to identify a necessary technology that is available and practicable, a Consolidated Permit cannot be issued.

This review of BAPNT considers site-specific conditions including climate, mineralization, geological, geotechnical, hydrogeological, and morphological conditions that differ in gold mining areas throughout the world where technologies have been developed.

The information contained in this appendix is based on professional experience and available information at the time of writing. It is not meant to be inclusive of *all* available technologies for gold mining. The assessment focuses on the more environmentally impactful aspects of mining Grassy Mountain so that other potential methods can be identified that may have lower adverse effects. The “best” available, practicable, and necessary technologies are those with the least damaging environmental effects.

A-2 SCOPE AND METHOD OF THE BAPNT REVIEW

The TRT proposed a list of items to research for technologies used in gold mining, which was supplemented with areas of interest arising from the review of alternatives (see Section 2.2 of the Project environmental evaluation [EE]).

The application of best available technologies for environmental protection included research and review of the following:

1. Mine construction methods, including extracting ore, backfilling, and transporting mined materials;
2. Mill operations, including chemical processing, cyanide management, air quality controls, process solution containments, wildlife exclusion, and mill closure;
3. Tailings management including disposal, tailings storage facility (TSF) design, leak detection, long-term pollution prevention controls, long-term monitoring, wildlife exclusion, and TSF closure;
4. Operations management including water management, fugitive dust control, equipment maintenance, and operations monitoring;
5. Acid rock drainage management;
6. Hazardous materials handling, storage, and management; and
7. Spill and emergency response.

These are described in Section A-3, and a summary of recommendations is provided in Section A-4.

A-3 IDENTIFICATION OF TECHNOLOGIES

A-3.1 Mine Construction Methods

The review of BAPNT for mine construction methods includes extracting ore, backfilling, and transporting mined materials and is described in further detail below.

Extracting Ore

Section 2.2 of this EE describes and compares underground and open-pit mining options. Of the two mining methods, underground mining would have the lower environmental impact since it requires far less surface area for extraction and produces less waste.

The underground mining method proposed for this Project is a mechanized cut-and-fill method in an underhand direction, which involves excavating waste rock and ore and backfilling the area with cemented rock fill (CRF) as support (see Figure 2-3 in Chapter 2 for a diagram showing this method). The underhand sequence starts at the top and works down in elevation.

Alternative underground mining methods include longhole open stoping and blind bench stoping, among others. These alternative mining methods are not suitable for the Grassy Mountain ore body due to the geotechnical properties of the ore and surrounding rock that are not amenable to these larger scale underground mining methods, which leave larger volumes of the ore body open before backfilling. The backfill utilized in the Applicant's proposed underhand cut-and-fill mining method provides a more stable ground condition suitable for extracting ore from this ore body.

Backfilling

The cut-and-fill method requires articulated haul trucks, water trucks, a blast hole drill, crushing area bobcat, dozer, elevated work platforms, front-end loaders, and other mining equipment. A more extensive equipment list is outlined in Table 2-4 in Section 2.1.14 of the EE. Using this equipment, the proposed mine would be accessed via a main mine portal and decline. The decline would lead to five level stations below the surface, each of which would be mined, followed by multiple level access ramps. The ore in the production levels would be mined using topcuts and undercuts. After extraction of waste rock and ore, the excavated areas would be backfilled with a CRF and/or rock fill for stability. Rock used as fill would be mostly basalt borrow material with some waste rock. This method and equipment are necessary, available, and practicable for their intended purpose.

The fill material used to backfill mining operations can be one of three options:

- **Dry fill.** Dry backfill material (i.e., quarry rock or non-acid-generating waste rock) is transported to the stopes using trucks or other mechanical equipment. This option would not include cement as structural support or as neutralization for potentially acid-generating rock.
- **Hydraulic fill.** Waste material is mixed with water to form a slurry, which is then transported to the stopes using pipelines. Similar to dry fill, this option would not include cement as structural support or as neutralization for potentially acid-generating rock and would also result in additional land disturbance arising from the installation of pipelines and associated environmental effects.
- **Cemented fill.** Waste material is mixed with cement to form a paste, which is then transported to the stopes using haul trucks. This option provides structural support for underground workings to allow excavation of ore in areas below and also provides neutralization for backfilled material to prevent acid rock generation.

Section 2.2.3.5 of the EE provides additional information on alternative tailings management. The proposed backfill method for the Project is cemented fill due to the requirement for structural supports for excavated areas. The cemented fill would comprise 85 percent basalt from the quarry and 15 percent waste rock. Since the waste rock has acid-generating potential, the use of cement as binder material would increase the physical and chemical stability of the fill and provide neutralization capacity to prevent acid rock generation and metals leaching. The other fill options would not be structurally sound (in the case of hydraulic fill) or provide neutralization capacity for underground workings (in the case of dry fill).

Transporting Mined Materials

The Applicant proposes to use haul trucks and hydraulic loaders to move mined material around the site, including within the underground mine. Blasted material (including ore and waste rock) would be transported to an underground stockpile using a loader and then put onto conventional load-haul-dump low-profile underground mining trucks and hauled to the surface. Haul trucks would be used to transport backfill materials from the surface to the underground workings to be used for backfilling. The Applicant proposes using mining equipment that is primarily fueled by diesel, with some equipment being electrically powered. Table 2-4 in Section 2.1.14 provides a list of mobile mining equipment for the Project. Effective fuel and power consumption can be accomplished through using appropriate speeds, reducing idle time, and conducting regular truck maintenance (Kaul and Soofastaei 2022). An alternative would be to use biodiesel as discussed in Section 2.2.3.13, which would lower greenhouse gas emissions both at the surface and in enclosed spaces.

The transport of mined material becomes less efficient the more frequently materials change mode of transportation such as loading and off-loading onto trucks. Material can also be lost or damaged and accidents can become more likely during transitions (Mining Technology 2021). Productivity and efficiency of transporting material throughout the site may be reduced by haul truck waiting queues, where engines are left to idle. Idling not only reduces efficiency in terms of time and money, but also burns fuel and increases air emissions. There are tools available to assist with mining processes including mining, hauling, and processing, that may reduce waste and improve operational efficiency. For example, commercial fleet management solutions can help manage truck haulage cycles and improve communication among the different operators (Kaul and Soofastaei 2022) and short interval control can help identify and act on opportunities to improve effectiveness and efficiency of mining processes (Global Mining Guidelines Group 2019). See Section 2.2.3.10 of the EE for further discussion of short interval control. These operational improvement technologies are not strictly necessary to manage the Project, but they may provide some benefits, such as increased productivity and revenue, and potentially minimize waste and emissions associated with transportation.

A-3.2 Mill Operations and Closure

The mill design was developed by Ausenco Engineering Canada Inc. (Ausenco), a consulting firm with global mill design experience and Oregon Professional Engineer licensing. Elements considered in the review of BAPNT for mill operations include chemical processing, cyanide management, air quality controls, process solution containments, wildlife exclusion, and closure of the mill.

Chemical Processing

The Applicant proposes to use cyanide to extract gold and silver from ore using a carbon-in-leach cyanide closed-loop circuit, elution, electrowinning recovery, cyanide detoxification, and tailings disposal (see Section 2.1.5 of the EE for descriptions of these processes). Some alternative methods of gold extraction include gold roasting and mercury amalgamation. Gold roasting is a process in which gold-aggregated ore is heated to remove sulfur compounds that would otherwise interfere with chemical leaching processes and is a common activity in a number of developing countries but is no longer practiced in North America because newer technologies have been developed that are less environmentally damaging (Hilson and Murck 2001). Similarly, mercury amalgamation is used in a number of gold mining regions throughout the world, including Brazil, Indonesia, and many African countries, but has been replaced almost completely by cyanidation technologies in both the US and Canada (Hilson and Murck 2001).

Other alternative chemical processing options were evaluated as part of the alternatives analysis, including gravity concentration, hydrometallurgical methods, pyrometallurgical methods, flotation, froth flotation, whole mud cyanide leaching, heap leaching, pressure oxidation, use of thiosulfate instead of cyanide, and offsite ore shipment for processing at an existing gold extraction facility. Additional information on these alternative chemical processing options evaluated in the alternatives analysis is provided in Sections 2.2.3.6 through 2.2.3.9 of the EE, where it was determined that the Applicant's proposed chemical processing method for ore extraction is the preferred option for extracting gold from ore since it would likely have the least impact to environmental resources.

Cyanide Management

The Applicant's mill design includes equipment and infrastructure for the detoxification and neutralization of cyanide in the mill tailings. When combined with personal protective equipment and industrial hygiene controls during operations, these control measures are typical for mill facilities that effectively reduce or remove cyanide concentrations in process solutions to levels where their presence in supernatant and process water ponds does not pose a risk to environmental receptors.

Cyanide would be managed in accordance with the general principles in the International Cyanide Management Code (ICMC) because the Applicant would seek ICMC certification (Ausenco 2023). Companies that use cyanide and adopt the ICMC must be audited by an independent third party to determine the status of ICMC implementation, which ensures that best practices for handling cyanide are followed. Many of the specific ICMC compliance actions, cyanide handling, storage design criteria, and operating procedures required would be developed during future phases of the Project. Participation in the ICMC and obtaining certification would be a best practice for the transport and management of cyanide at the Project site and for its disposal.

An alternative cyanide use strategy would be to reduce the amount of cyanide used to process gold and silver, which may reduce the concentration of cyanide in the tailings. However, using lower concentrations of cyanide in process solution for the proposed Project would result in lower gold and silver production, thus incurring environmental effects without realizing the full production benefits. Managing cyanide concentrations in process solutions (tailings) following the removal of gold from ore would be environmentally protective without affecting gold and silver production.

Cyanide concentrations in tailings and process solution would be managed via cyanide destruction. The carbon-in-leach tailings would be pumped to the cyanide detoxification tank, where lime would be added to buffer pH, copper sulfate added as a reaction catalyst, and sodium meta-bisulfite added as a source of sulfur dioxide. The feasibility study conducted for the Project demonstrated that the sulfur dioxide/air process is an effective detoxification method at reducing weak-acid dissociable (WAD) cyanide levels to 15 milligrams per liter (mg/L) (30 mg/L maximum) for the Grassy Mountain gold deposit (Ausenco 2020). This cyanide destruction technique is a well-known and effective method of reducing cyanide levels in tailings.

For monitoring of cyanide, typically samples are analyzed by a certified analytical laboratory to ensure quality and consistency with monitoring data. The Applicant proposes to monitor cyanide levels in samples collected from the TSF and reclaim pond during operations (Ausenco 2023). An alternative cyanide monitoring method would be through the use of an in-line device that generates more frequent monitoring data capable of capturing fluctuations in the process cyanide solution. This would allow for rapid adjustments to be made in the cyanide destruction process. The Applicant has indicated that the Cynoprobe™ equipment would be used to monitor cyanide prior to going into tailing (Van Treek pers comm. 2023). The use of sampling and laboratory analyses and an in-line device would be an effective strategy for cyanide monitoring and management.

Principle 7 of the Global Industry Standard on Tailings Management (2020) describes best practices for designing, implementing, and operating monitoring systems in all phases of the TSF lifecycle. This principle covers important monitoring designs including designing a monitoring plan with adaptive management, using the observation method to mitigate or reduce risk in unfavorable situations, creating specific and measurable performance objectives, recording and evaluating data at appropriate frequencies, addressing values outside of the expected range, and reporting results to meet company and regulatory requirements (Global Industry Standards on Tailings Management 2020). GKM Consultants reviewed the current recommendations for monitoring TSFs and compared manual monitoring, data loggers, and telemetry-enabled loggers. Manual monitoring is useful at large, stable sites, but produces sparse readings. This method allows monitors to make observations and inspections while sampling, but more effort is needed for data storage and quality control. Data loggers collect data more frequently and can be retrieved as needed, which allows more information to track events and changes. Telemetry-enabled loggers collect readings and transmit remotely and are typically newer technologies (Le Borgne et al. 2024).

In Chapter 13 of *Gold Ore Processing: Project Development and Operations*, Donato and Overdevest (2016) review Cyanide Code compliance for TSF monitoring programs. They cite various methods for measuring cyanide concentrations in groundwater, tailings solutions, and surface waters in laboratory settings. For sampling techniques, they emphasize the importance of careful and consistent field sampling methods to determine accurate measurements. In particular, Donato and Overdevest state "the use of screw-topped lids and opaque and labeled containers that are chilled while in transit to the laboratory are important in accurately preserving cyanides in solution samples" (Donato and Overdevest 2016). The Nevada Gold Mines LLC North Block Project determined WAD cyanide levels by sampling the tailings slurry liquid fraction following neutralization quarterly (Nevada Division of Environmental Protection 2019).

See Section 2.2.3.8 of the EE for further information on cyanide alternatives.

Air Quality Controls

A standard Air Contaminant Discharge Permit (ACDP) would be required from the Oregon Department of Environmental Quality (DEQ) for the Project prior to commencing construction and operation, and appropriate emission control equipment would be installed and operated in accordance with DEQ requirements. Pollution control devices would control combustion emissions and would be installed, operated, and maintained in good working order to minimize emissions.

The Applicant's proposed process of extracting gold and silver from ore includes the use of a mercury retort oven that collects elemental mercury from the refining process. Gas scrubbers would be equipped with mercury control carbon beds for absorption of mercury from the gas streams. Prior to construction, air quality permits typically require a maximum available control technology analysis of the mercury control devices to confirm that they are up to date per industry and regulatory standards. There are mercury retorts available from various suppliers that may have varying degrees of efficiency, such as the FLS Mercury Retort (FLSmidth 2024) and the EnviroCare Mercury Retort Furnace (EnviroCare International 2024). Lochhead Precision Engineering has both an electric and a propane gas-fired mercury retort (Lochhead Precision Engineering 2024). Regardless of which mercury retort is selected by the Applicant, these modern devices would be installed and operated in accordance with the DEQ operating air permit.

The Applicant's mill design includes dust collection provided in the gold room for smelting operations. Extraction fans would be included for the kiln, electrowinning cell, retort/drying oven, and smelting furnace, and all extraction fans would lead to a gas scrubbing system, called a wet scrubber.

Wet scrubbing processes for gaseous control involve using a liquid to remove pollutants from an exhaust stream. The removal of pollutants in the gaseous stream is done by absorption. Wet scrubbers used for this type of pollutant control are often referred to as absorbers. Most absorbers have removal efficiencies in excess of 90 percent, depending on the pollutant absorbed. Wet scrubbers have relatively small space requirements and are capable of achieving relatively high mass-transfer efficiencies; however, they may create a liquid disposal problem (US Environmental Protection Agency [EPA] 2023a).

Different methods for removing particulates from air streams include electrostatic precipitators and baghouse filters. For an electrostatic precipitator, as particulates enter the unit, they get laden with an electric charge and are then removed by the influence of an electric field. The charged particles are attracted to collector plates carrying the opposite charge. These systems have low energy requirements and operating costs because they act only on the particulate to be removed and only minimally hinder flue gas flow. They are capable of very high efficiencies, even for very small particles. However, they are susceptible to corrosion, are difficult to install in sites with limited space, and require specialized maintenance (EPA 2023b). As such, they would not be as practicable as the Applicant's proposed use of a wet scrubber.

Baghouse filters are a collection of fabric-filter bags that remove suspended particulates from the air stream. A baghouse consists of an array of long, narrow bags with a diameter of about 25 centimeters (10 inches) each. These are suspended upside down in a large enclosure. Dust-laden air is blown upward through the bottom of the enclosure by fans. Particulates are trapped inside the filter bags, while the clean air passes through the fabric and exits from the top of the baghouse. This method offers relatively high resistance to airflow, which leads to substantial energy usage for the fan system (EPA 2023c). This method of particulate removal would likely have higher energy requirements than the Applicant's proposed use of a wet scrubber.

Process Solution Containments

The Applicant's proposed secondary containments are appropriately sized to contain at least 110 percent of the largest container volume within the secondary containment plus allowances for design storm events (2.28 inches over a 24-hour period) and approximately 2 inches (50 millimeters) of freeboard. Containments are typically concrete structures sized per these requirements.

Additional secondary containment measures include installing water stops to protect against process solutions exiting containment via joints and seams in poured concrete and installing concrete coatings (e.g., acid-resistant epoxy coating) for all concrete containments (not just in the hydrochloric acid use areas). These additional containment measures would provide an additional layer of protection against spills migrating beyond containment systems.

Wildlife Exclusion from the Mill

The Applicant's Wildlife Mitigation Plan (EM Strategies and Mason, Bruce & Girard 2023) and Wildlife Protection Plan (Mason, Bruce & Girard 2023) outline a variety of methods to prevent wildlife from accessing the mill. A perimeter fence would be constructed around the Mine and Process Area consisting of an 8-foot-high chain-link fence with a 0.5-inch galvanized hardware cloth mesh that extends a minimum of 18 inches below the ground surface and 30 inches above the ground surface (total height 48 inches). Access to the site would be via a main gate with security guard. This perimeter fence around the Project boundary would prevent many wildlife species, including burrowing mammals, from entering the site, including the mill. Monitoring the perimeter fence would identify any wildlife accessing the Project area, signs of wildlife activity would be addressed, and appropriate measures would be taken. To reduce the attractiveness of the Project facilities, birds and bats would be excluded from potential nesting structures such as open pipes or vents by installing covers, mesh, or netting. Staff would monitor potential nesting structures during the nesting season to detect any failure of exclusion apparatus. In addition, the Applicant's Waste Management Plan (Calico Resources USA Corp. 2023a) describes proper and regular garbage disposal using covered waste bins, which would prevent corvids and other wildlife accessing waste that may be a food source.

No other necessary exclusion methods have been identified for excluding wildlife from the mill.

Closure of the Mill

The Reclamation Plan (Calico Resources USA Corp. 2023b) describes dismantling, salvaging, selling, and authorized offsite disposal of mill infrastructure. Non-movable mill components such as slabs and foundations would be broken, buried, and then recontoured in place. These are appropriate measures to remove infrastructure from the Project site.

An alternative strategy would be to remove all foundation materials after it is broken up for transport to an offsite disposal facility. Foundation materials consist of hardened concrete, which is chemically unreactive with the environment and once broken and buried does not represent a barrier to revegetation. Therefore, removal of foundation materials for offsite disposal involves an activity without a benefit to reclamation and revegetation.

Post-reclamation and removal of surface facilities, disturbed areas would be regraded and 12 inches of growth media placed over regraded surfaces and revegetated. The goal of reclamation is to establish a sustainable ecosystem similar to pre-mining conditions that supports defined land uses of livestock grazing or rangeland, wildlife habitat, and recreational land. For more native communities, such as the Big Sagebrush/Bluebunch Wheatgrass Community, it would take many years to re-establish a similar vegetation community post-mining. Additional measures to establish sagebrush habitats include using soil amendments and planting sagebrush plugs/seedlings, perennial grasses, and perennial forbs in appropriate quantities/ratios to achieve viable sagebrush habitats. Considering that sagebrush recovery and restoration are slow processes with high risks of failure, a robust monitoring program specifically designed to address re-establishment of sagebrush communities would assist with restoration success.

The internal electrical power distribution lines installed to support the Project are proposed to be removed as part of reclamation activities under the Applicant's proposed Project. An alternative would be to leave these power lines in place to support monitoring power requirements. Electrical power transmission lines installed to support the Project are the property of the power supplier and are maintained or removed by their owner. Following reclamation activities, electrical power requirements for the closed facility would be minimal. Power for ongoing monitoring of groundwater wells and piezometers would be supplied by batteries or generators associated with the monitoring and sampling equipment. Therefore, retaining power distribution lines within the Project area following the conclusion of reclamation activities is not required and does not have a foreseeable benefit.

In addition to these proposed measures, it is best practice to establish closure-period inspections of process facility components to detect contamination prior to closing those components in place. If contamination is identified, appropriate remediation should be undertaken prior to burying and recontouring the components in place to avoid contamination of the site.

A-3.3 Tailings Management

The review of BAPNT for tailings management and disposal includes tailings disposal, TSF design, leak detection, long-term pollution prevention controls, wildlife exclusion, and closure of the TSF.

Tailings Disposal

Options for tailings disposal include permanent storage of tailings in a lined TSF and mixing with cement and rock to create CRF to use as backfill in underground workings. The option for converting all tailings to paste tailings for use as backfill was eliminated from further review in the EE because this option would result in greater environmental effects than the use of a TSF only (see Section 2.2.3.5 for further information).

For storing tailings in a TSF, the Applicant considered different levels of pre-disposal dewatering technologies (Golder Associates 2019), including:

- Conventional tailings slurry (25 to 60 percent solids, weight by weight [w/w]); a pumpable slurry.
- Filtered tailings (75 to 85 percent solids w/w); vacuum or pressure filtration removes water to create the consistency of a solid material.
- High-density thickened tailings (50 to 80 percent solids w/w); paste tailings are dewatered to a non-segregating but pumpable slurry that typically has minor bleed water after placement.

The filtered tailings and high-density thickened tailings options would require the construction of additional infrastructure to mechanically dewater the tailings prior to storage/disposal, including a large aboveground waste disposal area and additional stormwater management and diversion structures. These options would require additional geotechnical design, closure, and reclamation planning and design (Golder Associates 2019). The conventional tailings slurry option was considered to be the preferred alternative for tailings management since it would result in less surface area disturbance and fewer infrastructure requirements and is included in the Applicant's proposed action.

The TSF process solutions recovered from the supernatant pond plus overdrain and leak detection systems would be monitored for pH to check the efficacy of lime addition in controlling potential acid generation by sulfide minerals within the tailings.

The TSF facility would maintain a facility water balance reflecting measured tailings slurry discharges, supernatant pond volumes and recycling, and meteorological inputs (i.e., measured precipitation) and withdrawals (i.e., calculated evaporation). The water balance accounting would also check the capacity of the TSF facility to contain deterministic design storm events plus stochastic representations of future meteorological conditions. The water balance would be used to confirm the ability of the facility to maintain containment of tailings and process solution under the foreseeable site meteorological conditions.

Tailings Storage Facility Design

The Applicant's TSF design was developed by Golder Associates (now WSP), a consulting firm with global tailings design experience and Oregon Professional Engineer licensing. The tailing facility design criteria were based on:

- Water Resources Department, Dam Safety Regulations OAR 690, Division 20;
- DOGAMI, Chemical Process Mine Regulations, OAR 632, Division 37;
- DEQ, Chemical Mining, OAR 340, Division 43; and
- Oregon Department of Fish and Wildlife (ODFW), Chemical Process Mining Consolidated Application and Permit Review Standards, OAR 635, Division 420.

The TSF is proposed to be located in a broad valley with embankments constructed on the north and west sides. This location requires smaller volumes of embankment fill (as compared to a TSF located outside of the valley), structural stability, and relatively short haul distances between the mine portal, processing mill, and TSF and represents the best location for the TSF. The Oregon Department of Water Resources (WRD) was consulted regarding applicable requirements for a tailings dam at this location. The WRD designated the proposed tailings design as a low-hazard dam, and its design criteria (e.g., stability factors of safety) conform with that classification. The WRD hazard-designation process is based on consideration of the effects of a dam in releasing stored water rather than tailings. The consideration of media impounded behind a dam (e.g., water, tailings) in establishing hazard designations varies by regulatory jurisdiction. However, the different systems for hazard designations commonly focus on dam failure risks to human life, public health, infrastructure damage, property losses or damage, and losses or damage to surface water bodies regardless of the impounded media. Water quality effects associated with release of tailings via dam breaches are generally not a component of the hazard designation.

The Applicant has designed the TSF as a zero-discharge facility that would contain all process solutions during operations and closure. The design includes double lining or containment for the impoundment, channels, piping, and other systems that would contain or convey process solutions. Facilities that would contain process solution would be equipped with leak detection infrastructure. The TSF design included a dam breach analysis with forecasting of effects in the event of a dam breach through examination of the potential tailings runout. The infrastructure predicted to be affected by a full-depth breach is limited to segments of Rock Canyon Road and Twin Springs Road. No habitations are predicted to be affected. No subsurface water at depths shallower than 120 feet was encountered during the site investigation below the TSF footprint (Ausenco 2020). Therefore, unwanted upward pressure from groundwater on TSF facilities is unlikely. Also, any uncontained seepage or releases from the facilities would need to infiltrate at least 120 feet into the subsurface before contacting groundwater.

Design drawings C1, C8, C10, and C12 in the TSF design report (Golder Associates 2021) appear to illustrate the tailings supernatant pond in contact with exposed liner on the eastern side of the tailings impoundment. Best practices for operating a tailings facility involve keeping the supernatant pond on tailings rather than in direct contact with the liner. Fine-grained tailings have low permeability and inhibit leakage through liner defects. The design grind size for the mill facility is particles passing a US mesh #150 sieve (89 microns). At this grind size, tailings particles would consist of clays, silts, and very fine sands that would exhibit low-permeability properties (but would not be impermeable). Further, placement of tailings on the liner limits the liner’s exposure to sunlight and environmental conditions that could weaken liner integrity, while supernatant pond water is not protective to the same extent. Therefore, the placement of tailings across the entire liner is the best method for placement of tailings to protect liner integrity.

Geosynthetic liner systems are reparable from the time of their installations until they are covered by stored materials that preclude further physical access to the liner system. Liner patches and seam repairs are affected by welding new liner material to the installed portions or re-welding installed liner together. These repairs require the ability to observe the location of the liner defect and then access it with welding equipment.

Alternative embankment designs would utilize engineered materials (e.g., concrete) in place of earthen materials in full or in part. Full replacement designs would resemble concrete water dams while partial replacement designs would use a starter dam constructed of engineered materials with subsequent dam phases constructed by earthen materials. For a mining application, earthen materials are readily available for embankment construction and have been demonstrated to be effective for TSFs. Laser imaging, detection, and ranging (LiDAR) is a remote-sensing technology that provides accurate measurements of objects and landforms. For geological and mining purposes, LiDAR can be used to detect changes in slopes that may reflect slope stability; to detect ground subsidence and wall stability in open-pit mines; and to detect landslide activity before other types of monitoring and sensors, among other applications (An et al. 2024, Casagli et al. 2023; Duffell et al. 2012). Since the Project is an underground mine, LiDAR is not an appropriate method for assessing mine wall stability because LiDAR is not able to detect changes under the ground surface. However, it could be used to monitor the stability of the TSF.

The TSF is designed to fill an existing valley at the Project site and requires staged embankment construction on two sides. LiDAR could be used to monitor the embankments and the valley walls during the period of operation of the TSF by periodically scanning the sides of the TSF. Comparing the data obtained from each scan could reveal changes in the slope or profile of the TSF walls that could indicate shifting or instability. For a relatively small area such as the TSF, LiDAR could be flown with a helicopter or obtained from a stationary ground- or water-based platform. However, this technology is not required to assess the stability of the TSF embankments because the embankment location would be static following construction compared to the changing conditions in ongoing excavations. The stability of the TSF embankment can be monitored via optical surveys, inspections for deformations, and pressure transducers that quantify changes in hydraulic pressure on the embankment.

The Applicant's TSF design incorporates technologies to design, build, operate, and monitor a tailings facility that are necessary, available, and practical, as demonstrated by their effective use at numerous regional tailings facilities constructed in accordance with regulatory requirements. When installed to design specifications, the Applicant's proposed synthetically lined TSF using prepared subgrades, an embankment dam designed for seismic conditions, plus leak detection, monitoring, and inspection equipment and procedures would be as protective or more protective of water resources compared to other designs in use.

Leak Detection

The Applicant's TSF design using a double-liner system with leak detection and collection would detect leaks quickly, contain waste and waste solutions effectively, and prevent releases to the environment. Leakage through the primary liner would appear in the leak detection sump in the amount of time that it takes for the water to flow through the collection pipes to the sump. The flow time in the collection pipes would be on the order of a few hours depending on the distance from the leak location to the sump. The detection of the leak would occur at the time that the leak detection sump was inspected and evacuated which is typically weekly. Therefore, leaks would be detected within approximately one week.

There are numerous other methods in common practice for detecting leaks through geosynthetic liners such as groundwater monitoring, electromagnetic methods, and geophysical methods (Oh et al. 2008). These are indirect (and often time-delayed) methods for detecting leaks that rely on a substantial volume of leakage for detection and are subject to other environmental influences such atmospheric electrical conditions and other constituent sources that require consideration and interpretations for their usage in assessing leaks. Leak collection systems using dual liners constitute the most accurate means for identification of leaks (Gilson-Beck 2019). See Section 2.2.3.4 for further information on alternative leak detection methods.

Long-Term Pollution Prevention Controls and Monitoring

Long-term pollution prevention controls and monitoring are important aspects of a mine project so that the environment is protected from contamination after a mine closes. Various features of a mine are monitored over the long term to ensure that the pollution controls and measures taken to prevent contamination are working as placed and actions can be taken to address identified problems should they occur. According to Hilson and Murck (2001), most gold mines operated by larger senior mining companies have implemented state-of-the-art measures that best prevent environmental problems in cyanidation practices and acid rock drainage management, but that small- and medium-sized junior mining companies are doing only what is necessary to comply with environmental regulations. Environmental controls used as best practices by other mining companies are considered here.

For this Project, the Applicant's long-term pollution prevention controls include:

- Backfilling the underground mine with CRF to prevent acid rock drainage and metals leaching;
- Plugging the mine portal to prevent oxygen and water from entering;
- Retaining liners on facilities in perpetuity, including the TSF and reclaim pond, to protect groundwater;
- Reclaiming mine areas, including the TSF, temporary stockpiles, building foundation areas, and parking lot, by grading, placement of growth media, and revegetating to provide long-term stability, mimic adjacent landforms, facilitate revegetation, control drainage, and minimize erosion;
- Converting the reclaim pond to an evaporation cell (e-cell) by covering the geomembrane-lined pond with growth media and revegetating to allow for long-term management of stormwater at the TSF; and
- Retaining stormwater diversion channels and surface water run-on diversion berms at the TSF and quarry to prevent stormwater from entering these areas.

These are necessary and appropriate long-term pollution prevention controls for the Project.

In the western United States, stormwater controls and diversions around mine facilities, including TSFs, are standard regulatory requirements. The Applicant would retain stormwater diversion channels and surface water run-on diversion berms at the TSF and quarry post-closure to prevent stormwater from entering these areas. Stormwater diversions are effective in protecting mine facilities as long as they retain their designed physical condition and do not experience larger-than-design events or erosion. Design requirements are typically specified by state regulations, and diversion construction is subject to quality controls and regular inspections during operations. Diversion failures during operations affect the operation of revenue-generating facilities and are therefore repaired as part of the operations. In the post-closure period, diversion failures have the potential to affect the physical and chemical stability of reclaimed facilities. Therefore, inspection and maintenance of diversions into the post-closure period is a best practice.

Monitoring of mined materials quarterly during operations could also be added to long-term pollution controls to confirm and update the potential for acid generation and metal leaching per the *a priori* site geochemical characterization and to allow adaptation of operational and closure plans, if necessary, to the observed conditions while mining.

With regard to long-term monitoring, the Applicant would create and submit a detailed post-closure monitoring plan to the Bureau of Land Management and DOGAMI prior to execution that would include methods, parameters, and frequencies of monitoring actions. The Applicant’s long-term monitoring plans include:

- Installing groundwater monitoring wells in locations close to the facility perimeter to detect contamination in groundwater;
- Monitoring for noxious weeds to identify and treat infestations;
- Conducting inspections, cleaning, maintenance, and repairs of catch basins, grates, screens, oil/water separators, and sedimentation basins to prevent possible contamination of stormwater equipment and systems;
- Conducting inspections and sampling of all non-contact stormwater discharge points if water is present to determine if stormwater discharge is causing or contributing to a violation of any instream water quality standard established in OAR 340-041 and to take corrective action if needed;
- Sampling of stormwater discharges for compliance with the Stormwater General Discharge Permit; and
- Inspecting and sampling stormwater diversion channels for 15 years during the reclamation monitoring period to ensure that sediment has not accumulated and that the lining in the channels has not been compromised.

Monitoring strategies used in other mine areas may include biomonitoring and vegetation cover indexes. Biomonitoring can be used to evaluate mining effects on aquatic ecosystems. Under this method, quantification of microbiota and the taxonomic richness of water invertebrates and basic physicochemical parameters are used to assess mining pollution. This method offers a cost-effective alternative to expensive monitoring methods (Borda et al. 2023). However, considering that there are no aquatic ecosystems at the Project site, this would not be a practicable alternative. Vegetation cover indexes can also be used as a pollution indicator in gold mining areas. Under this method, vegetation cover indexes created for areas surrounding mine facilities are tracked and analyzed over time, allowing for quantification of mining activity impacts on the surrounding vegetation (Andaryani et al. 2023). This method has been employed as a pollution warning tool in gold mining areas in the northwest of Iran that use heap leaching. However, considering that all mine areas containing contaminated materials would be protected with liners, stormwater diversion channels, and revegetated, this method would not likely succeed and is therefore not considered a necessary technology.

Rather than using biomonitoring and vegetation cover indexes, the Applicant proposes to use groundwater monitoring wells to detect contamination of groundwater from mine facilities. These groundwater monitoring wells would be installed close to the facility perimeter (e.g., within 250 feet) with a relatively short screen interval (e.g., 20 feet), with the top of the screen located approximately at the local groundwater surface elevation. This location targets the groundwater most likely to be affected by the facility, with minimal opportunity for dilution of samples by mixture with other groundwater areas or depths. The Applicant’s groundwater monitoring program is therefore considered to be effective in identifying contamination of groundwater.

Tailings Storage Facility Wildlife Exclusion

The Wildlife Mitigation Plan (EM Strategies and Mason, Bruce & Girard 2023), Wildlife Protection Plan (Mason, Bruce & Girard 2023), and Section 3.5 of the EE outline a variety of methods to deter wildlife from using the TSF. The perimeter fence around the Project area would prevent many wildlife species, including burrowing mammals, from entering the Project area and accessing the TSF. A permanent stormwater diversion channel would act as a physical barrier along the south side of the TSF, and the Applicant proposes installing an additional fence around the reclaim pond for extra protection. Monitoring the perimeter fences would ensure that wildlife are not accessing the Project area or the TSF. Any signs of wildlife activity would be addressed and appropriate measures taken.

Wildlife that can climb the fences or fly into the area would be able to access the TSF. The Applicant proposes deploying bird deterrent balls on the TSF reclaim pond to deter birds and bats from landing on the surface or drinking the water. Although specific studies on the effectiveness of bird balls as a deterrent are not available, the ICMC recommends this technique in the Cyanide Code guidance (International Cyanide Management Institute 2021).

Other types of deterrents such as radar-activated sounds, human or bird effigies, and propane cannons that activate when birds are detected may be used. One study conducted at the oil sands region of Alberta, Canada, found that the on-demand deterrent system significantly reduced the probability of birds landing in comparison with a continuous, randomly activated deterrent system and control periods with no deterrents (Ronconi and St. Clair 2006). The efficacy of different stimuli types within the on-demand system was also assessed and cannons were found to elicit significantly more response by birds in flight than mechanized peregrine falcon effigies with speakers broadcasting peregrine sounds. In addition, birds were more likely to land earlier in the spring and when they flew at lower altitudes, and shorebirds were more likely to land than ducks, geese, and gulls

The best deterrence techniques for birds appear to be the use of varied (i.e., changing the location, timing, and/or frequencies of sound and visual techniques) and targeted deterrence techniques in specific areas for known species or family taxa (Chilvers 2024). Applying this approach to the Project would require additional monitoring or surveys to determine the species most likely to be in the Project area in a given season and targeting deterrent methods toward those species. In summary, the most effective methods for deterring birds from landing on the TSF may:

- Use radar-activation;
- Be operational in the early spring when tailings ponds appear to be most attractive to migrating waterfowl;
- Target low-flying waterfowl and shorebirds;
- Be specific to species or groups of birds; and
- Be effective during both day and night.

Alternative deterrent methods may include non-lethal “hazing” methods such as sound air cannons, explosives, or bird tear gas. Since these methods are more disturbing to wildlife, they should be used in emergency situations only, such as if cyanide levels in the TSF were to become elevated beyond permitted levels. Such emergency hazing techniques would be coordinated with the ODFW prior to use.

Potential additional measures to prevent waterbirds from landing on the TSF pond and wildlife from entering the TSF area include the use of visual deterrents, motion-activated devices, laser deterrents, emergency hazing techniques, bio-exclusion zones, decoy ponds, use of hypersalinity, and netting and wires, as described herein. Using habitat management to attract birds to an alternate habitat nearby such as a decoy pond has the advantage of targeting waterfowl and is a more passive technique once constructed. However, disadvantages of decoy ponds include difficulty accessing freshwater, avian botulism outbreaks, high cost of development (Bradford et al. 1991), and attracting more birds to the area (Chilvers 2024). For these reasons, decoy ponds are not recommended as a wildlife exclusion method for this Project.

An alternative strategy to deter wildlife from consuming water at the TSF is to create an inhospitable hypersaline environment. Elevated levels of salinity in open impoundments have been shown to reduce wildlife drinking and foraging (Griffiths et al. 2014). Hypersalinity involves increasing the salt concentration in the water to levels that are unpalatable. This can be achieved by adding salts directly to the water or by manipulating natural salt deposits in the surrounding geology. The specific salts used and their concentrations depend on the local environment and the types of wildlife typically found in the area. Salinity levels need to be carefully monitored and maintained to ensure they are high enough to deter wildlife but not so high that they create other environmental issues, such as soil degradation or harm to other wildlife. Hypersalinity can affect the surrounding ecosystem if not responsibly managed. The challenges and limitations to using hypersaline tailing ponds is the initial cost of installation and maintaining the correct salinity levels required which requires ongoing monitoring and management including regular addition of salts and checking for dilution effects from rainwater or other sources. The salt can also cause significant wear and tear on equipment used to manage the ponds. This necessitates the use of corrosion-resistant materials and regular maintenance. Hypersalinity deterrence effects can vary based on bird species and environmental conditions. Some birds might be more tolerant of higher salinity levels, and local conditions such as climate and availability of fresh water sources can influence effectiveness. While hypersalinity can be effective, it is often used in conjunction with other avian deterrence strategies to enhance effectiveness and mitigate any potential negative impacts.

With regard to using netting and wires to exclude birds and bats from the TSF, the majority of studies on netting and wires have been conducted at smaller scales, and the National Academies of Sciences, Engineering, and Medicine suggest large-scale use of total exclusion measures, such as netting and wires, is impractical and cost prohibitive. Netting may interfere with routine daily maintenance, can be damaged by the wind or buildup of snow and ice, and if not maintained correctly may also present a hazard to wildlife, such as loose netting resulting in entanglement of bird species. (Bishop et al. 2003; Lowney 1993; National Academies of Sciences, Engineering, and Medicine 2011).

Several studies have reviewed the effectiveness of techniques to exclude birds from accessing ponds or sites such as airports where there is risk to human activity or wildlife. The National Academies of Sciences, Engineering, and Medicine reviewed literature on the effectiveness of bird deterrent techniques and found varying levels of effectiveness dependent on the surrounding area and species being deterred (2011). Therefore, monitoring of the deterrents’ effectiveness and contingency plans in the event of cyanide concentrations increasing are outlined in the Wildlife Protection Plan (Mason, Bruce & Girard 2023).

To reduce the attractiveness of the Project area in general, birds and bats would be excluded from potential nesting structures such as open pipes or vents by installing covers, mesh, or netting. Monitoring the TSF during operations for the presence of fish, aquatic invertebrates, aquatic algae, and vegetation and removing any findings would prevent the reclaim pond from becoming more attractive to other wildlife as a water or food source.

Closure of the Tailings Storage Facility

TSF closure options include dry closure, wet closure, and wetland establishment closure.

Dry closure methods involve allowing water content in the tailings to evaporate or drain to the reclaim pond, regrading the surface to shed water, installing a composite cover designed to prevent water and air infiltration, adding a soil layer, and revegetating. A dry closure is the most common closure method approved by the Nevada Division of Environmental Protection (2018). The Applicant proposes dry closure of the TSF due to the arid climate at the site (Calico Resources USA Corp. 2023b).

Wet closure methods are used in areas with low evapotranspiration and on sites when tailings facilities are situated in pits. This method involves permanent immersion of deposited tailings with water discharged into the TSF (Komljenovic et al. 2020). A simple soil cover can be added to the top of the tailings, and the groundwater level is raised to permanently cover the tailings, which eliminates sulfide oxidation. This method is applicable where the natural groundwater level in the tailings is very shallow.

Wetland establishment closure involves constructing a wetland on and around tailings as a nature-based solution to restoring waters polluted with heavy metals and other contaminants. Conditions and contaminants at each site influence the type of wetland constructed. Many mines use wetlands to treat tailings since they are cost-effective, low-maintenance, and can provide habitat and other benefits to wildlife. However, wetlands may take a long time to establish before they are self-sustained, require large areas to construct, may not address all contaminants in tailings, and may be less effective in climates with cold winters. In arid regions with prolonged droughts, there may be significant water loss due to evapotranspiration, in which case a supplemental source of water would be needed to maintain adequate water levels (Davis 1995).

The dry closure method is identified as the most suitable method for closure of the TSF due to the arid climate and deep water table, which are not suitable conditions for the other water-based closure methods.

The TSF closure method proposed by the Applicant includes decommissioning the reclaim pond liner in place. During the early closure period, the lined reclaim pond would be used to collect draindown from the TSF for active management (i.e., recirculation and evaporation) of that process water. Once draindown flow diminishes to a few gallons per minute, the lined reclaim pond would be backfilled with alluvial material in a way that residual draindown is introduced into the alluvial material above the liner. The backfilled material would be revegetated so that draindown water entering the backfill material is subject to evaporation and transpiration. This evapotranspiration rate would balance the draindown rate entering the backfilled pond to remove the process water from the system so that it does not accumulate.

The current cover design for the TSF uses a geosynthetic liner placed over the tailings surface and then covered with growth material and revegetated. Other regional closures for TSFs use store-and-release covers, which consist of a revegetated growth media without the geosynthetic liner. The store-and-release covers are sufficiently thick to contain winter season infiltration of meteoric waters that are subsequently removed by evapotranspiration during the summer season. While the store-and-release covers have been effective at other locations, they are not consistent with Oregon regulations requiring the use of geosynthetic covers.

At closure, the TSF and reclaim pond would be covered with 12 inches of growth media and revegetated. Hydroseeding is one potential method for revegetating the TSF area. Hydroseeding involves spraying a mixture of seed, mulch, and fertilizer in a water-based slurry onto the soil surface. The benefits of hydroseeding are that it is less labor intensive than hand seeding and can quickly cover large areas (approximately 1–2 hours per acre, depending on tank size) (Utah State University n.d.). Hydroseeding has been used to restore various types of mine waste areas, including waste rock areas and disposal ponds (Lorite et al. 2021).

The hydroseeding process involves a hydroseeder, a large tank with a sprayer attached that may be mounted on a truck or pulled as a trailer, and a substantial amount of water. A typical hydroseeder with a 500-gallon tank can cover 6,600 square feet, while a 1,000-gallon hydroseeder seeds 13,000 square feet (Turbo Turf 2024). With regard to seed germination and establishment, hydroseeding has been shown to be effective, but not substantially more effective than manual or broadcast seeding (Montalvo et al. 2002). According to the Natural Resources Conservation Service, when both mulch and seed are applied, split applications are generally more effective than applying all materials in one pass (Natural Resources Conservation Service 2024). The cost of hydroseeding is much greater than the cost of other seeding methods (estimates range from $550–$4,000 per acre for hydroseeding, compared with $10–$30 acre for broadcast seeding or $25–$55/acre for planting with a seed drill) (Pawelek et al. 2015). Due to the high cost and comparable effectiveness of other seeding approaches, hydroseeding is not recommended as an appropriate choice for revegetating the TSF after mine closure.

A-3.4 Operations Management

The BAPNT review for operations management includes water management, fugitive dust control, and operations monitoring.

Water Management

Water is required for the Project for mining, ore processing, fire protection, potable uses, dust suppression, and various other uses. Inflows to the system include precipitation and snowmelt falling on lined facilities; runoff from an upstream basin reporting to the TSF; seepage into the underground mine; and makeup water from the production well field as needed. Outflows include evaporation from the tailings surface, supernatant pool, and reclaim pond; dust control; CRF preparation; and water lost in the void spaces of the stored tailings. Overall, the proposed Project would have a negative water balance, requiring additional water. Water makeup requirements would vary during operations based on seasonal meteoric contributions and variable seepage flows in the underground mine.

Additional water required for operations would come from site production wells. A well field design report (SPF Water Engineering 2019) was prepared to support the Project needs. Currently, there are three wells onsite. One of the existing wells and two new wells would be sufficient to fill the raw water tank. Additional wells would be proposed and constructed if they become necessary. The other two existing wells onsite may be used for local water supply uses such as dust suppression.

Alternative water supplies were considered as part of the alternatives evaluation in Section 2.2 of the EE. There are no surface water supplies suitable for this Project, so the options for additional water supply are (1) from groundwater wells, or (2) from a municipal water supply via a buried pipeline. The alternatives analysis found that there would be greater detrimental environmental effects from installing a pipeline to supply municipal water than to install onsite wells. Considering that the Applicant has designed the Project to capture precipitation and recycle process water, no other water management options have been identified.

Water management is a continuous process that must be monitored and adjusted as needed throughout the mine's lifetime. A water balance maintained during operations monitors inflow versus outflow, which reduces the risk of operational water deficits. The Applicant's dedicated weather station to be installed onsite would allow for accurate data collection to estimate meteoric inputs and other factors affecting water during operations. Reliable weather data combined with regular monitoring of operational water levels, surface waters, and groundwater allows for forecasting hydrological conditions to prepare necessary adjustments such as constructing new wells if additional water makeup is required (Punkkinen et al. 2016). For this Project, water level and water quality sampling at each well would be conducted quarterly, with testing starting shortly after well construction and development. Background monitoring would occur at all new wells for at least a year prior to any facility use. Monitoring at all wells would occur throughout the mine's operation and after mining operations cease (SPF Water Engineering 2022).

Rather than collecting groundwater entering underground mine workings using sumps (see Section 2.1.2.2), perimeter pumping wells outside the workings could be used to intercept groundwater prior to it entering the underground workings. This dewatering technique would increase the volume of groundwater managed by the dewatering system by handling more groundwater than would actually enter the mine. However, intercepting groundwater prior to entering the underground workings decreases the potential for geotechnical failures in the workings associated with hydraulic pressures on the excavated areas and decreases the interaction between collected groundwater with mined materials and mine equipment. This interaction potentially results in acid rock drainage in mine areas prior to installation of cement ground support and/or backfill, increased analyte concentrations due to leaching, or introduction of equipment-related contaminants. However, the use of perimeter pumping wells requires sufficiently permeable aquifer characteristics to draw water away from the underground workings and sustain groundwater pumping from the wells. Pumping of existing wells in the vicinity of the Project orebody has not yielded the sustained groundwater production suitable for mine dewatering.

At closure, water supply pipelines would be removed from their operational alignment for salvage or disposal. Pipeline removal is preferred over decommissioning in place to eliminate conduits that could inadvertently convey flows or collapse resulting in uneven ground surface conditions in the post-closure period.

Fugitive Dust Control

Fugitive dust can arise from travel on roadways, construction and demolition activities such as concrete mixing and blasting, and from mine operations such as rock crushing. Dust is not expected to occur at the TSF due to the continual placement of wet tailings slurry on the surface. After operations cease, the tailings would settle and consolidate to allow for surface regrading and cover placement. When covered, the TSF would not be a source of dust. However, there is potential for the tailings to dry and create a dust hazard during the dry summer period after operations cease. For this reason, the closure plan should include regular monitoring of the TSF surface during the period after final TSF slurry placement and prior to cover placement.

To address fugitive dust from roadways, the Applicant would use CAT 777G and Normet Multimec MF100 water trucks to spray water in high traffic areas for dust suppression such as in the underground mine, at the quarry, and on roadways. Water used for fugitive dust suppression would be supplied by existing production Wells 1 and 2 at the Project site.

To address fugitive dust from mine facilities, certain equipment would be fitted with enclosures, hoods, curtains, movable and telescoping chutes, and shrouds as appropriate. Table A-1 provides a summary of the Project's dust and particulate matter sources and the Applicant's proposed control methods.

Table A-1 Dust Sources and Control Methods

Fugitive Dust and Particulate Matter Sources	Possible Control Methods
Unpaved roads	Dust suppression chemicals and water application
Stockpile (run-of-mine ore)	Inherent moisture content of the ore
Crushing units and associated handling (e.g., bins, conveyors)	Inherent moisture content of the ore
Lime silo loading	Bin vent
Carbon regeneration kiln	Wet scrubber/carbon filter
Electrowinning cells and pregnant solution tank	Carbon filter
Mercury retort	Condenser/carbon filter
Melting furnace	Baghouse/carbon filter
Laboratory operations	Fume hoods
Mixer loading	May include water sprays, enclosures, hoods, curtains, shrouds, movable and telescoping chutes, and central dust collection systems
Ore and waste rock crushing	Water application or other methods, to be determined
Rock drilling	Water application or other methods, to be determined
Rock blasting	Water application or other methods, to be determined
Material transfers	Water application or other methods, to be determined
Wind erosion	Water application or other methods, to be determined

Source: Ausenco 2022

The standard ACDP required for the Project would include the regulation of particulate matter emissions and fugitive dust from mining operations and onsite haul roads, including air quality monitoring requirements.

Other methods to control fugitive dust may include the following best practices suggested by the EPA (EPA 2022):

- Cover or enclose material piles;
- Install wind breaks and barriers around storage piles;
- Install wheel wash stations to minimize material tracked by vehicles;
- Install and maintain dust curtains at material transfer points;

- Enclose conveyor belts and spray water/dust suppressant at conveyor belts during material transfer;
- Cover open-bodied trucks when they are carrying materials that can be released into the air; and
- Provide fugitive dust control training and safety for staff.

In the event one is granted, the ACDP would identify the best management practices (BMPs) to be used for the proposed Project.

Equipment Maintenance

Common approaches for maintaining mining equipment in working order include reactive, preventative, and predictive maintenance. Reactive maintenance is the most costly and inefficient since it results in unplanned outages and unnecessary maintenance costs that may not have been required otherwise. Calendar-based preventative maintenance often proves to be inefficient because machine failures occur at random times. Predictive maintenance strategies use sensors and other monitoring equipment to collect data on the performance of equipment to identify issues and enable repairs before equipment fails. The most recent advances in mine maintenance technology are prescriptive methods, which involve the integration of big data, analytics, machine learning, and artificial intelligence to implement an action to solve an impending issue, rather than simply recommending an action.

The Applicant should conduct regular inspections and maintenance of equipment to ensure that it remains in good working order. While installing predictive maintenance sensors and other monitoring equipment is not a necessary technology to accomplish maintenance, it would likely result in cost-savings by identifying and conducting maintenance actions on equipment to avoid a major equipment failure and costly downtimes.

Operations Monitoring and Mitigation

The Applicant would monitor various systems and facilities as described in the Monitoring Plan Inventory (Calico Resources USA Corp. 2023c). Table A-2 summarizes the monitoring plans for the proposed Project, as required by future facility permits and to comply with applicable regulations.

Table A-2 Summary of Monitoring Requirements

Resource to Monitor	Monitoring Plan
Fugitive dust and process air emissions	N/A; air quality monitoring would be conducted pursuant to conditions of pending facility air permits
Stormwater	Stormwater Pollution Control Plan as required by an Industrial Stormwater Permit
Groundwater	Monitoring plan for groundwater and leakage detection systems as required by a Water Pollution Control Facility Permit
Hazardous wastes	Waste Management Plan
Tailings (TSF cyanide concentrations and net neutralization potential)	Tailings Chemical Monitoring Plan
Petroleum storage containers (including planned diesel fuel tanks) and spills	Spill Prevention, Control, and Countermeasures Plan; inspection requirements are provided in the Emergency Response Plan
Noxious weeds	Noxious Weed Monitoring and Control Plan

Resource to Monitor	Monitoring Plan
Wildlife, TSF pond, fences, exclusion devices	Wildlife Protection Plan
Noise	Noise Monitoring Plan
TSF and temporary waste rock storage facility leak detection systems	Monitoring plan for groundwater and leakage detection systems
Potable water	Public Drinking Water System Permit Conditional Approval Water System ID #4195624

Some monitoring actions have been identified in the Applicant's plans and others would be specified in future permits (Table A-2). It is assumed that regulatory authorities would impose monitoring requirements for resources under their purview.

With regard to long-term noxious weed management, noxious weed mapping approaches can range from on-the-ground field surveys, such as those performed at the project site, to unmanned aerial vehicle (UAV) surveys, to satellite data interpretation (Ubben et al. 2024; Xing et al. 2024). In UAV surveys, UAVs can be equipped with various camera systems, ranging from red-green-blue to hyperspectral imaging equipment. Due to the relatively low flight altitude of UAVs, spatial resolutions of well below 1 centimeter can be achieved, and a relatively large area can be mapped (Ubben et al. 2024). To identify noxious weed populations at even larger scales, vegetation indices can be applied to satellite imagery to detect spectral and textural differentiations between native plant species and invasive species with above 90 percent accuracy (Xing et al. 2024). Noxious weed mapping data can also be crowd-sourced. In Oregon, the Oregon Department of Agriculture supports an online weed mapping tool called WeedMapper to provide a clearinghouse for noxious weed presence data accumulated by public and private groups as well as individuals (WeedMapper). All these approaches can be useful in recording and monitoring changes in noxious weed coverage at different scales and assessing the effectiveness of noxious weed treatment and eradication strategies.

According to the Noxious Weed Monitoring and Control Plan for the Project, a noxious weed survey was performed at the Project site in 2019 (Calico Resources USA Corp. 2024). The results of this inventory were mapped to show the presence of noxious weeds within the Permit Area. The plan states that two types of weed survey would be conducted in the Project area through final reclamation: an annual informal noxious weed survey would be carried out by environmental department staff, and biennial formal weed surveys would be performed. The results of these surveys would be documented in a report provided to the Bureau of Land Management. Areas of noxious weed infestations noted during the annual and biennial surveys would be recorded with a global positioning system (GPS) unit and documented on area maps and in photographs. The maps generated with these survey data would be useful in determining the spread or containment of noxious weed species and whether weed management strategies applied in the Project area are effective. Noxious weed surveys conducted on the ground are considered appropriate for a Project of this scale and allow for areas with infestations to be targeted for specific management actions that would depend on the weed species.

The Applicant proposes to conduct monitoring of springs and seeps as described in the Spring and Seep Monitoring and Mitigation Plan (SLR International Corporation 2024). Alternative monitoring methods for springs and seeps may include observations of vegetation change in these areas. Wetland and riparian plant species have a strong connection to groundwater depth and soil water content and the cover of plants within wetland indicator groups, and the frequency of wetland indicator species can be an indication of depth of groundwater (Barrick Cortez Gold Mines and JBR Environmental Consultants, Inc.

2010). A water table decline can result in vegetation shift from obligate wetland to facultative wetland or upland species. Hydrophytic vegetation is broken into indicator categories based on the conditions under which the species can survive. Plant indicator groups requiring prolonged inundation or saturated soil conditions are considered obligate wetland species (plants that occur almost always in wetlands), facultative wetland species (plants that usually occur in wetlands but also occur in non-wetland areas) and facultative species (plants that have similar likelihood to occur in wetlands and non-wetlands). Shallow-rooted herbaceous hydric species (obligates and facultative wetland species) that require saturated soils or shallow water to survive are the first group to be influence by groundwater decline. Monitoring would consist of vegetation evaluations twice a year during spring and summer to determine the cover of species present. Effects to springs and seeps would be apparent when less than 50% of the total species present are obligate, facultative wetland, or facultative species.

If water levels in springs or seeps are affected by mine operations, mitigation measures would be followed as described in Section 3.3.4.2. Alternative spring and seep mitigation measures may include installing a water supply pump in an existing well to replace water in a spring or seep, installing a new production well, piping water from a new or existing resource, enhancing flow from an existing seep or spring by installing piping into the source to direct more flow to the surface, and installation of a guzzler (Barrick Cortez Gold Mines and JBR Environmental Consultants, Inc. 2010). Guzzlers are systems used to collect precipitation and runoff and store the water in a surface or buried container which feeds an open trough for use by wildlife.

A-3.5 Acid Rock Drainage Management

The Project site would have a negative water balance, where annual evaporation exceeds annual precipitation. Formation of acid rock drainage requires exposure of sulfide minerals in mined materials to both oxygen and water for the sulfide oxidation reaction and acid generation to occur. While a negative water balance does not preclude acid generation, it does limit the rate of sulfide oxidation and acid generation to the availability of water to generate that oxidation reaction. In practice, sulfide-bearing materials in this type of negative water balance environment are slow to oxidize, allowing management of acidic drainage by covers for surface facilities and cement ground controls in underground applications. Upon mine closure, underground workings would eventually be inundated with groundwater. This would saturate the sulfide minerals, limiting their exposure to atmospheric oxygen and, hence, acid generation.

For this Project, the use of inert rock fill and 7 percent cement would constitute CRF, which would eliminate the potential for acidic drainage in the CRF-backfilled portions of the underground workings because sulfide minerals in the rock fill would be neutralized by the cement. The 7 percent cement required to meet structural strength requirements for the underground mine is a higher percentage of cement than that needed to geochemically stabilize sulfide minerals in the rock fill materials. The neutralization effects of cement application are immediate.

In addition to adding neutralizing potential, the cement reduces the air and water permeability of the backfill material (compared to un-cemented material). Because the sulfide oxidation reaction that generates acidity requires both atmospheric oxygen and water, the reduced air and water permeability of the CRF rate-limits the sulfide oxidation reaction by limiting the availability of oxygen and water to the sulfide minerals. Further, most of the rock fill and CRF would be formulated from inert basalt with no acid-generating potential.

In cases where the sulfide concentration in exposed rock is very high and the cement does not inhibit oxygen exposure, acid drainage could occur once the neutralization capacity of the cement is exhausted. In practice, these instances are rare and location-specific. Such areas of high sulfide concentration can be addressed by adding cement to the specific locations that have been identified as forming acidic drainage based on ground support inspection.

Acidic rock drainage could occur in underground mine access drifts, which are not backfilled with CRF. However, when the access drifts are excavated, exposed rock would be covered with a cement ground support that would limit exposure of sulfides in the exposed rock to oxygen and would neutralize any acid drainage that occurs up until the neutralization component of the cement is exhausted. Additional cement may need to be added in areas of high sulfide concentrations.

Once placed in the underground workings, the backfilled materials are physically and geochemically stable. However, additional monitoring and testing can be conducted to confirm expectations and refine operations. For example, during operations, inspections of the backfill can be conducted to note, quantify, and characterize any seepage and its chemistry. In addition, the different type of mined materials (e.g., ore, waste rock, borrow material) can be sampled at least quarterly and analyzed for acid-generating potential (e.g., acid-base accounting) and metal leaching potential (e.g., meteoric water mobility procedure). By characterizing mined materials at the time they are produced, potential acid-generating conditions can be observed and addressed during active operations ahead of mine closure. This would confirm the pH and leachability of these backfill materials. If there is variability in the source material used for backfill or in the CRF mixture used, sampling frequency can be adjusted or samples can be collected from each backfill type to refine the characterization. The amount of cement added to the rock fill can be adjusted depending on the sampling results. See Appendix D for further information on acid rock drainage and its management.

The Applicant proposes to test waste rock stored at the temporary waste rock storage facility for acid-generating potential weekly for the first 6 months of mine operations, at which time sampling frequency would be re-evaluated to account for variations (or lack thereof) in the mineralogy and the physical and chemical composition of the waste rock (Calico Resources USA Corp. 2023d). The basalt borrow used for CRF does not have a potential to generate acid and is not proposed to be tested for acid-generating potential (SRK Consulting 2022).

Additional water quality monitoring can be conducted to detect acid rock drainage as the underground mine area is dewatered. During operations, water produced from mine dewatering can be sampled and analyzed quarterly for evidence of acid-generation reactions (e.g., changing pH, alkalinity, sulfate). The Applicant's proposed Cynoprobe™ equipment also measures pH. If monitoring results indicate acid generation or its precursors during operations, measures to apply additional neutralizing agents (e.g., cement) or preclude exposure of sulfides to atmospheric oxygen (e.g., cemented backfill placement around sulfide-bearing rock) can be employed.

Following mine closure, direct observation of backfill performance is difficult as groundwater recovers into the mine workings when dewatering ceases. At this point, any further oxidation of sulfide minerals becomes inhibited by the groundwater's displacement of atmospheric oxygen, which is a necessary component of the oxidation reaction. The oxidation reaction would only continue until the remnant oxygen at the time of closure was consumed by the reaction. In the presence of sulfide minerals, this reaction would occur in a short time span (i.e., weeks, as occurs in laboratory kinetic testing). In the closure and post-closure periods, potential formation of acid rock drainage from rock fill and CRF on groundwater chemistry can be monitored via groundwater monitoring wells located downgradient of the underground workings.

The Applicant's groundwater monitoring plans consist of 15 groundwater monitoring wells, including seven existing wells and eight wells proposed to be constructed. The new wells to be constructed include one monitoring well upgradient of the facility, six monitoring wells downgradient of the TSF, and one monitoring well downgradient of the reclaim pond. Groundwater quality would be monitored by routinely collecting and testing groundwater from these 15 monitoring wells. Monitoring would occur quarterly for 5 years, semi-annual monitoring would occur for 10 years, and annual monitoring would occur for 15 years (Calico Resources USA Corp. 2023b). In addition to these plans, in the event acid rock drainage is found in groundwater samples, passive or active treatment can be implemented to prevent metals from being released into the environment.

The Applicant plans to store ore temporarily at the run-of-mine (ROM) ore stockpile before it is processed. Ore would be processed daily, and material is not expected to reside in the stockpile for more than a week, which would reduce the likelihood of acid rock drainage. BMPs for management of ore include processing stockpiled ore material within a period of weeks from mining. Potentially acid-generating ores should not reside in the stockpile for more than one-quarter of a year following their excavation. In addition to these plans, in the event of a temporary or unexpected shut-down of the process plant for an extended period of time, accommodations can be made to relocate stockpiled ores to the temporary waste rock storage facility or another facility with the capacity for permanent containment of acid-generating rock to prevent potential release of contaminants from the ROM ore stockpile.

For further information on acid rock drainage, see Appendix D.

A-3.6 Hazardous Materials and Waste Handling, Storage, and Management

The Applicant has developed a Toxic and Hazardous Substances Transportation and Storage Plan (Calico Resources USA Corp. 2021) and a Waste Management Plan (Calico Resources USA Corp. 2023a), which describe procedures and training for proper transportation, use, storage, and disposal of hazardous materials. These plans have been developed in accordance with applicable federal, state, and local provisions regarding the management of hazardous and non-hazardous materials and wastes. In addition, the Applicant has developed a Stormwater Pollution Control Plan (WSP USA Inc. 2023) that describes the management of spills to secondary containment and pallets to prevent leaks and spills into stormwater runoff. Regular inspections of hazardous materials storage areas would be conducted to identify potential cracks, deterioration, or other signs of leakage.

These Applicant management plans would be updated and revised as the Project proceeds and new information is developed, such as finalizing hazardous substances quantities and storage locations and changes in procedures or processes, or in response to modifications to applicable regulations. The plans would be reviewed and updated on a regular basis to ensure they remain applicable to the hazardous or toxic substances transported to, and stored at, the facility. No alternative hazardous materials handling, storage, spills, or management methods are identified.

A-3.7 Spill and Emergency Response

A Spill Prevention, Control, and Countermeasures (SPCC) Plan would be created by the Applicant in accordance with the requirements of 40 Code of Federal Regulations (CFR) 112 and stamped by an Oregon Professional Engineer. The SPCC Plan would include regular inspections of oil storage tanks, piping, and secondary containment areas and would specify the frequency of these inspections, typically monthly (Calico Resources USA Corp. 2023e). The SPCC Plan is a necessary document that would adhere to applicable regulations and be reviewed by appropriate parties. An additional spill measure would be to install water stops concrete coatings for all concrete containments as described in Section A-3.2 to provide an additional layer of protection against spills migrating beyond containment systems.

Per the regulation at Oregon Revised Statute (ORS) 517.971, the Applicant has an Emergency Response Plan (Calico Resources USA Corp. 2023e), which provides information needed to respond to an incident, including equipment, procedures, training, and clean-up methods in the event of a spill of hazardous material. The Emergency Response Plan would minimize the potential for accidental spills and environmental degradation by describing precautionary measures that must be adhered to and by being prepared for potential emergencies.

Two mobile emergency refuge stations would be installed in the case of a fire or rockfall that block the primary decline evacuation route and secondary vent raises evacuation routes. These refuge stations can accommodate up to 20 people within the protected chamber and remain safe within the underground mine for 48 hours. These are mobile stations that would be moved as the mine is developed, so that they are never more than 1,000 feet from the areas where mine operation personnel are located.

Other technologies to assist mine workers and responders during emergency situations requiring rapid escape include strobe lights to mark underground areas and escapeways, light vests to identify team members, laser pointers to negotiate travel through smoke, and lifelines to aid escape (Conti 2001). Lifelines consist of rope or other material secured to the rib of the mine leading to the exit portal that miners physically hold and follow to escape. Cones that point in the direction of the exit and reflective strips can be added to the lifeline to assist in following the line in the correct direction.

To alert underground personnel of an emergency, the Applicant would provide and maintain an operating fire alarm system in the underground mine area per Mine Safety and Health Administration (MSHA) regulations at 30 CFR 57.4360. This alarm system would be used to initiate evacuations and alert personnel of emergency situations. Alternative warning system technologies include wireless signaling systems, which transmit an emergency warning to quickly reach every underground miner using a transmitter loop antenna on the surface, and a receiver/transmitter loop antenna underground, with small wearable receivers incorporated into a miner's cap lamp assembly. Upon receiving an emergency or paging signal, the cap lamp begins to flash, which in turn alerts the miner to evacuate the mine or call the surface for a message, depending on which signal is received.

The Applicant’s Emergency Response Plan identifies evacuation procedures for workers, which include a full evacuation drill every 60 days, emergency firefighting drills at least once every 6 months for persons assigned surface firefighting responsibilities, and mine evacuation drills every 6 months following MSHA regulations to assess the ability of all persons underground to reach the surface or designated safety point within a time limit. In addition, all personnel who work underground would be instructed in the escape and evacuations plans, procedures, and warning signals for an emergency on an annual basis.

The MSHA regulations and guidelines for emergency response incorporated into the Applicant's Emergency Response Plan are the health and safety standards for the protection of life and prevention of injuries in US mines.

A-4 SUMMARY OF BEST AVAILABLE, PRACTICABLE, AND NECESSARY TECHNOLOGIES

The identified technologies were reviewed to determine if they achieved the objectives of being available, practicable, and necessary for the specific site at Grassy Mountain (Table A-3). The analysis considered site-specific conditions including climate, mineralization, geological, geotechnical, hydrogeological, and morphological conditions when determining whether a technology is necessary and practicable. All technologies are available, with the exception of gold roasting and mercury amalgamation, which are no longer practiced in North America because newer technologies have been developed that are less environmentally damaging.

The BAPNT review process first requires the TRT to determine the necessary technologies to achieve the objectives of the Project. If a technology is considered to be unnecessary, it is not considered further. For the technologies that are needed, the TRT must determine if these are available and technically feasible.[1] If a technology is considered not to be technically feasible, it is not considered further. The technologies that are deemed necessary, available, and technically feasible were then ranked according to their environmental benefits, as follows:

- 0 = the technology has a negative implication for the resource;
- 1 = the technology has a neutral implication for the resource, or is approximately equal to another technology that would achieve the same purpose;
- 2 = the technology has some environmental benefit when compared with an alternative technology.

Those technologies that are deemed to be necessary, available and practicable are also assessed for economic feasibility. Those that are not economically feasible are not considered to be the best option. The BAPNTs that are technically and economically feasible have the highest scores. Table A-3 provides this information. The Applicant's proposed technologies are identified in bold.

[1] A technology is technically feasible if it would meet the Project purpose and environmental standards.

Table A-3 Ranking of Best Available, Practicable, Necessary Technology for Project Components

Project Component	EE Section	Name of Technology	Necessary	Available	Technically Feasible	Practicable / Environmental Benefit (Score 0 to 2)					Economically Feasible	Total Score
						Air Quality	Water Resources	Waste	Energy	Wildlife		
Mine Construction Methods												
Extracting Ore	2.1.3, 2.2.3.2, A-3.1	**Underground Mining**	Yes	Yes	Yes	2	2	1	2	2	Yes	9
	2.2.3.2, A-3.1	Open-Pit Mining	Yes	Yes	No	-	-	-	-	-	-	-
	2.1.3, A-3.1	**Mechanized Cut-and-Fill with CRF**	Yes	Yes	Yes	1	2	2	2	2	Yes	9
	A-3.1	Longhole Open Stoping	No	-	-	-	-	-	-	-	-	-
	A-3.1	Blind Bench Stoping	No	-	-	-	-	-	-	-	-	-
Backfilling	A-3.1	Dry Fill	No	-	-	-	-	-	-	-	-	-
	A-3.1	Hydraulic Fill	No	-	-	-	-	-	-	-	-	-
	2.1.3, A-3.1	**Cemented Fill**	Yes	Yes	Yes	1	2	2	2	2	Yes	9
	2.2.3.5, A-3.3	Paste Fill	Yes	Yes	No	-	-	-	-	-	-	-
Transporting Mined Materials	2.1.15, A-3.1	**Diesel Fuel (Trucks and Loaders)**	Yes	Yes	Yes	1	1	1	1	1	Yes	5
	2.2.3.13, 2.2.5, 5.4, A-3.1	Biodiesel Fuel (Trucks and Loaders)	Yes	Yes	Yes	2	1	1	2	1	Yes	7
	2.2.3.10, 2.2.5, 5.4, A-3.1	Operational Improvement Technologies (e.g., Short Interval Control)	No	-	-	-	-	-	-	-	-	-
Mill Operations												
Chemical Ore Processing	2.1.6.2, 2.1.6.3, 2.1.6.4, 2.2.3.6, A-3.2	**CIL Cyanide Circuit, Elution, and Electrowinning Recovery**	Yes	Yes	Yes		1	1	1	1	Yes	5
	2.2.3.6, A-3.2	Gold Roasting	No	-	-		-	-	-	-	-	-
	A-3.2	Mercury Amalgamation	No	-	-	-	-	-	-	-	-	-
	2.2.3.9, 2.2.5, 2.2.6.3, A-3.2	Thiosulfate Leach	Yes	Yes	No	-	-	-	-	-	-	-
	2.2.3.6, A-3.2	Alternative Mill Processing (gravity concentration, hydrometallurgical, pyrometallurgical, flotation, pressure oxidation)	Yes	Yes	No	-	-	-	-	-	-	-
	2.2.3.6, A-3.2	Heap Leaching	Yes	Yes	Yes	2	0	1	0	0	No[2]	-
	2.2.3.6, A-3.2	Offsite Ore Processing	Yes	Yes	Yes[1]	0	2	1	0	1	No[2]	-
	2.2.3.9, A-3.2	Non-cyanide Gold Extraction Processes (gravity separation, microbial leaching, biological, leaching agents)	Yes	Yes	No	-	-	-	-	-	-	-
Cyanide Management	2.1.7, 2.2.3.7, A-3.2	**Detoxification and Neutralization of Cyanide**	Yes	Yes	Yes	1	2	1	1	2	Yes	7
	2.2.3.8, A-3.2	Cyanide Reduction	No	-	-	-	-	-	-	-	-	-
	2.1.6, A-3.2	**Cyanide Destruction Circuit**	Yes	Yes	Yes	1	1	2	1	2	Yes	7
Cyanide Monitoring	2.2.3.8, A-3.2	**Certified Laboratory Testing**	Yes	Yes	Yes	1	2	2	1	2	Yes	8
	2.1.7, 2.2.3.8, A-3.2	**In-Line Device (e.g., Cynoprobe)**	Yes	Yes	Yes	1	2	1	1	2	Yes	7

Project Component	EE Section	Name of Technology	Necessary	Available	Technically Feasible	Practicable / Environmental Benefit (Score 0 to 2)					Economically Feasible	Total Score
						Air Quality	Water Resources	Waste	Energy	Wildlife		
Air Quality Controls	2.1.6.4, A-3.2	**Mercury Retort Oven**	Yes	Yes	Yes	2	1	0	0	1	Yes	4
	A-3.2	**Wet Scrubber**	Yes	Yes	Yes	2	1	1	1	1	Yes	6
	A-3.2	Electrostatic Precipitator	No	-	-	-	-	-	-	-	-	-
	A-3.2	Baghouse Filter	No	-	-	-	-	-	-	-	-	-
Process Solution Containments	A-3.2	**Concrete Secondary Containments**	Yes	Yes	Yes	1	1	1	1	1	Yes	5
	A-3.2	Water Stops and Concrete Coatings	Yes	Yes	Yes	1	2	1	1	1	Yes	6
Wildlife Exclusion from Mill	3.5.4.2, 5.3, A-3.2	**Perimeter Fencing and Monitoring**	Yes	Yes	Yes	1	1	1	1	2	Yes	6
	3.5.4.2, 5.3, A-3.2	**Covers, Mesh, or Netting to Reduce Bird and Bat Nesting**	Yes	Yes	Yes[1]	1	1	1	1	2	Yes	6
	5.3, A-3.2	**Covering Waste Bins**	Yes	Yes	Yes	1	1	2	1	2	Yes	7
Closure of the Mill	2.1.17, 2.2.3.14, A-3.2	**Dismantling, Salvaging, Selling, or Authorized Disposal of Mill Infrastructure**	Yes	Yes	Yes	1	2	2	1	1	Yes	7
	2.1.17, 2.2.3.14, A-3.2	**Breaking, Burying, and Recontouring Foundations**	Yes	Yes	Yes	1	1	2	2	1	Yes	7
	A-3.2	Removal of Foundation Materials	Yes	Yes	Yes	0	2	0	0	1	Yes	3
	A-3.2	Retaining Power Lines Post-Closure	No	-	-	-	-	-	-	-	-	-
	2.1.17, 2.2.3.14, 5.3, 5.4, A-3.2	Planting Sagebrush Plugs/Seedlings and Perennial Grasses and Forbs with a Monitoring Program	Yes	Yes	Yes	1	1	1	1	2	Yes	6
	2.1.17, A-3.2	Closure-Period Inspections	Yes	Yes	Yes	2	2	2	1	2	Yes	9
Tailings Management												
Tailings Disposal	2.1.8, A-3.3	**Permanent Storage of Tailings in Lined TSF**	Yes	Yes	Yes	1	1	1	1	1	Yes	5
	2.1, 2.1.5.2, 2.1.6, A-3.2	**TSF Lime Addition**	Yes	Yes	Yes	0	2	2	1	2	Yes	7
	2.2.3.5, A-3.3	Mix with Cement and Use as Backfill in Underground Mine	Yes	Yes	No	-	-	-	-	-	-	-
	A-3.3	**TSF pH Monitoring**	Yes	Yes	Yes	1	2	1	1	2	Yes	7
Tailings Water Content	2.2.2.2, A-3.3	**Conventional Tailings Slurry**	Yes	Yes	Yes	1	1	1	1	1	Yes	5
	2.2.2.2, A-3.3	Filtered Tailings	No	-	-	-	-	-	-	-	-	-
	2.2.2.2, A-3.3	High-density Thickened Tailings	No	-	-	-	-	-	-	-	-	-
	A-3.3	Water Balance Accounting (including probabilistic and deterministic meteorological water projections)	Yes	Yes	Yes	1	2	1	1	2	Yes	7
TSF Design	2.1.8, 2.2.2.4, 2.2.3.3, 2.2.3.4, A-3.3	**Zero-discharge with Synthetic Double Lining**	Yes	Yes	Yes	1	2	1	1	1	Yes	6
	2.2.3.4, A-3.3	Alternative Liners	Yes	Yes	Yes	1	2	1	1	1	No[2]	-
	A-3.3	Reparable Liner	Yes	No	-	-	-	-	-	-	-	-

Project Component	EE Section	Name of Technology	Necessary	Available	Technically Feasible	Practicable / Environmental Benefit (Score 0 to 2)					Economically Feasible	Total Score
						Air Quality	Water Resources	Waste	Energy	Wildlife		
	A-3.3	Alternative Embankment Designs (using different materials)	No	-	-	-	-	-	-	-	-	-
	A-3.3	LiDAR Slope Monitoring	No	-	-	-	-	-	-	-	-	-
Leak Detection	2.1.4, 2.1.8, 2.2.3.4, 5.3, A-3.3	**Liner Leak Detection and Collection**	Yes	Yes	Yes	1	2	1	1	1	Yes	6
	2.1.19.1, A-3.3	**Groundwater Monitoring for Leaks**	Yes	Yes	Yes	1	2	1	1	1	Yes	6
	2.2.3.4, A-3.3	Electromagnetic Leak Detection	No	-	-	-	-	-	-	-	-	-
	A-3.3	Geophysical Leak Detection	No	-	-	-	-	-	-	-	-	-
Long-Term Pollution Prevention Controls and Monitoring	2.1.19.3, A-3.3	**Backfilling using CRF**	Yes	Yes	Yes	1	2	1	1	1	Yes	6
	2.1.17, A-3.3	**Plugging the Mine Portal**	Yes	Yes	Yes	1	1	1	1	2	Yes	6
	2.1.17, A-3.3	**Retaining Liners in Perpetuity**	Yes	Yes	Yes	1	2	2	1	1	Yes	7
	2.1.17, A-3.3	**Reclaiming Mine Areas**	Yes	Yes	Yes	2	2	2	1	2	Yes	9
	2.1.17, A-3.3	**Converting the Reclaim Pond to an Evaporation Cell**	Yes	Yes	Yes	1	2	2	2	1	Yes	8
	2.1.17, A-3.3	**Retaining Stormwater Infrastructure**	Yes	Yes	Yes	1	2	1	2	2	Yes	8
	D-5.1, A-3.3	Monitoring Mined Materials Quarterly During Operations	Yes	Yes	Yes	1	2	2	2	2	Yes	9
Long-Term Monitoring	2.1.19.2, A-3.3	**Monitoring Groundwater**	Yes	Yes	Yes	1	2	1	1	2	Yes	7
	2.1.19.2, A-3.3	**Monitoring Noxious Weeds**	Yes	Yes	Yes	1	2	1	1	2	Yes	7
	A-3.3	Noxious Weed Mapping via UAV or Satellite Imagery	No	-	-	-	-	-	-	-	-	-
	2.1.19.2, A-3.3	**Facility Inspections, Maintenance, and Repairs**	Yes	Yes	Yes	1	2	2	1	2	Yes	8
	2.1.19.2, A-3.3	**Inspections and Sampling of Stormwater Facilities and Discharges**	Yes	Yes	Yes	1	2	1	1	2	Yes	7
	A-3.3	Spring and Seep Monitoring	Yes	Yes	Yes	1	2	1	1	2	Yes	7
	2.1.19.2, A-3.3	Biomonitoring	No	-	-	-	-	-	-	-	-	-
	2.1.19.2, A-3.3	Vegetation Cover Indexes	No	-	-	-	-	-	-	-	-	-
TSF Wildlife Exclusion	3.5.4.2, 5.3, A-3.3	**Perimeter Fence and TSF Fences and Barriers**	Yes	Yes	Yes	1	1	1	1	2	Yes	6
	3.5.4.2, 5.3, A-3.3	**Bird Deterrent Balls on TSF Pond**	Yes	Yes	Yes	1	1	1	1	2	Yes	6
	3.5.4.2, 5.4, A-3.3	Visual Deterrents: Effigies, Predator Models	Yes	Yes	Yes1	1	1	1	1	2	Yes	6
	3.5.4.2, A-3.3	Radar-activated Propane Cannons	Yes	Yes	Yes1	1	1	1	0	2	Yes	5
	3.5.4.2, 5.4, A-3.3	Laser Bird Deterrents	Yes	Yes	Yes1	1	1	1	1	2	Yes	6
	3.5.4.2, A-3.3	Emergency Hazing	Yes	Yes	Yes	1	1	1	1	2	Yes	6
	3.5.4.2, 5.4, A-3.3	Bio-exclusion Zones	Yes	Yes	Yes1	1	1	1	1	2	Yes	6

Project Component	EE Section	Name of Technology	Necessary	Available	Technically Feasible	Practicable / Environmental Benefit (Score 0 to 2)					Economically Feasible	Total Score
						Air Quality	Water Resources	Waste	Energy	Wildlife		
	3.5.4.2, A-3.3	Decoy Ponds	No	-	-	-	-	-	-	-		-
	3.5.4.2, A-3.3	Hyper-salinization	Yes	Yes	Yes	0	0	1	0	1	No2	
	3.5.4.2, 5.3, A-3.3	**Monitoring Perimeter for Signs of Wildlife**	Yes	Yes	Yes	1	1	1	1	2	Yes	6
	3.5.4.2, 5.3, A-3.3	Netting and Wires on TSF	No	-	-	-	-	-	-	-	-	-
	5.3, A-3.3	**Monitoring and Removal of Aquatic Species in TSF Pond**	Yes	Yes	Yes	1	1	1	1	2	Yes	6
Closure of the TSF	A-3.3	**Dry Closure**	Yes	Yes	Yes	1	2	2	1	2	Yes	7
	2.1.16, A-3.3	**Conversion of Process Pond to Evapotranspiration Cell**	Yes	Yes	Yes	1	2	1	2	2	Yes	8
	A-3.3	Wet Closure	No	-	-	-	-	-	-	-	-	-
	A-3.3	Wetland Establishment Closure	No	-	-	-	-	-	-	-	-	-
	A-3.3	Alternative TSF Cover Design	No	-	-	-	-	-	-	-	-	-
	A-3.3	Hydroseeding	Yes	Yes	Yes	1	1	1	1	1	Yes	5
Operations Management												
Water Management	2.1.9.1, 2.1.9.2, A-3.4	**Site Groundwater Production Wells and Water Level and Quality Monitoring**	Yes	Yes	Yes	1	1	1	1	1	Yes	5
	2.2.2.5, A-3.4	Pipeline from Municipal Supply	No	-	-	-	-	-	-	-	-	-
	A-3.4	Perimeter Well Dewatering	Yes	Yes	No	-	-	-	-	-	-	-
	A-3.4	Groundwater Production Sumps for Dewatering	Yes	Yes	Yes[1]	1	0	0	1	1	Yes	3
	A-3.4	Closure Reclamation of Water Supply Piping	Yes	Yes	Yes	1	1	1	1	1	Yes	5
Air Quality Control Measures	A-3.4	Monitor TSF for Dust after Operations Cease and Prior to Cover	Yes	Yes	Yes	2	1	1	1	1	Yes	6
	5.3, A-3.4	**Dust Suppression Water Spray**	Yes	Yes	Yes	2	0	1	0	1	Yes	4
	5.3, A-3.4	**Equipment Hoods, Curtains, Chutes**	Yes	Yes	Yes	2	1	1	1	1	Yes	6
	A-3.4	**Cover/Enclose Material Piles**	Yes	Yes	Yes	2	1	1	0	1	Yes	5
	5.3, A-3.4	**Air Permit BMPs**	Yes	Yes	Yes	2	0	1	1	1	Yes	5
	A-3.4	**Dust Control Staff Training**	Yes	Yes	Yes	2	1	1	1	1	Yes	6
Equipment Maintenance	A-3.4	Reactive Maintenance	Yes	Yes	Yes	0	0	1	1	1	Yes	3
	A-3.4	**Preventative Maintenance**	Yes	Yes	Yes	1	1	1	1	1	Yes	5
	A-3.4	Predictive Maintenance	No	-	-	-	-	-	-	-	-	-
Operations Monitoring	2.1.19.1, 5.3, A-3.4	**Resource-Specific Monitoring Plans**	Yes	Yes	Yes	2	2	2	1	2	Yes	9
	A-3.4	**Permit Monitoring Requirements**	Yes	Yes	Yes	2	2	2	2	2	Yes	10
Acid Rock Drainage Management	D-3, D-4.6, A-3,5	**CRF**	Yes	Yes	Yes	0	2	1	1	1	Yes	5
	A-3.5	Additional Monitoring and Testing (by mine level)	Yes	Yes	Yes	1	2	1	1	1	Yes	6
	A-3.5	Additional Water Quality Monitoring	Yes	Yes	Yes	1	2	1	1	1	Yes	6

Project Component	EE Section	Name of Technology	Necessary	Available	Technically Feasible	Practicable / Environmental Benefit (Score 0 to 2)					Economically Feasible	Total Score
						Air Quality	Water Resources	Waste	Energy	Wildlife		
	A-3.5, D-6.1	**Groundwater Monitoring for Acid Rock Drainage**	Yes	Yes	Yes	1	2	1	1	1	Yes	6
	A-3.5	Passive or Active Treatment of Acid Rock Drainage	Yes	Yes	Yes	1	2	1	1	1	Yes	6
Hazardous Materials Handling, Storage, and Management	5.3, A-3.6, B-3.2	**Toxic and Hazardous Substances Transportation and Storage Plan**	Yes	Yes	Yes	2	2	2	1	2	Yes	9
	5.3, A-3.6, B-3.2	**Waste Management Plan**	Yes	Yes	Yes	2	2	2	1	2	Yes	9
	2.1.5, 2.1.10.3, A-3.6	**Offsite Hazardous Materials Disposal**	Yes	Yes	Yes	1	2	2	1	2	Yes	8
	A-3.6	Toxic and Hazardous Substances Transportation and Storage Plan	Yes	Yes	Yes	1	2	2	1	2	Yes	8
	3.1.4, 5.3, A-3.6	**Stormwater Pollution Control Plan**	Yes	Yes	Yes	1	2	1	1	2	Yes	7
	A-3.6	**Regular Inspections of Hazardous Materials Storage Areas and Updates to Management Plans**	Yes	Yes	Yes	2	2	2	1	2	Yes	9
Spill and Emergency Response	A-3.7, B-3.2	**Spill Prevention, Control, and Countermeasures Plan**	Yes	Yes	Yes	1	2	1	1	2	Yes	7
	A-3.2	Water Stops and Concrete Coatings	Yes	Yes	Yes	1	2	1	1	1	Yes	6
	A-3.7, B-3.2	**Emergency Response Plan**	Yes	Yes	Yes	2	2	2	1	2	Yes	9
	A-3.7, B-4.3, B-5.1	**Mobile Emergency Refuge Stations**	Yes	Yes	Yes	1	1	1	1	1	Yes	5
	A-3.7, B-3.2	Strobe Lights, Light Vests, Laser Pointers, Lifelines, Cones, and Reflective Strips	Yes	Yes	Yes	1	1	1	1	1	Yes	5
	A-3.7, B-4.2	**Fire Alarm System**	Yes	Yes	Yes	1	1	1	1	1	Yes	5
	A-3.7, B-3.2	Wireless Signaling System	No	-	-	-	-	-	-	-	-	-

Notes:

[1] Technically feasible for many but not all applications.

[2] Alternative performance does not merit cost difference.

Necessary Technology: A technology that is required or can substituted for an alternative technology to ensure compliance with environmental standards.

Available Technology: A technology that is obtainable and has been demonstrated to meet environmental standards.

Practicable Technology: A technology that is technically feasible (i.e., has been demonstrated to meet project purpose and environmental standards), has assessable implications for environmental resources (i.e., air, water, waste, energy, and wildlife scored as 0 = negative implication, 1 = neutral implication, 2 = positive implication), and is economically feasible (i.e., has costs that do not render the project uneconomic and do not exceed the expected environmental benefit of the alternative).

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Environmental Evaluation

Grassy Mountain Gold Project

Malheur County, Oregon

APPENDIX B

ANALYSIS OF CREDIBLE ACCIDENTS

Environmental Evaluation

Grassy Mountain Gold Project

Malheur County, Oregon

APPENDIX C

CYANIDE CHEMISTRY

Environmental Evaluation

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APPENDIX D

ACID ROCK DRAINAGE ASSESSMENT AND ANALYSIS