United States Environmental Protection Agency

Superfund Proposed Plan for Interim Record of Decision Barite Hill Superfund Site Operable Unit 1 (OU1)

McCormick, McCormick County, South Carolina **February 2020**

Introduction

This **Proposed Plan** presents the Preferred Remedial Alternatives for the **Interim Record of Decision** (IROD), which addresses **Contaminated Media Zones** (CMZ) identified within **Operable Unit** 1 (OU1) at the Barite Hill / Nevada Goldfields Superfund Site (aka, "the Site") (Figure 1). This document is issued by the **United States Environmental Protection Agency** (EPA), the Federal agency responsible for Site activities, with support from the **South Carolina Department of Health and Environmental Control** (DHEC). In addition to the on-going work for OU1, the EPA and DHEC continue to investigate the Site's impacts to additional areas of concern and to groundwater at the Site. These additional areas of concern and groundwater will be evaluated as separate OUs and addressed under individual corresponding decision documents. A glossary defining key terms is provided at the end of this document; the key terms appear in **bold** the first time they are used.

This Proposed Plan: (1) describes the remedial alternatives evaluated in the 2019 **Feasibility Study** (FS) to address the CMZs in OU1 and (2) presents the rationale for EPA's Preferred Alternative. The EPA, the lead agency for the Site, in consultation with the DHEC, will select an interim remedy for OU1 the Site after reviewing and considering all information submitted during the 30-day public comment period. The EPA, in consultation with the DHEC, may modify the Preferred Alternative or select another **response action** presented in this Proposed Plan based on new information or public comments.
Therefore, the public is encouraged to review and comment on the alternatives presented in this Proposed Plan.

The EPA is issuing this Proposed Plan as part of its public participation responsibilities under the Superfund law (Comprehensive Environmental Response, Compensation, and Liability Act [CERCLA]), Section 117(c) and Section 300.435(f)(2) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This Proposed Plan summarizes and identifies key information that can be found in greater detail in the FS, which is housed in the Administrative Record file for the Site. The EPA and DHEC encourage the public to review this Proposed Plan and other documents contained in the Site's Administrative Record file. The Administrative Record file and Information Repository for the Site can be found at the McCormick County Library at 201 Railroad Ave. in McCormick, South Carolina and at the EPA's Regional Headquarters, Region 4 Information Center at 61 Forsyth Street, Sam Nunn Atlanta Federal Center, Atlanta, Georgia.

Community Involvement Opportunities

30 Day Public Comment Period

Dates: February 07, 2020 - March 08, 2020
Purpose: To solicit comments on the Proposed Plan for Interim Record of Decision, Barite Hill / Nevada Goldfields Superfund Site, Operable Unit (OU1) – Barite Hill Main Pit Lake System

Public Meeting

Date: **March 05, 2020**
Time: 6:00PM – 8:00PM
Place: McCormick County Administration Center
601 S. Mine Street
McCormick, South Carolina

Purpose: To discuss the Proposed Plan for OU1 at the Barite Hill / Nevada Goldfields Site

EPA Contacts

Direct questions or written comments to:
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The Administrative Record and an Information Repository for the Barite Hill Superfund Site is located at:
201 Railroad Ave.
McCormick, South Carolina

Community Role in Selection Process

This Proposed Plan is being issued to inform the public of the EPA's Preferred Alternative for the interim remedial action for CMZs identified in OU1 and to solicit public comments pertaining to all remedial alternatives evaluated, including the Preferred Alternative. Changes to the Preferred Alternative may occur if public comments or additional data indicate that such a change would result in a more appropriate remedy for the Site. The final decision regarding the selected interim remedy will be made after the EPA has reviewed all public comments. The EPA is soliciting public comments on all alternatives considered in the Proposed Plan. This Proposed Plan has been made available to the public for a public comment period that concludes on March 05, 2020.

A public meeting will be held during the public comment period to present the conclusions of the RI/FS, and to explain the Preferred Alternative for the interim remedy. The public meeting will include a presentation by EPA of the Preferred Alternative and other **cleanup** options. Information concerning the public meeting and how to submit written comments can be found in the "Community Involvement Opportunities" text box on Page 1. Comments received at the public meeting, as well as written comments received during the public comment period, will be documented in the **Responsiveness Summary** section of the IROD. The IROD is the document that explains which remedial alternative has been selected and the basis for the selection of the remedy.

Scope and Role

The purpose of this interim remedial action is to address CMZs identified in OU1 at the Site. Contaminants detected in groundwater and surface water at the Site are a result of **acid mine drainage** (AMD) that has been created by the weathering and oxidation of naturally occurring sulfide minerals. AMD results from the interaction of mine waste materials with precipitation (rain) and the subsequent leaching of metals and inorganic constituents to groundwater and storm water run-off. AMD impacts to the surface water bodies occur by overland flow, the infiltration of precipitation through mine wastes, and the subsequent migration and discharge of AMD-impacted groundwater to surface water.

The EPA and DHEC are conducting a phased approach to remediate the Site. The phased approach employs a step-wise design, implementation, and evaluation of technically appropriate, and cost-effective remedial actions. The phased approach for this Site entails implementing remedial actions for contaminated groundwater, waste rock, sediments and surface water in OU1.

Since 2011, the EPA has collected samples at the Site which confirm the presence of metals contamination in the soil, surface water, sediment and groundwater. These investigations revealed contamination in surface water and sediments in the North Tributary to Hawe Creek (OU3) and subsequently concluded that contaminated water from the Pit Lake and groundwater in OU1 migrate via fractures and seeps in the bedrock to the North Tributary.

Using the environmental data collected at the Site, the EPA and DHEC have completed the OU1 Remedial Investigation Report (RI) and OU1 Feasibility Study Report (FS). The FS addresses OU1 (Barite Hill Main Pit Lake System) which includes runoff and surface water in the Pit Lake, as well as groundwater entering and discharging from the Pit Lake. The FS also addresses source materials contributing contamination to the Pit Lake, including waste rock, sediments and exposed acid generating material along the walls (highwalls) enclosing the lake. The purpose of the OU1 FS is to develop remedial alternatives that will prevent or control source contamination migration from the Barite Hill Main Pit Lake System to the North Tributary to Hawe Creek. Restoration of site groundwater and surface water within the Pit Lake is not within the scope of the interim remedial action for OU1. The interim remedial action for OU1 is a source control remedy. The EPA expects that once source control measures have been implemented in the Barite Hill Main Pit Lake System, water and sediment quality will subsequently improve in the North Tributary to Hawe Creek. In addition, the interim remedial action implemented at OU1 will include monitoring of seeps in the North Tributary to Hawe Creek.

Based on a thorough evaluation of the alternatives developed in the FS and described in this Proposed Plan, the EPA and the DHEC believe the following alternatives for each CMZ identified will effectively address contamination migration from OU1 to OU3.

Site Location and Description

The Site is located approximately three miles southwest of the town of McCormick in McCormick

County, South Carolina and is surrounded by forested and agricultural land, and rural residential areas. No buildings, homes or commercial facilities are located within a 0.5 mile radius of the Site. (Figure 1-1)

The 795-acre site is located west of U.S. Route 221 and north of State Road S-33-30. Coordinates for the Site are: 33°52'25'N, 82°17'41"W. Approximately 135-acres of the property has been disturbed by historic and modern mining activities. The remaining property serves as an undisturbed buffer zone in a natural state. The most recent mining operations at the Site occurred between 1991 and 1994.

The EPA has divided the Site into five OUs:

- OU1 – Barite Hill Main Pit Lake System
- OU2 – Overburden and Bedrock Groundwater
- OU3 – North Tributary to Hawe Creek
- OU4 – Southwest Tributary to Hawe Creek
- OU5 – Hawe Creek

The EPA identification number of the Site is SCN000407714. Because of the threat posed by the potential catastrophic release of surface water, sediment and soil contaminated with metals and low pH to Hawe Creek and Clarks Hill Lake, the Site was proposed to the National Priorities List (NPL) in September 2008 and finalized on the NPL April 9, 2009.

Site Background

Exploratory gold mining operations began at the Site as early as the mid to late 1800s, consisting of at least two shafts and small underground workings. Intermittent exploration activities occurred in the 1960s to early 1980s. The Site was purchased in 1988 and mined for gold and silver between 1991 to 1994. Reclamation activities began in 1994 and continued until the Site was abandoned in July 1999. DHEC assumed control of the Site in 1999.

In July 2003, DHEC's Bureau of Land and Waste Management, Site Assessment Section, visited the Barite Hills Site. At that time, the Pit Lake was partially filled with water and waste rock with an estimated 30 - 40% sulfide was present at the surface of the pit above the water table. In addition, the former solution ponds were at capacity. Subsequently, DHEC recommended further investigation of the Site to prevent acid generation and runoff. In November 2003, DHEC conducted a second site visit. At that time, water in the Pit Lake had a pH of 2.0 to 2.2.

In 2004, DHEC conducted a preliminary assessment/site inspection (PA/SI) at the Site. Activities included the collection of 12 source samples (eight surface water and four sediment samples) from the on-site process area ponds, permanent leach pad solution ponds, and the Pit Lake. CERCLA hazardous substances detected in the source samples included arsenic, barium, cadmium, chromium, copper, lead, zinc, mercury, and cyanide. The PA/SI report concluded the acidic water in the Pit Lake represented the greatest potential for adverse impacts to the groundwater and surface water pathways.

In 2007, the EPA conducted a Removal Site Evaluation and also prepared an Expanded Site Investigation report. Activities included physical characterization of the Site, collecting and analyzing sediment samples along tributaries of Hawe Creek that received runoff from the Site, and collecting and analyzing sediment and surface water samples from the Pit Lake and onsite ponds.

In September 2007, the Bureau of Reclamation also conducted a streamlined remedy assessment for the Pit Lake which formed the basis for the Removal Action conducted in 2008.

The Removal Action included treating the Pit Lake water to near neutral pH, grading and covering waste rock dumps on the southern margin of the Pit Lake, and constructing a spillway to control the Pit Lake level. The spillway, which was cut into bedrock along the northwestern margin of the pit, was sized to limit Pit Lake level rise to 2 ft during a 100-year storm event. Excess water from the top of the lake is released to the North Tributary of Hawe Creek. The Pit Lake was treated from February to May 2008 by neutralizing with 1,860 tons of hydrated carbide lime, 23 tons of sodium hydroxide, 21 tons of methanol, 1,300 tons of wood chips and approximately 400 tons of molasses blends. In addition, an estimated 50,000 cubic yards (cy) of strongly acid-generating waste rock was pushed below the water line along the south side of the Pit Lake. The remaining 250,000 cy of waste rock were graded to reduce their slope and capped ((Capped Waste Rock (CWR)) following the Bureau of Reclamation design. Sediment detention ponds and riprap lined channels were also constructed to control and manage surface water runoff from the hill slope south of the Pit Lake. The Removal Action was completed in October 2008.

In 2011, the EPA initiated a Remedial Investigation of the Site and conducted field sampling for OU1 between 2011 and 2018. The EPA, through its Superfund Technical Assessment and Response Team (START) contractor, collected laboratory and field analytical data in the Pit Lake to monitor the effectiveness of the neutralization efforts performed during the Removal Action. START collected data for selected metals (total and dissolved) and other parameters such as total organic carbon (TOC), pH, sulfate, and ferric and ferrous iron forms. Samples were collected from a floating platform in the Pit Lake and/or a boat and generally from within 1-meter (m) of the surface, and near the bottom of the Pit Lake at approximately 16 meters (m) depth.

During October 2012 through March 2013, the U.S. Geological Survey (USGS) in cooperation with the EPA collected geophysical information to characterize and determine the extent of groundwater and surface water contamination. As part of the surface geophysical surveys the USGS delineated areas of contaminated groundwater discharge into the North Tributary of Hawe Creek using fiber-optic, distributed temperature measurements. Results from this survey are consistent with groundwater seeps identified during previous investigations.

The EPA Science and Ecosystem Support Division (SESD) and EPA contractors continued to collect surface water, groundwater and sediment samples and monitor various field parameters in OU1 through November 2016. A total of twelve groundwater sampling events have been conducted at the Site since 2011.

In May of 2016 and September 2017 additional geophysical investigations were performed at the Site. These investigations focused on identifying, mapping, and modeling groundwater flow paths into and out of the Pit Lake. These studies identified two specific locations where preferential groundwater infiltrates the Pit Lake. The groundwater flow paths exist south of the CWR and appear to follow the alignment of a shear zone known to exist beneath the Site. The two flow paths also appear to merge upgradient and prior to infiltrating the CWR. (Figure 2-2)

Beginning October 2017 and ending May 2018, Sovereign Consulting, Inc., of Lakewood, Colorado, conducted treatability testing on OU1 Pit Lake surface water, groundwater and waste rock to determine the potential of reducing and controlling acid generation at the Site. The following sections summarize Sovereign's findings.

Acidithiobacillus ferrooxidans (ATBFO) Suppression

Data in literature verify that **acid rock drainage (ARD)** is directly linked to the oxidation of the sulfide mineral, pyrite. ARD is caused by the exposure of pyrite to water, oxygen, ferric iron (Fe^{+3}), and a microbe, Acidithiobacillus ferrooxidans (ATBFO). The microbe, ATBFO, can increase the oxidation of pyrite and the generation of acid rock drainage.

Treatability study results demonstrated that a mixture of sodium lauryl sulfate (SLS) buffered with sodium bicarbonate (HCO_3) was effective at suppressing ATBFO in waste rock samples from the unsaturated and transition zone units. In addition, a dilute solution of milk, also buffered with HCO_3, was effective at neutralizing existing acid rock drainage and suppressing additional acid rock drainage generation in the OU1 waste rock saturated zone test unit.

Passive Treatment of Pit Lake Water

Treatability studies also demonstrated that water samples collected from the uppermost 0.5 meters of the Pit Lake could be treated by using passive treatment with a biochemical reactor (BCR) filled with a typical mixture of organic materials such as wood chips, straw, and limestone.

However, groundwater samples which contained more acidity and sulfate than surface water samples, would require pre-treatment, to remove acidity prior to its delivery to a BCR.

Pit Lake Bottom Sediment Encapsulation

Metals contaminated sediments located in the bottom of the Pit Lake can leach into Pit Lake surface water and groundwater. Treatability tests have demonstrated that site soils amended with clays such as bentonite, and commercially available products, such as AquaBlok®, have the capability of producing an encapsulating (protective) layer on the bottom of the Pit Lake. This layer would reduce leaching of metals contamination from sediments and also seal off fractures and seeps from the Pit Lake to the North Tributary.

In summary, the technologies tested appear to produce conditions that can suppress ARD generation, passively treat pit water, neutralize pit water with common reagents, and encapsulate sediments on the Pit Lake floor.

Site Characteristics

The Barite Hill Mine lies within the Lincolnton-McCormick Mining District. Gold was discovered in the district in 1852 and several small mines began operating shortly thereafter. Early mines consisting of at least two shafts and small underground workings were constructed at the Site at an unknown time, followed by intermittent exploration activities in the 1960s to early 1980s. These mines were purchased by Gwalia (USA) Ltd. in 1988. Gwalia (USA) Ltd. began mining the Site in 1991, after which the Site was purchased by Nevada Goldfields, Inc. The Site operated as an open-pit, cyanide heap leach mining facility from 1991 to 1994, during which, an estimated 64,700 ounces of gold and 119,500 ounces of silver was recovered from oxide and mixed oxide/sulfide ores.

Prior to mining, topsoil was stripped and stockpiled on-site. Ore was then loosened using standard drill-and-blast techniques, excavated and loaded onto haul trucks, then carried either to the ore processing area, sub-ore stockpile, or waste rock dump.

Mined ore was trucked to the ore processing area located in the central part of the Site which hosted a crusher, agglomerator, and conveyor system. The agglomerated ore was then conveyed to either an asphalt-lined reusable leach pad or to a permanent heap leach pad for cyanide leaching. Various process ponds were used to collect the leachate, recycle the cyanide solution and for other water management operations.

Wastes generated by the mining operation included waste rock, spent ore, and process waste water.

The largest open-pit (Main Pit) at the Site was excavated to a depth of approximately 55 ft below the present water elevation at full pool. When the Site was abandoned, the Main Pit began to fill with water, forming the Pit Lake. In addition, two large stockpiles of acid generating waste rock were left on the sides of the Pit Lake. This waste rock was also used to partly backfill the Pit Lake during the final stages of mining. The remaining portion was capped as part of EPA's 2008 Removal Action.

Soils at the Site are those characteristic of upland terranes which have a silty surface layer that overlies clayey subsoil. Two soil series from the Carolina Terrane, the Tatum-Goldston-Nason series and Georgeville-Herndon-Kirksey series, are also identified in the area.

Rocks comprising the Site are part of the Carolina Terrane, which extends from southern Virginia southwest into Georgia. The Carolina Terrane primarily is composed of intermediate-grade metamorphic rocks. The Carolina Terrane is bounded on the west by igneous and high-grade metamorphic rocks, and on the east by an extensive zone of ductile shearing.

Overland flow at the Site is directed down the slopes and out of the Site's drainage area through defined drainage features in the topography and constructed diversion ditches. The most significant surface water drainage features at the Site are two unnamed perennial tributaries to Hawe Creek referred to as the North and Southwest Tributaries (OUs 3 and 4, respectively). Hawe Creek discharges to Clark Hill Lake along the Savannah River approximately two miles downstream of the Site.

The Pit Lake is a new feature that began forming when mining ceased in the 1990s. At its maximum elevation of 418.3 ft above mean sea level (amsl) (top of spillway), the lake covers about 7.75 acres and is approximately 50 ft deep at its deepest point. Estimated volume of water in the lake at full pool is approximately 73 million gallons.

Under wet conditions, the Pit Lake is a flow-through system which receives storm water runoff and groundwater from a small area of approximately 25 acres; water is released from the from the Pit Lake across an engineered spillway and through groundwater seeps to the North Tributary. During dry spells, evaporative loss lowers the pit elevation below that of the spillway. Under these conditions, the pit continues to gain and lose groundwater, but the Pit Lake does not discharge to the North Tributary across the spillway. Surface water gaining to the Pit Lake includes direct precipitation, runoff from pit walls exposed above the shoreline, surface drainage through a system of small sediment retention dams constructed in the soil borrow area during the 2008 Removal Action, and runoff through engineered diversions which collect water from the CWR. Groundwater gains to the pit from up-gradient areas including the CWR on the south shore.

Four wells were installed as part of EPA's Removal Action to monitor the quality of groundwater flowing through and beneath the capped sulfide-bearing CWR on the south end of the Pit Lake. In October 2012 three wells were installed into the overburden and bedrock aquifers to investigate potential groundwater discharge through fractures west of the Pit Lake. Measurements of depth to water in on-site monitoring wells define the general potentiometric surface across the Site and identify a groundwater divide in the central part of the Site. Groundwater in the area of the Pit Lake flows generally northward, and northwestward on the western side of the lake.

Nature and Extent of Contamination

<u>Pit Lake System Soils</u>

Analytical results for the soils in OU1 indicate elevated concentrations of arsenic, barium, cadmium, chromium, copper, and lead are potential concern with some elevations of antimony, iron, manganese, molybdenum and vanadium. Most of these metals are only slightly elevated above twice the background soil concentrations. Two organic compounds were detected (benzaldehyde and isophorone), but these were below the soil quality benchmarks. No soil contamination patterns, trends, or multiple contaminant hotspots have been identified at the Site.

Pit Lake System Groundwater

Groundwater quality in the vicinity of the Pit Lake was compared to the State of South Carolina drinking water standards or to the maximum contaminant levels (MCLs) in EPA's Regional Screening Levels (RSLs) for residential land use. Groundwater analysis has included total metals and classical parameters/nutrients in all wells. Concentrations of metals above the MCL have occurred during most sampling events. These metals included antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, selenium, and thallium. The highest concentrations of metals have been detected in the samples from the four wells installed within the CWR. Exceedances of MCLs have also occurred in wells down-gradient of the Pit Lake. The concentrations of these metals have remained relatively stable throughout the monitoring period.

Pit Lake System Surface Water

Water flows into the Pit Lake as direct precipitation, rainfall runoff from the highwalls, stormwater that is shed from the CWR and sedimentation pond area south of the lake and groundwater inflow from the southeast and southwest, including water entering from the CWR area.

Rainfall runoff from oxidized to partly weathered highwalls contribute metals to the Pit Lake in total and dissolved forms. The concentrations of dissolved metals, specifically copper, are higher from areas that have remnant sulfide mineralization. They are slightly acidic (pH 4.7 to 5.2) with low concentrations of sulfate.

Storm runoff conveyed to the lake from upslope areas contains dissolved metals including copper in concentrations lower than runoff from the sulfide-bearing highwalls and small amounts of alkalinity.

Relatively clean groundwater migrating from the south, becomes contaminated with metals after interacting with the CWR or natural mineralization before discharging into the Pit Lake. Groundwater flowing toward the Pit Lake from the southeast is alkaline with low concentrations of metals. Groundwater also discharges from the lake through seeps to the North Tributary to Hawe Creek. Monitoring wells and seeps located west of the Pit Lake appear to share some chemical similarities to the water in the lake, but comparisons are not straightforward and elevated concentrations of manganese distinguish these waters from Pit lake water.

Most samples collected from wells on the north end slope of the Pit Lake exceeded South Carolina groundwater quality standards for cadmium and selenium, the Federal MCL action levels for copper and lead, and the Federal Secondary MCLs for aluminum, copper, iron, manganese, zinc, sulfate, TDS, and pH. The composition of water in these wells overlaps the compositions of samples from the lower layer of the Pit Lake indicating chemical similarity despite being screened at elevations significantly higher than the elevation of the chemocline. Chemical considerations suggest that water escapes from depth within the lake and then is forced upward perhaps by the hydraulic head.

Water contained within the Pit Lake exhibits a chemical stratification at a depth of approximately 40 to 45 ft. This stratification is defined as a chemocline/thermocline and represents a boundary in water density. The density varies throughout the year, being greatest in late summer when the upper water column has warmed. Water below the chemocline has consistently exhibited acidic pH and near anoxic conditions. While the water above the chemocline displays a range of pH values and is variably oxygenated. Samples collected from below the chemocline share many compositional similarities with water in the CWR.

Cadmium, copper, and manganese in the Pit Lake water exceeded their surface water quality benchmark values with the greatest frequency and magnitude. Other COCs include aluminum, arsenic, barium, cobalt, iron and zinc. Conductivity has been nearly constant in the upper 40 ft with values typically ranging from 2.5 to 3.5 millisiemens per centimeter (mS/cm). Conductivity below the chemocline has been increasing over time. Median pH values measured over time, indicate that the pit continues to acidify. Dissolved oxygen (DO) has shown a trend of increasing with time vertically through the upper water layer. Similarly, redox potential has become more oxidizing at depth and reducing conditions are no longer present throughout most of the water column.

Vertical profiles, especially of temperature, are suggestive that the pit may undergo some seasonal turnover and mixing; however, turnover has not been observed. If turnover does occur, it is unlikely to involve the entirety of the water column and is expected to exclude water from the lower layer (i.e., meromictic behavior). The concentrations of dissolved cobalt, copper, and zinc at two depths in the upper water layer appear to have increased with time while those of dissolved manganese, hardness, and total sulfate appear to have decreased slightly or remain unchanged.

The lake does not receive significant inputs of natural organic matter. Since 2013, the concentration of total organic carbon (TOC) in the water column has been less than 1 milligram per liter (mg/L) with the exception of two samples collected from the lower water layer in 2016. TOC concentrations decline rapidly following amendment of the water column; TOC does not appear to remain in the upper water column for any significant period of time.

Alkalinity added during the various amendment events has not produced a long-term effect of increasing the Pit Lake pH or stabilizing acid generation. Dissolved metals, acidity, and hardness are generally similar for samples collected at the same depth but different locations within the lake, suggesting that water within the upper layer is well mixed across the lake.

Evaporative loss of water from the Pit Lake tends to concentrate contaminants within the water column. Based on regional pan evaporation rates measured at nearby Lake and monthly precipitation for McCormick, SC combined with a pit area of 7.75 acres, annual evaporative loss is estimated to be approximately 3.5 inches, which is equivalent to about 735,000 gallons of water or about 1% of the water contained in the lake.

Pit Lake System Sediment

Primary metals of concern in sediment are barium, cadmium, copper, iron, lead and zinc. Other metals which exceed the conservative benchmarks include aluminum, arsenic, cobalt, mercury, nickel, and silver. Crystalline phases identified by x-ray diffraction (XRD) in sediment samples from the Pit Lake were predominantly kaolinite and quartz with subordinate muscovite and gypsum. Although iron oxide or sulfide phases were not identified by XRD, scanning electron microscopy-energy dispersive spectrometry also identified heavy metals (e.g., cadmium, copper, zinc) associated with some particles and nanoparticles in all samples. Virginia Tech noted a rapid change in color as the samples were exposed to the atmosphere during sample preparation. Since none of the major phases identified in the sediment are reactive, this may indicate that reduced transition metal sulfide nanoparticles are present in Pit Lake sediments but were oxidized during sample preparation.

Summary of Site Risks

A **Baseline Risk Assessment** (BRA) was conducted in 2017 to estimate the risks and hazards associated with the current and future effects of contaminants on human health and the environment. A **Human Health Risk Assessment** (HHRA) was conducted to assess the risks posed to human health due to site related contamination, and a **Baseline Ecological Risk Assessment** (BERA) was conducted to assess the risks posed to ecological receptors due to site related contamination. The purpose of the HHRA and BERA is to identify potential cancer risks and noncancer health hazards and ecological effects caused by hazardous substance exposure in the absence of any actions to control or mitigate these exposures under current and future site uses. The HHRA and BERA are summarized in the RI and FS Reports.

Human Health Risk Assessment

The purpose of the HHRA is to quantify the human-health risks associated with potential exposures to Site-related contaminants under current and possible future land use conditions, in the absence of any remedial actions. The HHRA was performed using USEPA CERCLA guidance for risk assessment and the analytical data collected in support of the RI for the Site. In the HHRA, cancer and non-cancer health hazard estimates are based on reasonable maximum exposure (RME) scenarios. The estimates were developed by considering various health protective assumptions regarding the concentrations, frequency and duration of an individual's exposure to chemicals selected as chemicals of potential concern (CPOCs), as well as the toxicity of these contaminants.

A four-step human health risk assessment process was used for assessing site-related cancer risks and noncancer health hazards. The four-step process described in EPA Risk Assessment Guidances (RAGs) is comprised of: Hazard Identification, Exposure Assessment, Toxicity Assessment and Risk Characterization.

The HHRA evaluated health risks to receptor populations that could potentially be exposed to chemicals of potential concern (COPCs) under current and possible future land use conditions. Presently, the Site and surrounding area is a mix of rural residential development and open space that predominately wooded. Potential receptors and potentially complete exposure pathways were identified for both current and future land uses. The future use of the Site and surrounding area is not expected to change. However, the HHRA assumed that additional exposure pathways to Site media could be complete under future land use conditions. In summary, the following scenarios were identified:

- Current/future Trespasser / Recreational user exposed to surface water
- Current/future Industrial / Commercial Worker exposed to groundwater
- Current/future Construction Worker exposed to groundwater
- Future Resident exposed to surface water and groundwater

The HHRA indicate that excess lifetime cancer risks for current and potential future Trespasser/Recreational user and Construction Worker exposed to soil, sediment, surface water and groundwater are within the EPA's acceptable excess lifetime cancer risk range of 10-6 (one in a million) to 10-4 (one in ten-thousand). The HHRA indicate cancer hazards exist for a future Resident and current/future Industrial/Commercial Worker exposed to Site groundwater. The primary driver for cancer hazards associated with exposure to groundwater water is arsenic.

Non-cancer hazards were acceptable (HIs < 1) for all receptors exposed to soil and sediment.

However, non-cancer hazards were unacceptable (HIs > 1) for current and potential future Industrial/Commercial Worker, Construction Worker and Residents exposed to groundwater. The primary drivers for non-cancer hazards associated with exposure to groundwater are aluminum, antimony, arsenic, beryllium, cadmium, cobalt, copper, iron, lead, manganese, mercury, nickel, selenium, thallium, vanadium and zinc.

Non-cancer hazards were also unacceptable for current and future Trespasser/Recreational users and future Residents exposed to surface water. Manganese is the primary COC for non-cancer hazards associated with exposure to surface water.

Table 1 summarizes the excess lifetime cancer risks (ELCR) and noncancer hazard indices for each receptor group evaluated, specific media and COCs. COCs were identified in accordance with EPA guidance for HHRA.

Baseline Ecological Risk Assessment

A BERA was performed as part of the RI conducted in 2017. The objective of the BERA was to evaluate the risk of ecological harm associated with site-related contaminants which consist primarily of high acidity and metals. The BERA considered assessment endpoints to evaluate risk in aquatic and terrestrial exposure areas. The BERA concluded the following:

The Pit Lake does not support a viable traditionally recognized aquatic community. However, Pit Lake water and sediment quality were evaluated by comparing the concentrations of constituents with screening-level benchmarks considered protective of aquatic life. Given the highly acidic condition in the lake (pH generally less than 4), most organisms cannot survive with the exception of specialized microbial and algal forms. This low pH also results in the release of high concentrations of metals.

The BERA concluded that adverse effects would be expected to wildlife that may utilize the Pit Lake water as their only daily drinking water source. Refined screening of the wildlife drinking water COPECs, retained aluminum, copper and iron.

The BERA concluded sediment quality in the Pit Lake would pose a risk to benthic organism if they were present. Refined screening of the sediment COPECs, retained arsenic, barium, cadmium, copper, iron, and zinc.

Soils in OU1 were also evaluated for potential risks to terrestrial receptors. Most of the soil in OU1 is part of a constructed cap over mine waste material that was installed during the Removal Action. Vegetation on the cap has been well established and there is evidence of use by small mammals and birds. The remaining disturbed soils (access roads and former operation/storage areas) were not re-vegetated and provide marginal habitat value. The comparative analysis of site soil concentrations with various conservative benchmark values indicated risk to terrestrial receptors. Refined screening of the soil COPECs, retained barium, cadmium, chromium, copper and lead.

Basis for Action

It is the EPA's current judgment that the Preferred Alternative identified in this Proposed Plan, or one of the other active measures considered in the Proposed Plan, is necessary to protect public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment. Water flows into the Pit Lake as direct precipitation, rainfall runoff from the highwalls, stormwater that is shed from the CWR and sedimentation pond area south of the lake and groundwater inflow from the southeast and southwest, including water entering from the CWR area.

Rainfall runoff from oxidized to partly weathered highwalls contribute metals to the Pit Lake in total and dissolved forms. The concentrations of dissolved metals, specifically copper, are higher from areas that have remnant sulfide mineralization. They are slightly acidic (pH 4.7 to 5.2) with low concentrations of sulfate.

Storm runoff conveyed to the lake from upslope areas contains dissolved metals including copper in concentrations lower than runoff from the sulfide-bearing highwalls and small amounts of alkalinity.

Relatively clean groundwater migrating from the south, becomes contaminated with metals after interacting with the CWR or natural mineralization before discharging into the Pit Lake. Groundwater flowing toward the Pit Lake from the southeast is alkaline with low concentrations of metals. Groundwater also discharges from the lake through seeps to the North Tributary to Hawe Creek. The proposed interim remedial action for OU1 is to effectively address contaminant migration from OU1 to OU3 and is driven by the need to restore and protect the designated uses for OU3. Restoration of Site groundwater and restoration of surface water within the Pit Lake is not within the scope of this source control remedy for OU1. The Pit Lake is a former mine pit and was previously utilized as a treatment system and thus has been determined not to be waters of the U.S. The primary risk associated with the Barite Hill Site involves the migration of Site-related contaminants to the OU3 and ecological risks to wildlife drinking from the Pit Lake.

Because the OU1 portion of the Site was reclaimed by placing waste rock back into the Pit Lake and installing a cap over the graded waste rock, future residential use of this land is unlikely. Given the surrounding wooded nature of the Site and proximity to the town of McCormick, recreational use would be a likely future land use following closure, however private parties have also expressed an interest in re-mining the site.

As previously summarized, the Baseline Ecological Risk Assessment (BERA) results indicate that aquatic invertebrates and most phytoplankton species would be unable to survive in the Pit Lake. Risks exist to wildlife that ingest all of their water from the Pit Lake and cadmium and copper concentrations in Pit Lake sediments would pose a risk to benthic communities, if they existed. Copper in OU1 soils poses some risk to ecological receptors.

Lifetime cancer risks exist for future Residents, and current and potential future Industrial/Commercial Workers exposed to groundwater, and non-cancer hazards were unacceptable for current and potential future Industrial/Commercial Workers, Construction Workers and Residents exposed to groundwater. Non-cancer hazards were also unacceptable for current and future Trespasser/Recreational users and future Residents exposed to surface water.

Remedial Action Objectives (RAOs)

Before developing cleanup alternatives for a **Superfund** site, EPA establishes **remedial action objectives** (RAOs) to protect human health and the environment. RAOs are specific goals to protect human health and the environment. These objectives are based on available information and standards, such as **Applicable Relevant and Appropriate Requirements (**ARARs), **to-be-considered** (TBC) guidance, and site-specific, risk-based levels.

The following RAOs for this proposed interim remedial action were developed (or retained from the FS) based on the current and potential future land use at the Site and scope of the interim remedial action:

Surface Water and Sediment in Pit Lake

- Minimize leaching from contaminated Pit Lake sediments to groundwater and surface water
- Minimize benthic organism exposure to COCs in sediments exceeding levels protective of ecological risk

- Prevent exposure to COCs in surface water above protective levels

Groundwater

- Prevent or control the migration of contaminated groundwater to the Pit Lake and/or to seeps that discharge to the North Tributary

Soil/Waste Rock

- Prevent exposure to ecological receptors from COCs in soils above acceptable risk-based levels
- Prevent or control migration of contaminants in soil or waste rock to groundwater

Preliminary Remedial Goals (PRGs)

In general, preliminary remedial goals (PRGs) are used to develop the long-term contaminant concentrations needed to be achieved to meet RAOs by the remedial alternatives. Per the NCP, PRGs are identified in the FS and presented in a Proposed Plan, but are subsequently renamed as "cleanup levels" once incorporated into a final remedy as documented in a ROD. PRGs are based upon promulgated chemical-specific applicable or relevant and appropriate requirements (ARARs) where available for a particular contaminant and media, or risk-based concentrations protective of ecological receptors or human health, as appropriate, if ARARs are not available. The Safe Drinking Water Act (SDWA) Maximum Contaminant Levels (MCLs) at 40 C.F.R. Part 141 and the state or federal ambient water quality criteria (AWQC) established under Section 303 or 304 of the Clean Water Act are examples of Chemical-Specific ARARs used to establish remediation levels for restoration of groundwater that is a current or potential sources of drinking water and restoration of surface water to meet its designated uses or classifications, respectively.

The PRGs, presented in Table 2, for Pit Lake water, Pit Lake water discharging to surface water, and groundwater seeps discharging to surface water were developed for OU1 by evaluating current and future risks to human health and wildlife. The limited scope of this proposed interim action, which does not include restoration of surface water or groundwater, is not expected to attain PRGs. However, the PRGs presented in Table 2 will be utilized in an EPA-approved monitoring plan to evaluate the effectiveness of the interim action in preventing or controlling contaminant migration from OU1 to OU3 and in reducing contaminant concentrations in Pit Lake water. The PRGs may be retained or refined when EPA selects a final remedy for groundwater and surface water in future ROD(s) for each applicable OU.

The PRGs for protection of human health for Pit Lake water discharging into the North Tributary, and groundwater discharging through seeps into the North Tributary were developed by selecting the National Recommended Water Quality Criteria, or the more stringent South Carolina water quality standards when available for a particular COC. Where a promulgated standard was not available for a particular COC, risk-based standards (for residential HQ=1) from the HHRA were selected. The PRGs are applied at the point where groundwater discharges to the North Tributary or where Pit Lake water discharges via the spillway to the North Tributary as indicated in Table 2.

The PRGs for protection of terrestrial ecological receptors utilizing Pit Lake water as their sole daily drinking water source were developed from the BERA. The PRGs are applied in the Pit Lake.

The PRGs for protection of ecological receptors from intermittent discharges of Pit Lake water through spillway overflow (such as during 24 hr/ 25-year storm events) to the North Tributary to Hawe Creek were developed based on the acute and chronic standards in the National Recommended Water Quality Criteria, or the more stringent South Carolina Ambient Water Quality Criteria (AWQC) for protection of freshwater aquatic life when available. The PRGs for ecological COCs are applied at the point of discharge of Pit Lake water via the spillway to North Tributary.

Summary of Alternatives

CERCLA, Section 121(b)(1), 42 U.S.C. Section 9621(b)(1), mandates that remedial actions must be protective of human health and the environment, cost-effective, comply with ARARs and utilize permanent solutions and alternative treatment technologies and resource recovery alternatives to the maximum extent practicable. CERCLA Section 121(d), 42 U.S.C. Section 9621(d) further specifies that a remedial action must attain a level or standard of control of the hazardous substances, pollutants, and contaminants, which at least attains ARARs under federal and state laws, unless a waiver can be justified pursuant to CERCLA Section 121(d)(4), 42 U.S.C. Section 9621(d)(4).

The NCP requires an FS to identify ARARs related to chemicals at the site, site location characteristics and remedial activities. The FS identified all ARARs for the site remedial alternatives. A complete listing of ARARs for the Preferred Alternative will be provided in the IROD.

The proposed interim action is intended to provide protection of human health and the environment in the short term until a final ROD is selected. The proposed interim action complies with those federal and state requirements that are ARARs for this limited scope action and is cost effective. This action is an interim solution only and will become part of a total final remedial action that will attain ARARs. As an interim solution only, this limited scope remedial action partially addresses the statutory mandate to utilize permanent solutions and alternative treatment technologies to the maximum extent practicable. Because the proposed action does not constitute the final remedy for the Site, the statutory preference in CERCLA Section 121(b)(1) for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element may be further addressed in the final response action.

After identifying and considering numerous potential treatment technologies, the following remedial alternatives for each CMZ were retained, evaluated in the FS and are summarized below. More detailed descriptions of each remedial alternative can be found in the FS report.

Soil and groundwater contamination at the Site were classified into three CMZs. Alternatives were evaluated and a remedy was selected for each CMZ. A CMZ represents a portion of the Site contamination in OU1, which has a particular characteristic that defines the optimal remediation approach. Defining characteristics can include one or more parameters such as lithology, COCs, depth, and/or areal extent. Segregation of the Site into CMZs allows remedial alternatives to be tailored to these conditions, thereby resulting in a more economical and focused remedy. CMZs have been established to address contaminants in the Pit Lake Water and Sediment (CMZ-1), Capped Waste Rock (CMZ-2), and Groundwater (CMZ-3). The CMZs are established based on existing data and may require refinement if additional data is collected in the future.

EPA is proposing an Interim remedial action and a **Preferred Alternative** that includes **Institutional Controls (ICs), and Monitoring**. Both of these remedy components are part of remedial alternatives evaluated in the FS. The capital cost for implementing the ICs is the same for any of the remedial alternatives, including EPA's Preferred Alternative.

This interim Preferred Alternative prevents exposure to, and potable use of groundwater that contains concentrations of metals that pose potential non-cancer risks to human health by implementing ICs until a final groundwater remedy is selected. These ICs will include a recorded environmental restrictive covenant, a deed notice, or other proprietary controls, as deemed necessary by EPA, prohibiting installation of new groundwater wells within the area of impacted groundwater and restricting potable use of untreated groundwater containing COCs exceeding levels protective of human health. In addition, ICs may include the use of public notices, advisories, and signage. This will provide a visible and practical reminder for the local public to maintain awareness of the Site and to minimize exposure for a negligible cost.

During this interim remedial action, monitoring of groundwater seeps discharging to the North Tributary, Pit Lake water, and Pit Lake water discharging to North Tributary will continue, and additional data will be collected, which may be used to further refine RGs during final remedy selection for OU1.

Monitoring data will be compared against PRGs presented in Table 2 to evaluate the effectiveness of the source control measures being implemented during this proposed interim action. This data will be used to evaluate potential final remedial actions, including the viability of MNA or the need for additional active remedial measures, prior to selecting a final remedy for OU1, or developing a technical impracticability waiver evaluation, as appropriate, if chemical-specific ARARs cannot be attained.

Capital costs are those expenditures that are required to construct remedy components included in a remedial alternative. **Operation and Maintenance** (O&M) costs are those post-construction costs necessary to ensure or verify the continued effectiveness of a remedial alternative and are estimated on an annual basis. Periodic costs are the project costs necessary for **Five-Year Reviews**, and groundwater monitoring. Present value is the amount of money which, if invested in the current year, would be sufficient to cover all the costs over time associated with a project, calculated using a discount rate of seven percent and a 30-year time interval.

Construction time is the time required to construct and implement the alternative and does not include the time required to design the remedy or procure contracts for design and construction.

Because hazardous substance will be left behind at levels that do not allow for unlimited use and unrestricted exposure for all of the remedial alternatives (including the Preferred Alternative), statutory five-year reviews will be required for each alternative, as required by CERCLA 121(c) and the NCP [40 C.F.R. §300.430(f)(4)(ii)].

CMZ-1, Pit Lake Water and Sediment. The current estimate of lake water volume is approximately 73 million gallons (Mgal) with a relative accuracy of 10%. This is based on merging bathymetric and Lidar data sets and estimating volume of the pit in 5 ft depth increments. The Pit Lake occupies an area of approximately 7.7 acres.

The alternatives for the Pit Lake address the water within the pit as well as the submerged waste rock. None of the individual alternatives for the Pit Lake will meet all of the proposed OU1 RAOs. It will require a combination of the best individual alternatives to meet all the proposed RAOs as presented herein.

Pit Lake Alternative 1 (CMZ-1): No Action
Estimated Capital Cost: $0
Total Estimated Operation and Maintenance Cost for 30 years: $94,160
Net Present Value: $94,160

The NCP requires that a "No Action" alternative be developed as a baseline for comparing other remedial alternatives. The No Action alternative does not include remedial action components to prevent exposure to contaminated Site groundwater, reduce AMD generation or the migration of AMD and would not implement an environmental monitoring program to assess long-term changes in groundwater quality. The No Action alternative provides for an assessment of the environmental conditions if no remedial actions are implemented.

Pit Lake Alternative 2 (CMZ-1): Drain Lake, Add Amendments to Pit Floor, and Backfill Pit
Estimated Capital Cost: $17,636,097
Total Estimated Operation and Maintenance Cost for 30 years: $142,394
Net Present Value: $17,778,500

This alternative consists of the following components:

- Treat approximately 73 Mgal of lake water and other inflows through a temporary onsite treatment plant that will discharge clean water to the North Tributary.
- Amend the pit floor with lime and other reactants to reduce acid generation.
- Backfill pit by using on-site and off-site borrow sources.
- Recontour to minimize groundwater inflow and surface water runoff controls.
- Monitor seeps and North Tributary.
- Engineering and Institutional Controls
- Five-Year Reviews

The treatment plant would likely be built in the former staging area and the outfall discharge would be in the OU3 downstream of the beaver pond. As the pit floor becomes exposed, oxidization of pyritic materials will need to be prevented or minimized to prevent acid generation. This would be accomplished by adding various amendments to kill bacteria that promote acid generation and coat the material with other reactants and/or lime application. Management and treatment of water entering the pit during backfill operations is required. Backfill will be accomplished using clean materials from on-site and off-site soil borrow areas. The backfilling will be completed to re-contour the new "hill" with surface water runoff controls. It is estimated that approximately 400,000 cy of backfill will be needed. This alternative would meet the RAO for the surface water and sediments in the Pit Lake but would not address the RAOs for the capped waste rock or groundwater.

Pit Lake Alternative 3 (CMZ-1): Drain Lake, Cap Pit Floor, Partial Backfill and Create Wetland
Estimated Capital Cost: $14,394,139
Total Estimated Operation and Maintenance Cost for 30 years: $155,863
Net Present Value: $14,550,000

This alternative consists of the following components:

- Treat approximately 73 Mgal of lake water and other inflows through a temporary onsite treatment plant that will discharge clean water to the North Tributary.
- Amend the pit floor with lime and other reactants to reduce acid generation and cover with impermeable cap.
- Reduce depth and size of pit by partially backfilling with material from on-site and off-site borrow areas, lower spillway, and re-contour pit.
- Construct a wetland system to treat groundwater and surface water inflows.

- Engineering and Institutional Controls
- Five-Year Reviews

The temporary treatment plant would be the same as described for Pit Lake #2. The exposed pit floor and walls would be treated with reactants to reduce acid generation prior to placement of an impermeable cap over the floor. Then material from borrow areas will be used to re-contour the pit and lower the spillway to allow clean water to discharge to the North Tributary. The shallower pit will be designed as a passive wetland to sequester metals from runoff and groundwater input. This alternative would meet the RAO for the surface water and sediment in the Pit Lake. It would aid in addressing the RAO for groundwater but would not address the RAO for the capped waste rock

Pit Lake Alternative 4 (CMZ-1): Amendments to Pit Lake and Cap Pit Floor
Estimated Capital Cost: $9,224,251
Total Estimated Operation and Maintenance Cost for 30 years: $91,426
Net Present Value: $9,315,700
This alternative consists of the following components and is shown on Figure 5-3:

- Amend the lake with alkalinity and organic carbon to increase the pH and reduce metals concentrations.
- Cover the pit floor with an impermeable cap to seal off from groundwater discharging into the Pit Lake. This would also seal off the Pit Lake water from fractures leading to the seeps near the North Tributary to Hawe Creek.
- Monitor lake water, seeps and North Tributary.
- Engineering and Institutional Controls
- Five-Year Reviews

Lime-based amendments such as sodium hydroxide and substantial amounts of organic carbon from cost-effective sources such as wood chips, molasses, or liquid manure would be mixed into the Pit Lake based on accurate water volumes and titration techniques. Large carbon "tea bags" containing the organic carbon sources would be used to help prevent the carbon source from settling to the bottom. The pit floor would be encapsulated using an impermeable material such as AquaBlok® or a sodium bentonite/soil mixture. This alternative would meet the RAO for the surface water and sediments in the Pit Lake but would not address the RAOs for the capped waste rock or groundwater.

CMZ-2, Capped Waste Rock. There are no definitive records of how much waste rock was covered with the existing caps or the volume of waste rock placed into the southeast area of the pit. However, based on estimates of material in previous reports it is estimated that approximately 250,000 cy remain beneath the cap and another 50,000 cy in the saturated zone or under water in the Pit Lake. The capped waste rock disposal area occupies approximately 6.6 acres.

The alternatives for the capped waste rock were developed to address the acid production from the waste rock in order to reduce or eliminate its impact on the Pit Lake water and groundwater within the waste rock area. None of the individual alternative for the waste rock will meet all of the proposed OU1 RAOs. A combination of the best individual alternatives designed to meet all of the proposed RAOs is presented.

Waste Rock Alternative 1 (CMZ-2): No Action
Estimated Capital Cost: $0
Total Estimated Operation and Maintenance Cost for 30 years: $94,084
Net Present Value: $91,084
Section 300.430(e)(6) of the NCP directs that a "No Action Alternative" be developed for all FSs to provide a baseline scenario to compare all other alternatives against. This alternative does not include any remedial action components or funds to reduce T/M/V of contaminants and does not meet any of the proposed RAOs for the waste rock.
Waste Rock Alternative 2 (CMZ-2): Excavate, Onsite Disposal and Encapsulation, Backfill, Cap Excavation
Estimated Capital Cost: $14,258,471
Total Estimated Operation and Maintenance Cost for 30 years: $325,857
Net Present Value: $14,584,300
This alternative consists of the following components:

- Excavate the approximately 250,000 cy of capped waste rock and encapsulate on-site.
- Backfill the excavated area with clean materials.
- Cap backfilled excavation.
- Monitor lake water, seeps and North Tributary.

This alternative would remove, through excavation, the 250,000 cy of capped waste rock. The waste rock would be transported to a location on-site and encapsulated in a geomembrane liner and finished with a clay cap. The encapsulation will be designed to prevent infiltration of water into the waste rock or seepage from the waste rock. Sheeting piling may be required along the edges of the Pit Lake during excavation activities to prevent the excavation from filling with Pit Lake water. The excavated area would be backfilled with clean material brought in from off-site. The backfilled excavation would be revegetated and contoured to control storm water runoff. This alternative would address the capped waste rock and its associated RAOs, and indirectly aid in addressing the RAOs for the surface water and groundwater by removing the major source of acid generation in OU1. This alternative would not address the RAO for sediments.

Waste Rock Alternative 3 (CMZ-2): Amendments to Waste Rock, Enhancement of Existing Caps
Estimated Capital Cost: $4,400,646
Total Estimated Operation and Maintenance Cost for 30 years: $79,079
Net Present Value: $4,479,700

This alternative consists of the following components and is shown on Figure 5-5a through Figure 5-5d:

- The capped waste rock would be amended with reactants (e.g., sodium lauryl sulfate and milk) to neutralize acid generation.
- An expansion and/or enhancement of the existing cap.
- Monitor lake water, seeps and North Tributary.

Amendments such as sodium lauryl sulfate buffered with sodium bicarbonate (used in Sovereign's treatability study) would be added to the unsaturated and transition zones of the waste rock. Amendments to the unsaturated zone would be applied through a series of shallow injection wells. Amendments such as milk buffered with sodium bicarbonate would be added to the saturated zone of the waste rock to stop acid generation. The amendments would be added to the saturated waste rock through a series of injection wells that extend into the underlying bedrock. The waste rock is currently capped with two HDPE liners and an existing clay cap. The existing clay cap would be expanded and/or enhanced to minimize rain and storm water infiltration. In addition, much of the cap area is compromised by shrub and tree growth. Removal of this vegetation would further minimize infiltration. This alternative would address the RAO for the waste rock area and aid in addressing the RAOs for the Pit Lake and groundwater by reducing or stopping acid generation within the waste rock area.

CMZ-3, Groundwater. Groundwater quality in OU1 has been measured in 16 monitoring wells: BH26 – 29, 49-51, 55, 56, 64-66, and 71-74. Groundwater in OU1 exceeding the Remedial Goal (RGs) is predominately concentrated in the waste rock area.

The alternatives for OU1 groundwater were developed to reduce or eliminate contaminated groundwater from impacting the waters of the Pit Lake and the North Tributary. No individual alternative for OU1 groundwater will meet all of the proposed RAOs. A combination of the best individual alternatives designed to meet all of the proposed RAOs is presented.

Groundwater Alternative 1 (CMZ-3): No Action
Estimated Capital Cost: $0
Total Estimated Operation and Maintenance Cost for 30 years: $122,206
Net Present Value: $122,206

Section 300.430(e)(6) of the NCP directs that a "No Action Alternative" be developed for all FSs to provide a baseline scenario to compare all other alternatives against. This alternative does not include any remedial action components or funds to reduce T/M/V of contaminants and does not meet any of the proposed RAOs for OU1 groundwater.

Groundwater Alternative 2A (CMZ-3): Dewatering of Capped Waste Rock and Groundwater Diversion with Barrier Wall and Grout Curtain
Estimated Capital Cost: $7,432,326
Total Estimated Operation and Maintenance Cost for 30 years: $74,495
Net Present Value: $7,506,800

This alternative consists of the following components and is shown on Figure 5-6a:

- Install a barrier wall and grout curtain in the upper end capped waste rock area to divert unimpacted groundwater around the buried waste rock
- Dewater the capped waste rock area by installing extraction wells and pumping groundwater into the Pit Lake
- Install open limestone channels at the pit spillway and in channels where storm water discharges into the Pit Lake
- Monitor lake water, seeps and North Tributary

A barrier wall approximately 600 ft long and 70 ft deep would be installed on the upper slope of the southeast cap area. The barrier wall would be constructed by excavating a long, deep, and approximately 3-ft wide trench from ground surface to the top of bedrock. It would be constructed by removing the existing native soils from the trench and backfilling the trench with a low permeability clay / soil / cement backfill material.

The grout curtain would extend from the top of bedrock down to a total depth of 160 feet bls. It would consist of the installation of two grout lines offset 10 ft from the proposed centerline of the barrier wall. The grout line on the downstream (to groundwater flow) side of the barrier wall would be completed first, followed by the upstream line. Verification holes would be installed between the lines and water pressure tested to confirm the design intent of the drilling and grouting has been met.

As a possible finishing step, the groundwater within the waste rock area could be extracted using a series of extraction wells and pumped into the Pit Lake for treatment. Although not addressing groundwater directly, this alternative also recommends the installation of passive open limestone channels at the Pit Lake spillway and at areas where storm water runoff enters the pit. These would be considered as a passive treatment of water discharging from the lake at times of full pool. In addition, channels where storm water discharges into the Pit Lake would be lined with limestone to help add alkalinity to aid in raising the pH within its waters.

This alternative would not directly address the RAOs for the surface water or sediments in the Pit Lake, or the waste rock; however, it would prevent or minimize contamination of additional groundwater from upgradient sources.

Groundwater Alternative 2B (CMZ-3): Groundwater Diversion and Dewatering of the Capped Waste Rock – Hydraulic Barrier
Estimated Capital Cost: $1,995,286
Total Estimated Operation and Maintenance Cost for 30 years: $1,525,832
Net Present Value: $3,521,100

This alternative consists of the following components:

- Install a series of groundwater extraction wells in the upper end capped waste rock area to create a hydraulic barrier and reducing or preventing the flow of groundwater through the buried waste.
- Dewater the capped waste rock area by pumping groundwater into the Pit Lake.
- Install open limestone channels at the pit spillway and in channels where storm water discharges into the Pit Lake.
- Monitor lake water, seeps and North Tributary.

A hydraulic barrier approximately 600 ft long would be created on the upper slope of the southeast cap area. The hydraulic barrier would be constructed by installing a series of groundwater extraction wells drilled into the underlying bedrock. Eight 6-inch wells would be installed to a total depth of 160 feet bls at 75-foot centers along the line. Groundwater would be extracted from these wells to drawdown groundwater on the upper slope of the capped waste rock thus preventing or greatly reducing groundwater flow through the waste rock. Extracted groundwater would be pumped into the Pit Lake provided the water quality of the groundwater would not negatively impact the Pit Lake water. An alternative would be to pump the groundwater into an infiltration pond or ponds. If extracted groundwater is found to be impacted, it will need treatment prior to discharge to the Pit Lake or infiltration ponds.

As a possible finishing step, the groundwater within the waste rock area could be extracted using a series of extraction wells. The groundwater would be pumped into the Pit Lake for in-situ treatment.

As describe for #2B, this remedy would also install open limestone channels at the Pit Lake spillway and storm water entry points to the Pit Lake. This alternative would reduce the flow of groundwater into the waste rock area from the south-southwest which would aid in addressing the RAO for groundwater. It would not address groundwater discharging from fractures which feed the seeps. This alternative would not directly address the RAOs for surface water and sediments in the Pit Lake or the waste rock; however, it would prevent or minimize contamination of additional groundwater from upgradient sources.

Groundwater Alternative 3 (CMZ-3): Groundwater In-situ Neutralization
Estimated Capital Cost: $1,467,917
Total Estimated Operation and Maintenance Cost for 30 years: $5,253,119
Net Present Value: $6,721,000

This alternative consists of the following components:

- Install a series of injection wells into the saturated capped waste rock area to add reactants and/or alkalinity to neutralize groundwater from oxidizing the buried waste.
- Monitor lake water, seeps and North Tributary.

A series of injection wells will be installed to add alkalinity-related amendments to the groundwater within the waste rock and major fracture zones zone near the lake to reduce acidity. The wells would be installed into the regolith and bedrock at various depths. Final amendments and quantities, along with the number and spacing of injection wells would be developed at the design stage. This alternative may require multiple injections to address the RAO for groundwater. This alternative would address the RAO for groundwater. It would not directly address the RAOs for the waste rock area, or surface water and sediments in the Pit Lake.

Evaluation of Alternatives

The EPA uses nine criteria to evaluate the remedial alternatives individually and against each other to select a remedy (See insert "Nine Criteria for Superfund Remedial Alternatives"). This section of the Proposed Plan profiles the relative performance of each alternative against the nine criteria, noting how it compares to the other options under consideration. The nine evaluation criteria are discussed below. Detailed evaluation of the remedial alternatives is included in the FS report.

NINE CRITERIA FOR SUPERFUND REMEDIAL ALTERNATIVES
THRESHOLD CRITERIA
1. **Overall Protectiveness of Human Health and the Environment** determines whether an alternative eliminates, reduces, or controls threats to public health and the environment through institutional controls, engineering controls, or treatment.
2. **Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)** evaluates whether the alternative meets Federal and more stringent State environmental statutes, regulations, and other requirements that pertain to the site, or whether a waiver is justified.
PRIMARY BALANCING CRITERIA
3. **Long-term Effectiveness and Permanence** considers the ability of an alternative to maintain protection of human health and the environment over time.
4. **Reduction of Toxicity, Mobility, or Volume (T/M/V) of Contaminants through Treatment** evaluates an alternative's use of treatment to reduce the harmful effects of principal contaminants, their ability to move in the environment, and the amount of contamination present.
5. **Short-term Effectiveness** considers the length of time needed to implement an alternative and the risks the alternative poses to workers, residents, and the environment during implementation.
6. **Implementability** considers the technical and administrative feasibility of implementing the alternative, including factors such as the relative availability of goods and services.
7. **Cost** includes estimated capital and annual operations and maintenance costs, as well as present worth cost. Present worth cost is the total cost of an alternative over time in terms of today's dollar value. Benefits weighed against cost.
MODIFYING CRITERIA
8. **State/Support Agency Acceptance** considers whether the State agrees with the EPA's analyses and recommendations, as described in the RI/FS and Proposed Plan.
9. **Community Acceptance** considers whether the local community agrees with EPA's analyses and preferred alternative. Comments received on this Proposed Plan are an important indicator of community acceptance.

Threshold Criteria #1: Overall Protection of Human Health and the Environment

All alternatives evaluated except for the No Action alternatives would be protective of human health and the environment in the short term.

Threshold Criteria #2: Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

Federal and state requirements that are ARARs for the remedy components considered for this interim remedial action are addressed. All alternatives evaluated except for the No Action alternatives are expected to comply with the action- and location specific ARARs. ARARs are provided in Table 4. This limited scope interim action, which does not include a groundwater or surface water restoration objective, is not expected to attain chemical-specific

ARARs for groundwater or surface water. However, the PRGs presented in Table 2 will be utilized during on-going monitoring to evaluate the effectiveness of the source controls actions to be implemented under this proposed interim action.

Balancing Criteria #3: Long-Term Effectiveness and Permanence

A complete evaluation of the balancing criteria for all of the alternatives is contained in the FS. The no action alternatives would not provide long-term effectiveness or permanence in protecting human health and the environment through reduction, control, or elimination of contaminant source areas. The IC and monitoring components of groundwater would be protective of human health and the environment in the short-term until a final remedy is selected for Site groundwater. This criterion has importance for the remediation of OU1 due to the RAO of preventing continued impact to OU3. Aggressive and comprehensive technologies can be expected to provide better assurance of long-term effectiveness and permanence, which Groundwater #2A, Groundwater #2B, and Groundwater #3 remedial alternatives offer. Similarly, Waste Rock alternatives that physically remove contaminants from the Site media and address the long-term impact of the waste rock provide the most protection for the longest period, which Waste Rock #2 remedial alternative offers.

Balancing Criteria #4: Reducing Toxicity, Mobility or Volume through Treatment

As an interim solution only, this limited scope action is not intended to address the statutory mandate to utilize permanent solutions and alternative treatment technologies to the maximum extent practicable. Alternatives Pit Lake #3 and Pit Lake #4 offer the best reduction of the mass, volume, and concentration of COCs through treatment by directly addressing the Pit Lake and indirectly addressing groundwater in OU1. Pit Lake #2 only addresses the Pit Lake water. Alternative Waste Rock #3 offers the best reduction of the mass, volume, and concentration of COCs. Alternative Groundwater #3 offers the best reduction of the mass, volume, and concentration of COCs by directly addressing groundwater by conducting in-situ treatment. Groundwater #2A diverts groundwater away from the waste rock area and then removes impacted water which is pumped into the Pit Lake.

Balancing Criteria #5: Short-Term Effectiveness

The short-term effectiveness of remedial alternatives considers how well HH&E is protected in the community or potential site workers, the projected environmental impacts, and the time to achieve RAOs during implementation. The effectiveness of remedy at ensuring short-term protection during implementation of a RA depends on the procedure and safeguards used by the remediation contractor. The no action alternatives would not address short-term risks to community or environment. No actions would be taken to reduce, control, or eliminate existing risks. Pit Lake #4 should have the smallest impact on the community and construction workers and has a relatively short implementation timeframe (one year). Waste Rock #3 should have the smallest impact on the community and construction workers, and has minimal environmental impacts. Groundwater #2A, and Groundwater #2B do not reduce, in the short-term, the impact of wildlife drinking from the Pit Lake.

Balancing Criteria #6: Implementability

Under the No Action alternatives there is no action to implement. No action would be taken to protect human health or the environment, attain ARARs, or manage migration of contaminants. This approach would be unacceptable. Implementing remedial alternatives involves design, planning, construction or installation, and operational components of remedial actions. The overall reliability and operational flexibility is also considered in this criterion. The efficiency with which an alternative can be installed and operated impacts how well an alternative achieves its level of protection (the first threshold criterion) and attains ARARs (the second threshold criterion). All three alternatives are considered to be implementable. However, alternative Pit Lake #4 was the most reliable for meeting the ARARs. Pit Lake #2, Pit Lake #3 and Waste Rock #2 alternatives will involve extensive earthmoving efforts.

Balancing Criteria #7: Cost

The costs associated with each alternative are compared in Table 3. The capital cost for implementing the ICs is the same for any of the remedial alternatives, including EPA’s Preferred Alternative.

Modifying Criteria #8: State Acceptance

State acceptance of the Preferred Alternative will be addressed in the IROD following review of comments received on the Proposed Plan. State has indicated a willingness to accept the Preferred Alternative pending review of any public comments.

Modifying Criteria #9: Community Acceptance

Community acceptance of the proposed cleanup plan will be evaluated based on comments submitted to EPA as part of the public review and comment process. Comments received during this period will be addressed and responses will be presented in the Responsiveness Summary, which will be included in the IROD.

Preferred Alternative

The Preferred Alternative for cleaning up the Contaminated Media Zones in OU1 is:

- Alternative #4 (CMZ-1) - Pit Lake, Treat/Neutralize Pit Lake in place, Cap Pit Floor

- Alternative #3 (CMZ-2) – Waste Rock, Excavate and On-site Encapsulation, Backfill Excavation, and

- Alternative #2a (CMZ-3) – Groundwater Dewatering of Capped Waste Rock and Groundwater Diversion with Barrier Wall and Grout Curtain.

The Preferred Alternative consist of the following components:

- Amend the lake with alkalinity and organic carbon to increase the pH and reduce metals concentrations.
- Cover the pit floor with an impermeable cap to seal off from groundwater discharging into the Pit Lake. This would also seal off the Pit Lake water from fractures leading to the seeps near the North Tributary to Hawe Creek.
- Monitor lake water, seeps and North Tributary.
- The capped waste rock would be amended with reactants (e.g., sodium lauryl sulfate and milk) to neutralize acid generation.
- An expansion and/or enhancement of the existing cap.
- Monitor lake water, seeps and North Tributary.
- Install a barrier wall and grout curtain in the upper end capped waste rock area to divert unimpacted groundwater from oxidizing the buried waste rock
- Dewater the capped waste rock area by pumping groundwater into the Pit Lake
- Install open limestone channels at the pit spillway and in channels where storm water discharges into the Pit Lake
- Monitor lake water, seeps and North Tributary
- Install fencing around the perimeter of the lake
- Implement Institutional Controls
- Conduct Five-Year Reviews

The estimated total cost of the Preferred Alternatives is $21,902,000.

The Preferred Alternative is protective in the short-term while a EPA continues to develop a final remedy and satisfies the following statutory requirements of CERCLA Section 121(b), 42 U.S.C. § 9621(b) that the remedy be: 1) be protective of human health and the environment; 2) comply with ARARs; 3) be cost effective. This proposed interim action is not required to satisfy the statutory preference that remedial actions utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. EPA will assess the two modifying criteria of state acceptance and community acceptance in the IROD to be issued following the close of the public comment period.

Five-Year Reviews will be performed to evaluate the effectiveness of the completed source controls actions and natural attenuation processes in reducing contaminant concentrations in the overburden groundwater and to determine the impact on the bedrock groundwater zone. Five-Year reviews under CERCLA 121(c) will be conducted accordingly.

Community Participation

The EPA and the SCDHEC provided information regarding the cleanup of the Site to the public through meetings, the Administrative Record file for the Site, and an announcement published in the local newspaper, The McCormick Messenger.

The EPA and the SCDHEC encourage the public to attend the public meeting to gain a more comprehensive understanding of the Site.

The dates for the public comment period; the date, location, and time of the public meeting; and the location of the Administrative Record file are provided on the front page of this Proposed Plan.

For additional information on EPA's Preferred Alternative for the Site, please contact:

SUMMARY OF ADMINISTRATIVE RECORD

The Administrative Record (AR) contains all the information used by the Agency to select a Remedial Action. Electronic copies of smaller documents in the AR may be emailed on request. A link may be provided to larger documents. In addition, copies of the Administrative Record are kept at:

McCormick County Library
201 Railroad Ave.
McCormick, South Carolina
Phone: (864) 852-2821

Hours: Mon-Closed
Tues – Thurs. 10 am–7 pm
Fri. 9am–6 pm
Sat. – Sun. 1pm – 5pm

Candice Teichert, Remedial Project Manager
teichert.candice@epa.gov
(800) 435-9233

OR

Abena Moore, Community Involvement Coordinator
moore.abena@epa.gov
(800) 435-9233

GLOSSARY

Acid Mine Drainage (AMD): AMD is caused when water flows over or through sulfur-bearing materials forming solutions of net acidity and the subsequent leaching of metals and inorganic constituents to groundwater and storm water run-off. AMD comes mainly from abandoned and active mining areas.

Acid Rock Drainage (ARD): ARD occurs naturally within some environments as part of the rock weathering process, usually within rocks containing an abundance of sulfide minerals. Naturally acidic solutions cause leaching of metals and inorganic constituents.

Administrative Record: Material documenting EPA's selection of cleanup remedies at Superfund Sites, a copy of which is placed in the **Information Repository** near the Site.

Applicable or Relevant and Appropriate Requirements (ARARs): Refers to federal and state requirements a selected remedy must attain, which vary from site to site.

Baseline Ecological Risk Assessment (BERA): A qualitative and quantitative evaluation performed to define the risk posed to ecological receptors by the presence or potential presence of specific contaminants.

Baseline Risk Assessment (BRA): A qualitative and quantitative evaluation performed to define the risk posed to human health and the environment by the presence or potential presence and use of specific pollutants.

Bethany Elementary School: Location of Public Meeting - 337 Maynard Grayson Road, Clover, SC 29710.

Chemical of Concern (COC): Chemical constituents associated with a Superfund Site that have been released into the environment and pose an unacceptable risk to human health.

Cleanup: Actions taken to deal with a release or threat of release of a hazardous substance that could affect humans and/or the environment. The term "cleanup" is sometimes used interchangeably with the terms remedial action, removal action, response action, or corrective action.

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA): Also known as **Superfund**, is a federal law passed in 1980 and modified in 1986 by the Superfund Amendment and Reauthorization Act (SARA). The act created a trust fund, to investigate and cleanup abandoned or uncontrolled hazardous waste sites.

Feasibility Study (FS): Study conducted after the Remedial Investigation to assess what alternatives or technologies could be applicable to clean up the site-specific COCs.

Five-Year Review: A statutory requirement to evaluate the implementation and performance of a remedy to assess whether the remedy is or will be protective of human health and the environment.

Groundwater: Water located beneath the ground surface in soil pore spaces and in the fractures of lithologic formations.

Human Health Risk Assessment (HHRA): The process used to estimate the nature and probability of adverse health effects in humans who may be exposed to hazards in contaminated environmental media, now or in the future.

Information Repository: A library or other location where documents and data related to a Superfund project are placed to allow public access to the material.

Institutional Controls (ICs): Non-engineered instruments, such as administrative and legal controls, that help to minimize the potential for exposure to contamination and/or protect the integrity of a response action. ICs typically are designed to work by limiting land and/or resource use or by providing information that helps modify or guide human behavior at a site. ICs are a subset of Land Use Controls (LUCs). LUCs include engineering and physical barriers, such as fences and security guards, as well as ICs.

Interim Record of Decision (IROD): A decision document that selects and describes an interim remedy that will be implemented at a Site. The IROD is based on information and technical analysis generated during the remedial investigation/ feasibility study and consideration of public comments.

Monitored Natural Attenuation (MNA): Natural attenuation relies on natural processes to decrease or "attenuate" concentrations of contaminants in soil and groundwater. Conditions are monitored to make sure natural attenuation is working. Monitoring typically involves collecting soil and/or groundwater samples to analyze them for the presence of contaminants and other site characteristics that provide evidence of attenuation. The entire process is called "monitored natural attenuation" or "MNA."

Monitoring: The periodic or continuous surveillance or testing to determine the level of pollutants in various media.

National Oil and Hazardous Substances Pollution Contingency Plan (NCP): The federal regulation that guides the Superfund program. The NCP was revised in February 1990.

Operation and Maintenance (O&M): Activities conducted at sites after cleanup remedies have been constructed to make sure they continue functioning properly.

Permeable Reactive Barrier (PRB): A permeable reactive barrier, or “PRB,” is a wall created below ground to clean up contaminated groundwater. The wall is “permeable,” which means that groundwater can flow through it. Water must flow through the PRB to be treated. The “reactive” materials that make up the wall either trap harmful contaminants or make them less harmful. The treated groundwater flows out the other side of the wall.

Proposed Plan: A Superfund public participation fact sheet that summarizes the preferred cleanup strategy for a Superfund site.

Remedial Action: The actual construction or implementation phase of a Superfund site cleanup that follows remedial design.

Remedial Action Objectives (RAOs): Provide a general description of what the cleanup will accomplish (e.g., restoration of groundwater to drinking water levels). These goals typically serve as the as the basis for developing remedial alternatives.

Remedial Design: The development of engineering drawings and specifications for the implementation and construction of a remedial action.

Remedial Investigation/Feasibility Study (RI/FS): A two-part investigation conducted to assess the nature and extent of a release, or threat of release, of hazardous substances, pollutants, or contaminants, and to identify alternatives for cleanup. The Remedial Investigation gathers the necessary data to support the corresponding Feasibility Study.

Response Action: A CERCLA-authorized action involving either a short-term removal action or a long-term removal response. This may include but is not limited to: removing hazardous materials from a site to an EPA-approved hazardous waste facility for treatment, containment or treating the waste on-site, identifying and removing the sources of groundwater contamination and halting further migration of contaminants.

Responsiveness Summary: A summary of oral and written comments received by EPA during a comment period on key EPA documents, and EPA’s responses to those comments. The responsiveness summary is a key part of the IROD, highlighting community concerns for EPA decision-makers.

South Carolina Department of Health and Environmental Control (SCDHEC): SCDHEC is charged with promoting and protecting the health of the public and the environment in South Carolina.

Superfund: The common name used for CERCLA, the federal law that mandates cleanup of abandoned hazardous waste sites.

To-Be-Considered (TBC): The "to-be-considered" (TBC) category consists of advisories, criteria, or guidance that were developed by EPA, other federal agencies, or states that may be useful in developing cleanup goals for CERCLA remedies. TBCs are not considered legally enforceable and, therefore, are not considered to be applicable for a site but are evaluated along with ARARs as part of the risk assessment to set protective cleanup goals.

Table 1
Human Health Cancer Risks and Non-Cancer Hazards
Barite Hill / Nevada Goldfields Site

Media	Lifetime Carcinogenic Risk	Carcinogenic Risk COCs	Hazard Quotient	Non-Carcinogenic Risk COCs
Current/ Future Trespasser / Recreational				
Soil	1.0×10^{-6}	arsenic cobalt	0.03	arsenic, barium, cobalt, vanadium
Sediment	2.0×10^{-6}	arsenic	0.2	aluminum, arsenic, cadmium, cobalt, copper, iron, manganese, vanadium
Surface Water	4.0×10^{-6}		2	aluminum, arsenic, cadmium, cobalt, copper, iron, lead, manganese, vanadium, zinc, cyanide
Total	8.0×10^{-6}		2	aluminum, antimony, arsenic, beryllium, cadmium, cobalt, copper, iron, lead, manganese, mercury, nickel, selenium, thallium, vanadium, zinc,
Current/Future Industrial / Commercial Worker				
Soil	8.4×10^{-6}	arsenic, cobalt	0.9	arsenic, barium, cobalt, vanadium
Sediment	4.0×10^{-6}	arsenic	0.1	aluminum, arsenic, cadmium, cobalt, copper, iron, manganese, vanadium
Surface Water	1.0×10^{-6}		0.5	aluminum, arsenic, cadmium, cobalt, copper, iron, lead, manganese, vanadium, zinc, cyanide
Groundwater	5.0×10^{-2}		911	aluminum, antimony, arsenic, beryllium, cadmium, cobalt, copper, iron, lead, manganese, mercury, nickel, selenium, thallium, vanadium, zinc,
Total	5.0×10^{-2}		911	
Current / Future Construction Worker				
Soil	1.0×10^{-6}	arsenic, cobalt	0.06	arsenic, barium, cobalt, vanadium
Sediment	3.0×10^{-7}	arsenic	0.2	aluminum, arsenic, cadmium, cobalt, copper, iron, manganese, vanadium
Surface Water	4.0×10^{-8}		0.3	aluminum, arsenic, cadmium, cobalt, copper, iron, lead, manganese, vanadium, zinc, cyanide
Groundwater	6.0×10^{-6}		2	aluminum, antimony, arsenic, beryllium, cadmium, cobalt, copper, iron, lead, manganese, mercury, nickel, selenium, thallium, vanadium, zinc,
Total	7.0×10^{-6}		5	
Future Resident				
Soil	4.0×10^{-5}	arsenic, cobalt	0.4	arsenic, barium, cobalt, vanadium
Sediment	1.0×10^{-5}	arsenic	0.3	aluminum, arsenic, cadmium, cobalt, copper, iron, manganese, vanadium
Surface Water	1.0×10^{-5}		4	aluminum, arsenic, cadmium, cobalt, copper, iron, lead, manganese, vanadium, zinc, cyanide
Groundwater	2.0×10^{-1}		2948	aluminum, antimony, arsenic, beryllium, cadmium, cobalt, copper, iron, lead, manganese, mercury, nickel, selenium, thallium, vanadium, zinc,
Total	2.0×10^{-1}		2952	

Table 2
Ecological and Human Health RGs for Chemicals of Concern
Barite Hill / Nevada Goldfields Site

Ecological Based Remedial Goal		
Chemical of Concern	**Recommended Remedial Goal**	
Pit Lake Water (µg/L)		
Aluminum	86,000[1]	
Copper	14,000[1]	
Iron	30,000[1]	
Pit Lake Water Discharging to the North Tributary (µg/L)	Acute	Chronic
Aluminum (pH 6.5 - 9.0)	750[2]	87[2]
Iron	-	1,000[2]
Cadmium	0.53[3]	0.10[3]
Copper	3.8[3]	2.9[3]

Human Health Based Remedial Goal	
Chemical of Concern	**Recommended Remedial Goal**
Groundwater Discharging Through Seeps to the North Tributary (µg/L)	
Cadmium	5[4]
Cobalt	794[5]
Manganese	50[2]
Pit Lake Water Discharging to the North Tributary (µg/L)	
Cadmium	5[4]
Cobalt	794[5]
Copper	1,300[4]

1. Black & Veatch, 2017 – Baseline Ecological Risk Assessment, Barite Hill OU1
2. EPA, 2006 – National Recommended Water Quality Criteria for Non Priority Pollutants
3. SCDHEC, 2014 – SCR. 61-68, Water Classifications and Standards (acute and chronic values for cadmium and copper are based on total recoverable metals at a hardness of 25 mg/L $CaCO_3$)
4. SCDHEC, 2014 – SCR. 61-68, Water Classifications and Standards (cadmium RG based on maximum contaminant level; copper RG based on human health for consumption of water and organism)
5. Black & Veatch, 2018 – Human Health Risk Assessment, Barite Hill OU1 (residential HQ = 1)

Table 3
Summary of Remedial Alternative Costs
Barite Hill / Nevada Goldfields Site

Contaminated Media Zone and Remedial Alternatives		Total Capital Cost	Total O&M Cost	O&M Period (years)	Total Alternative Cost
CMZ-1, Pit Lake					
Pit Lake #1	No Action	$0	$94,200	30+	$94,200
Pit Lake #2	Drain Lake, Treat, Discharge to SW; Add Amendments to Pit Floor, Backfill Pit	$17,636,097	$142,394	30	$17,778,500
Pit Lake #3	Drain Pit Lake, Treat, Discharge to SW; Cap Pit Floor, Partial Backfill, Create Wetland	$14,394,139	$155,863	30	$14,550,000
Pit Lake #4	Amendments to Pit Lake, Cap Pit Floor	$9,224,251	$91,476	30	$9,315,700
CMZ-2, Waste Rock					
Waste Rock #1	No Action	$0	$91,100	30+	$91,100
Waste Rock #2	Excavate and On-Site Encapsulation of Waste Rock, Backfill Excavation and Cap	$14,258,471	$325,587	30	$14,584,100
Waste Rock #3	Amendments to Waste Rock, Enhance Existing Caps	$4,400,646	$79,079	30	$4,479,700
CMZ-3, OU1 Groundwater					
Groundwater #1	No Action	$0	$122,200	30+	$122,200
Groundwater #2A	Groundwater Diversion - Barrier Wall and Grout Curtain	$7,432,326	$74,495	30	$7,506,800
Groundwater #2B	Groundwater Diversion - Hydraulic Barrier	$1,995,286	$1,525,832	30	$3,521,100
Groundwater #3	Groundwater In-Situ Neutralization	$1,467,917	$5,253,119	30	$6,721,000

Table 5
ARARs
Barite Hill / Nevada Goldfields Site

The key chemical-specific ARARs for the Pit Lake are:

Action/Media	Requirements	Prerequisite	Citation(s)
Protection of surface water	Freshwaters (FW) are freshwaters suitable for primary and secondary contact recreation and as a source for drinking water supply after conventional treatment in accordance with the requirements of the Department. Suitable for fishing and the survival and propagation of a balanced indigenous aquatic community of fauna and flora. Suitable also for industrial and agricultural uses.	Surface waters classified as Class FW (fresh waters) – **relevant and appropriate**	SC R. 61-68.G.10
	Quality Standards for FW: b. No treated wastes, toxic wastes, deleterious substances, colored or other wastes, alone or in combination with other substances or wastes, in sufficient amounts to make the waters unsafe or unsuitable for primary contact recreation or to impair the waters for any other best usage as determined for the specific waters which are assigned to this class. c. Toxic pollutants listed in the *Appendix* [in SC R. 61-68] must meet the standards as prescribed in Section E of this regulation.		SC R. 61-68.G.10.b and c
	All ground waters and surface waters of the State shall at all times, regardless of flow, be free from: (d) High temperature, toxic, corrosive, or deleterious substances attributable to sewage, industrial waste, or other waste in concentrations or combinations which interfere with classified water uses, existing water uses, or which are harmful to human, animal, plant or aquatic life.		SC R. 61-68.E.5(d)

Action/Media	Requirements	Prerequisite	Citation(s)
	Numeric criteria for the protection and maintenance of all classes of surface waters are adopted and are listed in Sections E, G, and the *Appendix*. b. Application of numeric criteria to protect human health. (1) If separate numeric criteria are given for organism consumption, water and organism consumption (W/O), and drinking water Maximum Contaminant Levels (MCLs), they shall be applied as appropriate. The *most stringent* of the criteria *shall be applied* to protect the existing and classified uses of the waters of the State.		SC R. 61-68.E.14.b.
	Numerical water quality standards (maximum permissible levels): • • - Cadmium = 5 µg/L (MCL) • - Copper = 1300 µg/L (W/O)		SC R. 61-68. *Appendix:* Water Quality Criteria for Protection of Aquatic Life and Human Health
Protection of Surface Water *(discharges of pit water in spillway overflow event)*	Any discharge into waters of the State must be permitted by the Department and receive a degree of treatment and/or control which shall produce an effluent which is consistent with the Act, the Clean Water Act (P.L. 92-500, 95-217, 97-117, 100-4), this regulation, and related regulations. *Note:* Under CERCLA Section 121(e) permits are not required for on-site response actions. Instead discharges must meet any applicable effluent limits or other substantive requirements to protect the water quality of the receiving water.	Discharge of pollutants (including toxic substances) into waters of the State– **relevant and appropriate**	SCDHEC R. 61-68E.4.a

The key action-specific ARARs for the Pit Lake are:

Action	Requirements	Prerequisite	Citation
General Construction Standards — All Land-disturbing Activities (i.e., excavation, clearing, grading, etc.)			
Managing storm water runoff from land-disturbing activities	Must comply with the substantive requirements for stormwater management and sediment control of *NPDES Construction General (CG) Permit for Stormwater Discharges No. SCR100000, issued under R.122.8 and developed consistent with the conditions in R.61-9.122.41 applicable to all permits*.	Large and small construction activities (as defined in R. 61-9 and SCR100000) of more than 1 acre of land – **applicable**	SCDHEC R. 61-9.122.41 and 122.28(a)(2)(i)

Action	Requirements	Prerequisite	Citation
	Coverage under the CG Permit requires development of a stormwater management and sediment control plan which is to be consistent, at a minimum, to the substantive standards listed in SC Regulation 72-300, unless specifically exempted by SC Regulation 72-302.A	Large and small construction activities (as defined in R. 61-9 and SCR100000) of more than 1 acre of land – **TBC**	*NPDES Construction General (CG) Permit for Stormwater Discharges*, Permit No. SCR100000
	The stormwater management and sediment control plan shall contain at a minimum the information provided in the following subsections: • A plan for temporary and permanent vegetative and structural erosion and sediment control measures which specify the erosion and sediment control measures to be used during all phases of the land disturbing activity and a description of their proposed operation; • Provisions for stormwater runoff control during the land disturbing activity and during the life of the facility meeting the peak discharge rate and velocities requirements in subsections (e)1. and (e)2. of this section.	Activities involving more than two (2) acres and less than five (5) acres of actual land disturbance which are not part of a larger common plan of development or sale – **applicable**	SCDHEC R. 72-307I(3)(d) and (e) – *South Carolina Storm Water Management and Sediment Reduction Regulations*
Managing fugitive dust emissions from land disturbing activities	Emissions of fugitive particulate matter shall be controlled in such a manner and to the degree that it does not create an undesirable level of air pollution. Volatile organic compounds shall not be used for dust control purposes. Oil treatment is also prohibited.	Activities that will generate fugitive particulate matter (Statewide) – **applicable**	SCDHEC R. 61-62.6 Section III(a)- *Control of Fugitive Particulate Matter Statewide* SCDHEC R. 61-62.6 Section III(d)
Waste treatment and disposal - e.g., contaminated soils, wastewaters, monitoring well purge water			
Disposal of solid waste	Shall ultimately dispose of solid waste at facilities and/or sites permitted or registered by the	Generation of solid waste intended for off-site disposal –	SCDHEC R. 61-107.5(D)(3)

Action	Requirements	Prerequisite	Citation
	Department for processing or disposal of that waste stream.	**relevant and appropriate**	
Land disposal of RCRA-hazardous waste	May be land disposed if it meets the requirements in the table "Treatment Standards for Hazardous Waste" at § 268.40 before land disposal.	Land disposal, as defined in 40 CFR 268.2, of restricted RCRA waste – **applicable**	40 CFR 268.40(a) SCDHEC R. 61-79 §268.40*(a)*
	All underlying hazardous constituents (as defined in 268.2(i)) must meet the Universal Treatment Standards, found in § 268.48, Table Universal Treatment Standards, prior to land disposal as defined in § 268.2(c).	Land disposal of restricted RCRA characteristic wastes (D001-D043) that are not managed in a wastewater treatment system that is regulated under the CWA, that is CWA equivalent, or that is injected into a Class I nonhazardous injection well – **applicable**	40 CFR 268.40(e) SCDHEC R. 61-79 §268.40*(e)*
	Must be treated according to the alternative treatment standards in 268.49(c) **<u>or</u>** must be treated according to the Universal Treatment Standards (UTS) [specified in 268.48 Table UTS] applicable to the listed and/or characteristic waste contaminating the soil prior to land disposal.	Land disposal, as defined in 40 CFR 268.2, of restricted hazardous soils – **applicable**	40 CFR 268.49(b) SCDHEC R. 61-79 268.49*(b)*
	To determine whether a hazardous waste identified in this section exceeds the applicable treatment standards of 40 CFR 268.40, the initial generator must test a sample of the waste extract or the entire waste, depending on whether the treatment standards are expressed as concentration in the waste extract or waste, or the generator may use knowledge of the waste. If the waste contains constituents (including UHCs in the characteristic wastes) in excess of the applicable UTS levels in 40 CFR 268.48, the waste is prohibited from land disposal, and all requirements of part 268 are applicable, except as otherwise specified.	Land disposal of RCRA toxicity characteristic wastes (D004-D011) that are newly identified (i.e., wastes or soil identified by the TCLP but not the Extraction Procedure) – **applicable**	40 CFR 268.34(f) SCDHEC R. 61-79 268.34*(f)*
Discharge of Wastewater from On-Site Groundwater or Surface Water Treatment Unit			
Disposal of wastewaters into CWA	Wastes that are hazardous only because they exhibit a hazardous characteristic, and which are otherwise prohibited under this part, are not	Restricted RCRA characteristic hazardous	40 CFR §268.1(c)(4)

Action	Requirements	Prerequisite	Citation
wastewater treatment unit	prohibited [from land disposal] if the waste meet any of the following criteria, unless the wastes are subject to a specified method of treatment other than DEACT in §268.40, or are D003 reactive cyanide: (i) The wastes are managed in a treatment system which subsequently discharges to waters of the U.S. pursuant to a permit issued under section 402 of the Clean Water Act [SC R.61-9 and R. 61-68]; or (ii) The wastes are treated for purposes of the pretreatment requirements of section 307 of the Clean Water Act [SC R. 61-9 and R.61-68]; or (iii) The wastes are managed in a zero discharge system engaged in Clean Water Act-equivalent treatment as defined in 268.37(a); and (iv) The wastes no longer exhibit a prohibited characteristic at the point of land disposal (i.e., placement in a surface impoundment).	wastewaters managed in a wastewater treatment system —**applicable**	SCDHEC R. 61-79 §268.1(c)(4)
Monitoring requirements for discharges from on-site WWTU	To measure compliance with effluent limitations, must monitor, as provided in subsections (i) thru (iv) of 122.44(i)(1). *NOTE: Monitoring parameters, including frequency of sampling, will be developed as part of the CERCLA process and included in a Remedial Design, Remedial Action Work Plan, or other appropriate CERCLA document.*	Discharge of pollutants to surface waters – **applicable**	40 CFR §122.44(i)(1)
Transportation of Wastes			
Transportation of hazardous waste *on-site*	The generator manifesting requirements of §262.20 and §262.32(b) do not apply. Generator or transporter must comply with the requirements set forth in §§263.30 and 263.31 in the event of a discharge of hazardous waste on a private or public right-of-way.	Transportation of hazardous wastes on public or private right-of-way within or along the border of contiguous property under control of same person – **applicable**	40 CFR §262.20(f) SCDHEC R. 61-79 §262.20*(f)*
Transportation of samples (i.e. solid waste, soils and wastewaters)	Are not subject to any requirements of 40 CFR Parts 261 through 268 or 270 when: • the sample is being transported to a laboratory for the purpose of testing; or • the sample is being transported back to the sample collector after testing. • the sample is being stored by sample collector before transport to a lab for testing.	Samples of solid waste <u>or</u> a sample of water, soil for purpose of conducting testing to determine its characteristics or composition – **applicable**	40 CFR §261.4(d)(1)(i)-(iii) SCDHEC R. 61-79 §261.4*(d)* (1)

Action	Requirements	Prerequisite	Citation
	In order to qualify for the exemption in 40 CFR 261.4 (d)(1)(i) and (ii), a sample collector shipping samples to a laboratory must: • Comply with U.S. DOT, U.S. Postal Service, or any other applicable shipping requirements. • Assure that the information provided in (1) thru (5) of this section accompanies the sample. • Package the sample so that it does not leak, spill, or vaporize from its packaging.		40 CFR 261.4(d)(2) 40 CFR 261.4(d)(2)(ii)(A) and (B) SCDHEC R. 61-79 261.4*(d)*(2)(ii)(A) and (B)

The key location-specific ARARs for the Pit Lake are:

Location Characteristic(s)	Requirements	Prerequisite	Citation(s)
Location encompassing aquatic ecosystem as defined in 40 *CFR* 230.3(c)	Except as provided under CWA §404(b)(2), no discharge of dredged or fill material is permitted if there is a practicable alternative that would have less adverse impact on the aquatic ecosystem or if it will cause or contribute to significant degradation of the waters of the United States.	Actions that involves discharge of dredged or fill material into *waters of the United States* including jurisdictional wetlands – **relevant and appropriate**	40 *CFR* 230.10(a) and (c)
	Except as provided under CWA §404(b)(2), no discharge of dredged or fill material shall be permitted unless appropriate and practicable steps have been taken that will minimize potential adverse impacts of the discharge on the aquatic ecosystem. 40 CFR 230.70 et seq. identifies such possible steps.		40 CFR 230.10(d)
Nationwide Permit Program	Must comply with the substantive requirements of the NWP 38, General Conditions, as appropriate.	Discharge of dredged or fill material into *waters of the United States*, including jurisdictional wetlands – **relevant and appropriate**	Nationwide Permit (38) – Cleanup of Hazardous and Toxic Waste 33 *CFR* 323.3(b)
Presence of wetlands	Requires Federal agencies to evaluate action to minimize the destruction, loss or degradation of	Actions that involve potential impacts to, or	Executive Order 11990 – *Protection*

Location Characteristic(s)	Requirements	Prerequisite	Citation(s)
	wetlands and to preserve and enhance beneficial values of wetlands.	take place within, wetlands – **TBC**	*of Wetlands* - Section 1(a)
Presence of floodplains	Shall consider alternatives to avoid, to the extent possible adverse effects and incompatible development in the floodplain.	Federal actions that involve potential impacts to, or take place within, floodplains –**TBC**	Executive Order 11988- *Floodplain Management* Section 2.(a)(2)

December 8, 2010

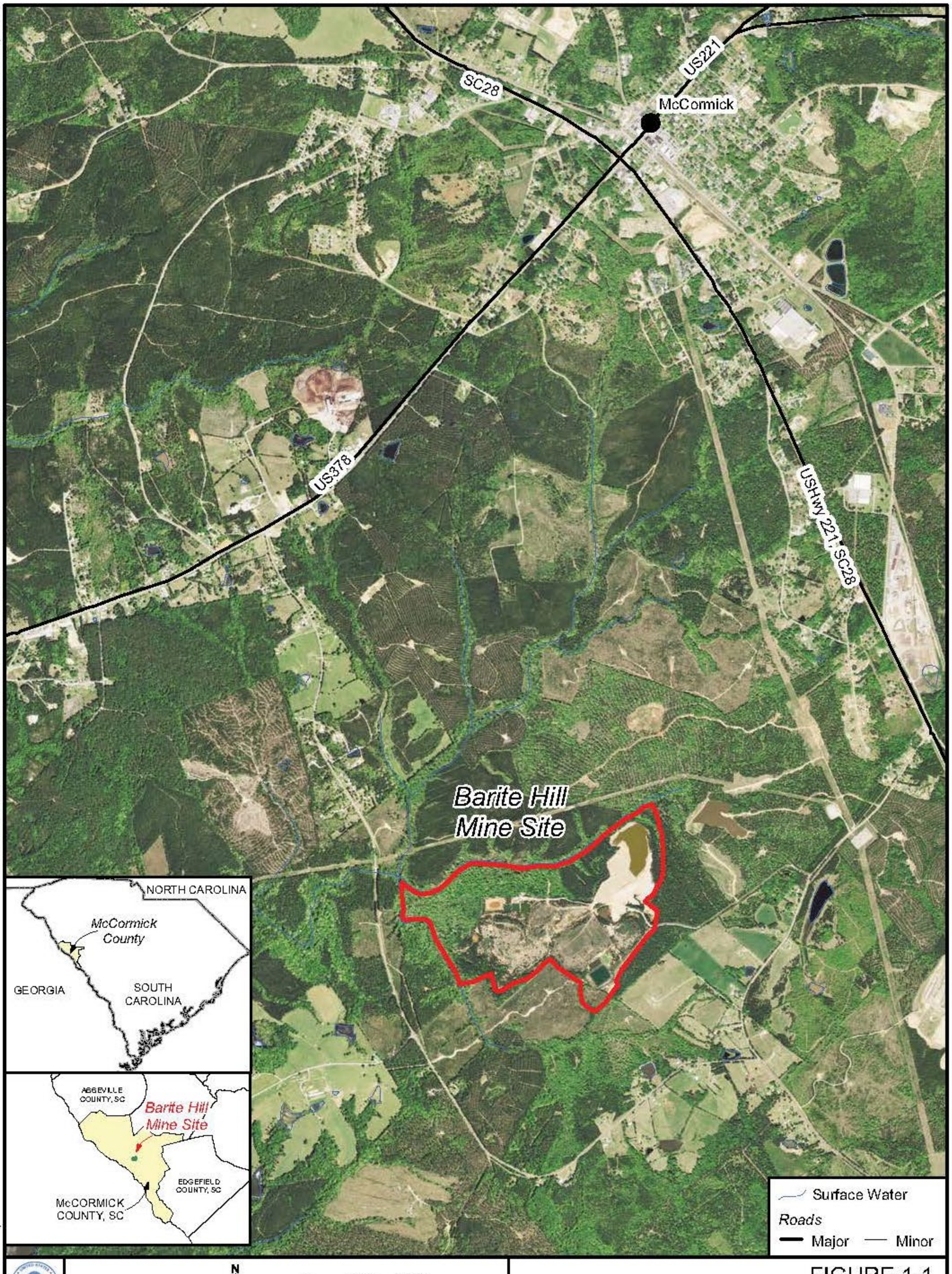

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FIGURE 1-1
Barite Hill Mine Site Location
McCormick County, South Carolina

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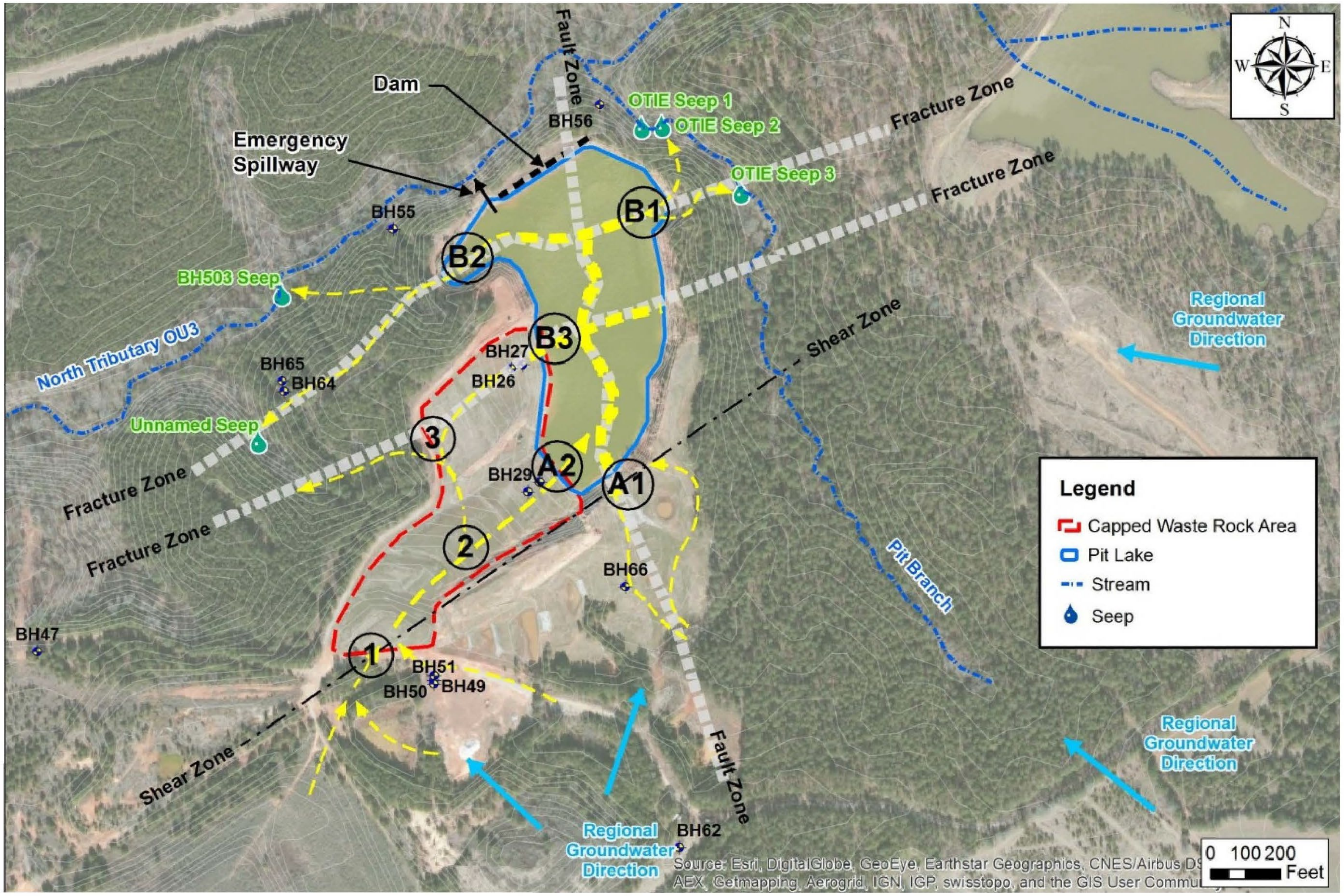

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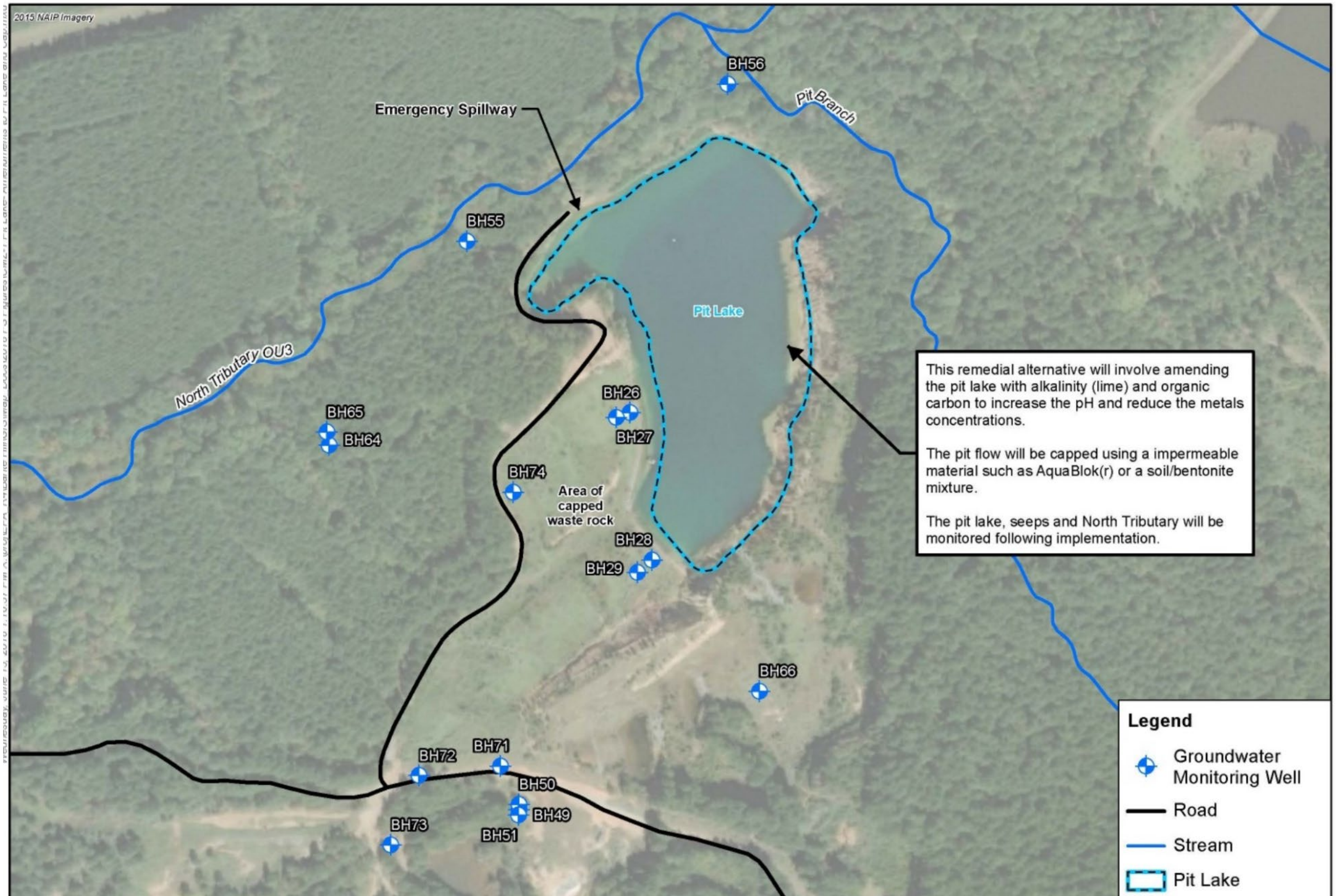
willowstick

Figure 2-2

Willowstick Investigation Results - After Willowstick (2017)

Barite Hill Mine, McCormick County, South Carolina



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0 300 600

Feet

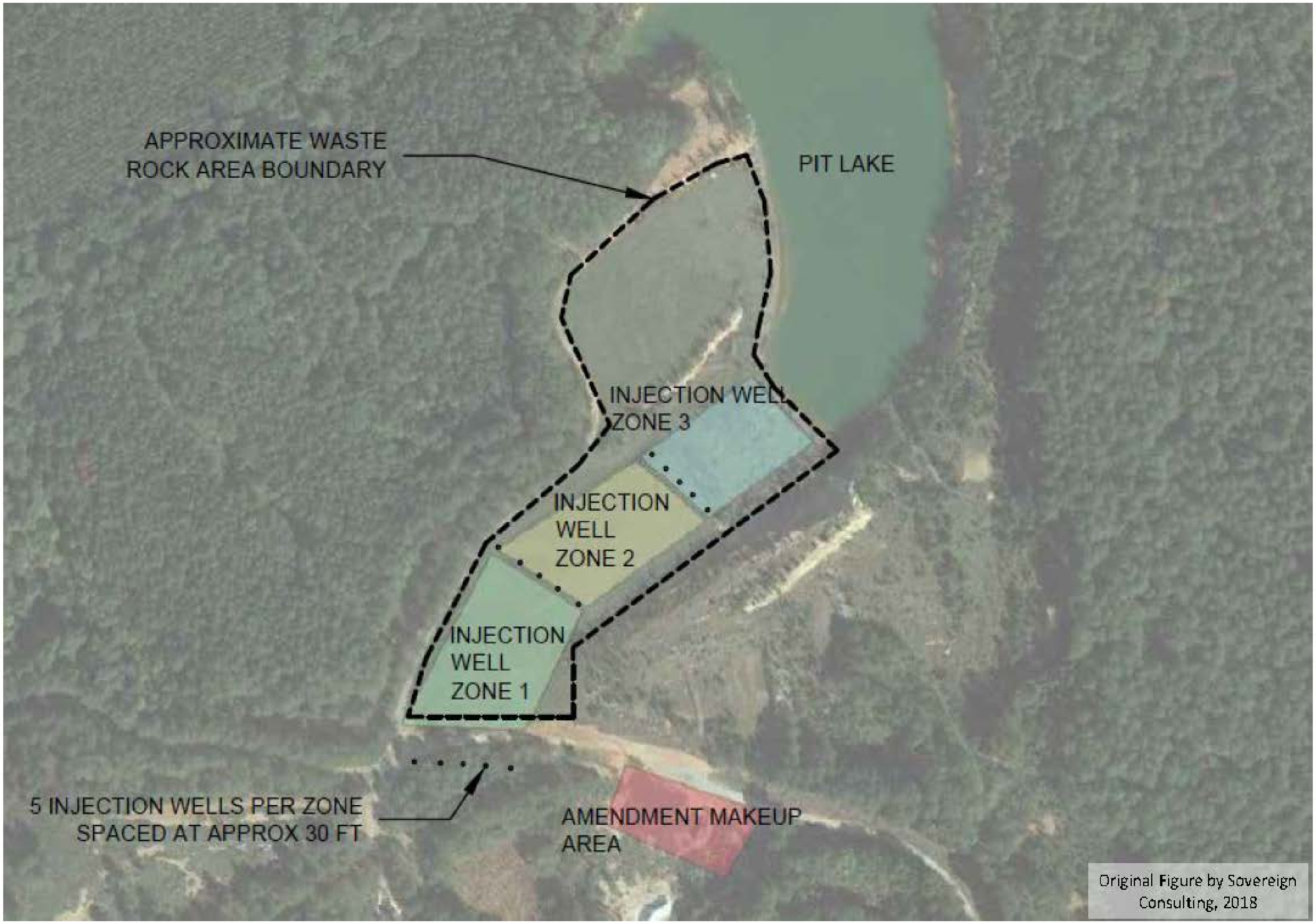
NAD83 State Plane South Carolina, Feet

FIGURE 5-3

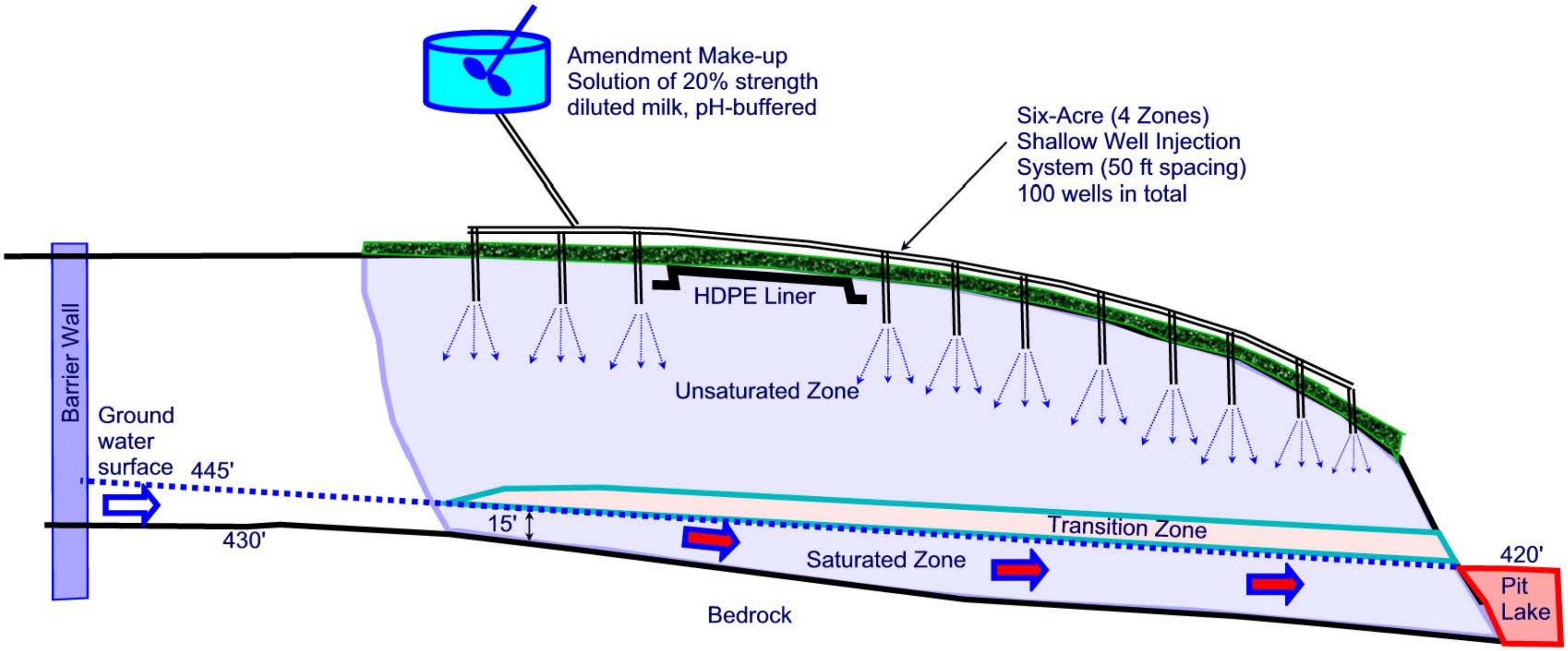
CMZ-1 Pit Lake #4:

Amendments to Pit Lake and Cap Pit Floor

Barite Hill Mine, McCormick County, South Carolina



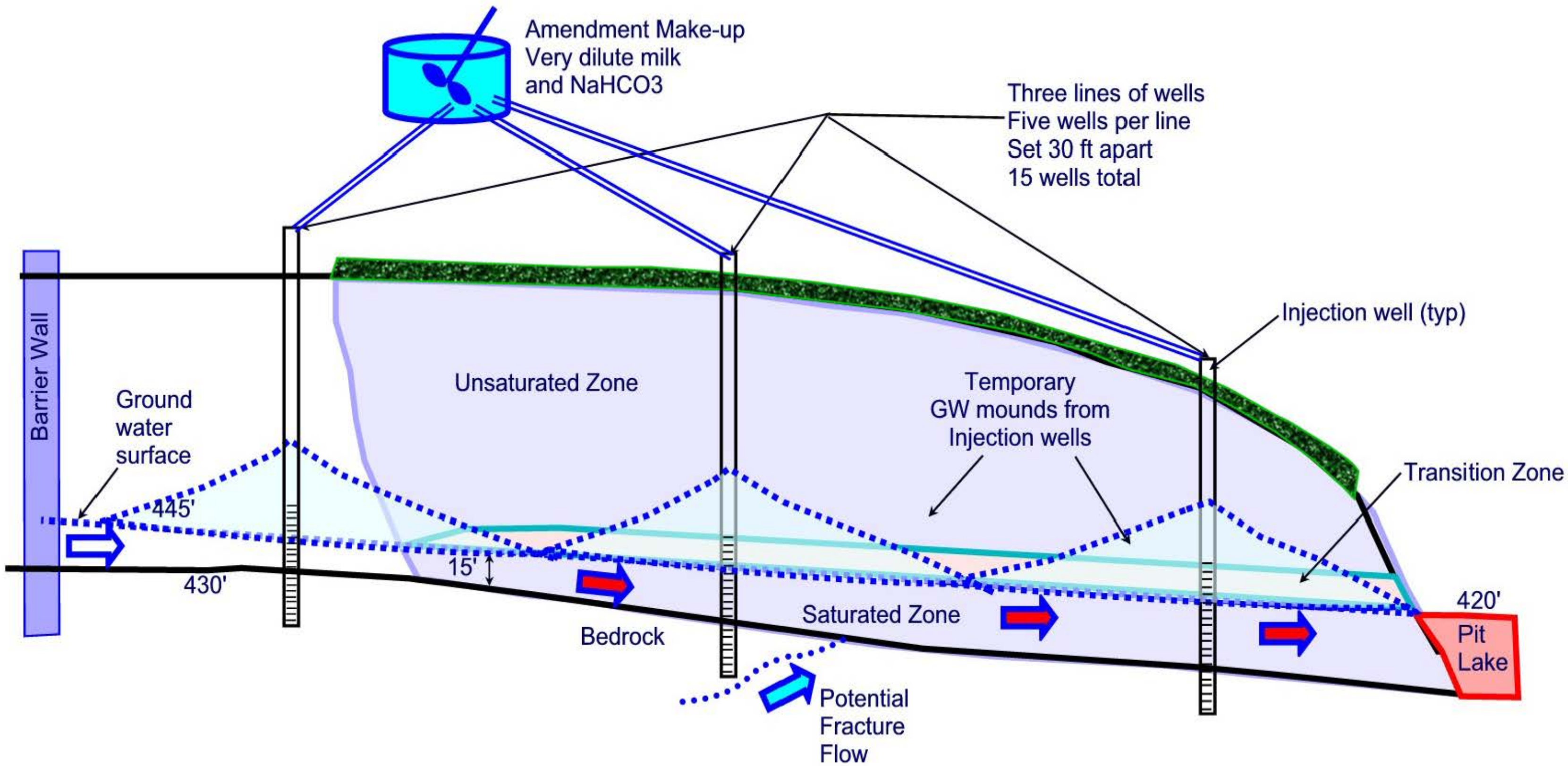
	Barite Hill Goldfields Site McCormick County, South Carolina	CMZ-2, Waste Rock 3 Deep Injection Well Plan View	Figure 5-5a



Original Figure by Sovereign Consulting, 2018

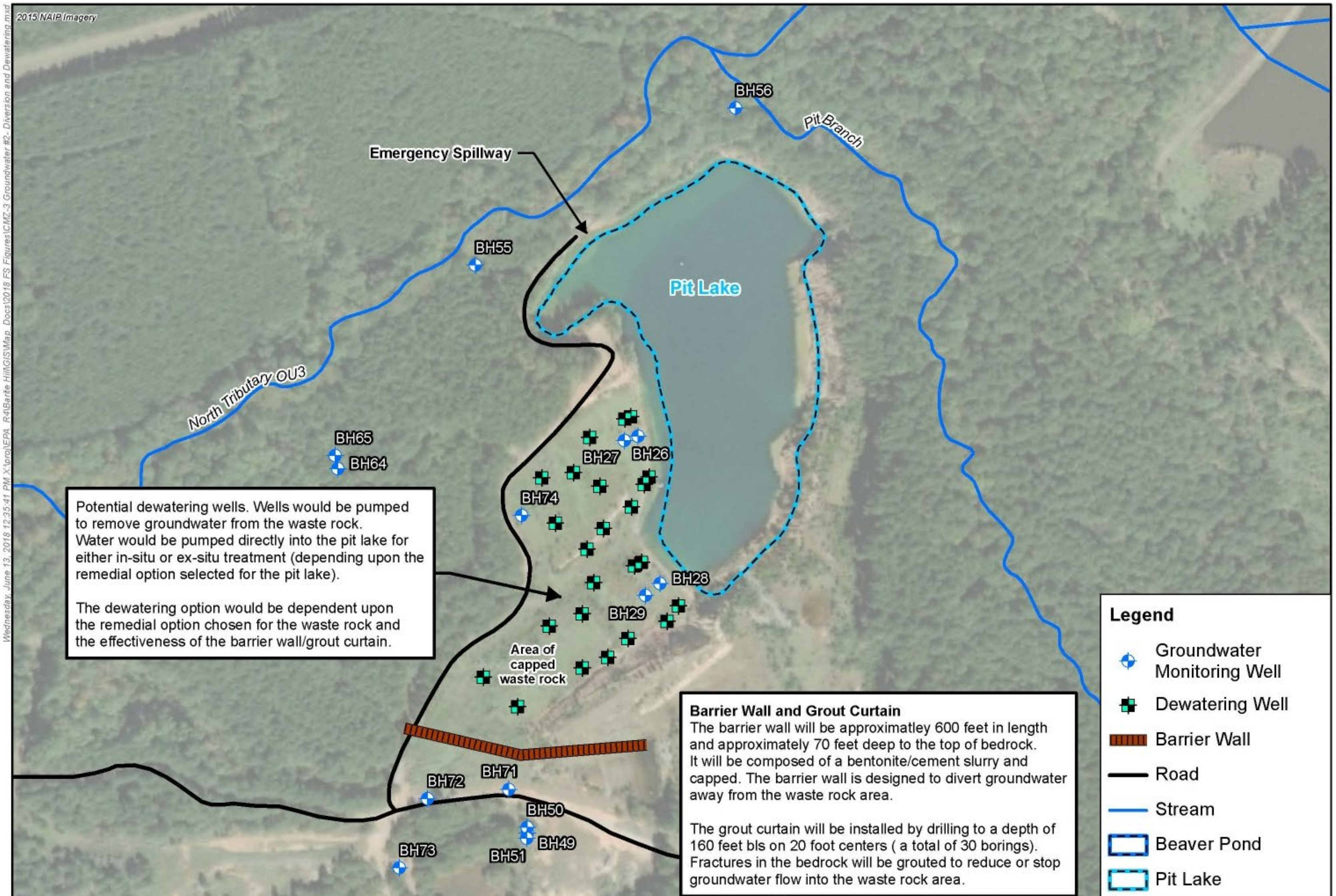
	Barite Hill Goldfields Site McCormick County, South Carolina	CMZ-2, Waste Rock 3 Shallow Injection Well Schematic	Figure 5-5d

Barite Hill Goldfields Site McCormick County, South Carolina	CMZ-2, Waste Rock 3 Shallow Injection Well Plan View	Figure 5-5c



Original Figure by Sovereign Consulting, 2018

Barite Hill Goldfields Site McCormick County, South Carolina	CMZ-2, Waste Rock 3 Deep Injection Well Schematic	Figure 5-5b



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Feet

NAD83 State Plane South Carolina, Feet

FIGURE 5-6a

CMZ-3 Groundwater #2A:

Groundwater Diversion and Dewatering of the Capped Waste Rock

Barite Hill Mine, McCormick County, South Carolina

USE THIS SPACE TO WRITE YOUR COMMENTS

Your input on the Interim Proposed Plan for the Barite Hill / Nevada Goldfields Superfund Site is important in helping EPA to select a remedy for the Site. Use the space below to write your comments, then fold and mail. A response to your comment will be included in the Responsiveness Summary.

BARITE HILL / NEVADA GOLDFIELDS SUPERFUND SITE

PUBLIC COMMENT SHEET

Place

Stamp

Name___________________________

Address____

City_______________State_______Zip___________

Candice Teichert, Remedial Project Manager
U.S. EPA, Region 4
Superfund Restoration and Sustainability Branch
Superfund and Emergency Management Division
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