Five-Year Review Report

First Five-Year Review Report
for
Brewer Gold Mine Superfund Site
EPA ID SCD987577913

Jefferson
Chesterfield, South Carolina

September 2011

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For:
United States Environmental Protection Agency
Region 4
Atlanta, Georgia

Approved by: _____

Franklin E. Hill
Director, Superfund Division

Date: 9/13/2011

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1/2 mile north of intersection of SR 265 and CR110
Jefferson
Chesterfield, South Carolina

List of Acronyms

AOC	Administrative Order on Consent
ARAR	Applicable or Relevant and Appropriate Requirement
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CIC	Community Involvement Coordinator
EPA	United States Environmental Protection Agency
FYR	Five-Year Review
gpm	gallons per minute
lb/MG	pounds per million gallons
MCL	Maximum Contaminant Level
mg/L	milligrams per liter
NA	not available
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
O&M	Operation and Maintenance
OU	Operable Unit
PRP	Potentially Responsible Party
RAO	Remedial Action Objective
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RPM	Remedial Project Manager
SARA	Superfund Amendments and Reauthorization Act
SCDHEC	South Carolina Department of Health and Environmental Control
TBC	To-Be-Considered

Executive Summary

Introduction

The Brewer Gold Mine site (the Site) is located in a rural area about one mile west of the Town of Jefferson in Chesterfield County, South Carolina. The Site is approximately 1,000 acres in size; about 230 acres were disturbed by gold and topaz mining and processing. These operations occurred intermittently from 1828 to 1995. From 1987 through 1995, the Brewer Gold Company mined over 12 million tons of ore and waste rock from several open pits. The company crushed ore and placed it in large heaps on one of several plastic-lined surfaces called pads. A dilute solution of sodium cyanide was then applied to the surface of the heaps and it dissolved the gold and silver as it trickled through the heaps. The company collected the solution at the bottom of the heaps and recovered the gold in an on-site plant. In 1990, following large rainstorms, a dam broke and allowed over 10 million gallons of stored cyanide solution to flow into Little Fork Creek. The solution resulted in a fish kill in the Creek and a 50-mile stretch of the Lynches River. The United States Environmental Protection Agency (EPA) and the South Carolina Department of Health and Environmental Control (SCDHEC) responded to the emergency. Following the release, SCDHEC conducted an assessment of impacts to aquatic macroinvertebrates in Little Fork Creek, Fork Creek and the Lynches River, the results of which were compared to an assessment conducted in 1988. After that time, macroinvertebrate studies were conducted annually through 2001 to monitor recovery of the insect population in the affected streams. The overflow plastic-lined pond and dam were redesigned and reconstructed and the mine resumed normal operation in 1991.

In 1995, the most recent owner/operator notified SCDHEC of its intent to close its operations and SCDHEC issued an Administrative Order on Consent (AOC) that required state-approved closure and reclamation. Following reclamation, the owner abandoned the Site and a wastewater treatment plant in 1999. The State requested EPA assistance in continuing to operate the wastewater treatment plant, which treated ground water and surface water contaminated with acidity and heavy metals. EPA took control of the plant under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) removal authority. The Site was placed on the National Priorities List (NPL) in April 2005, which shifted responsibility for the plant from EPA's Emergency Response Program to the Remedial Program. An interim Record of Decision (ROD) was signed in September 2005 recommending continued treatment of the contaminated water. EPA then initiated a sitewide remedial investigation/feasibility study (RI/FS) to identify and evaluate a permanent remedy. The triggering action for this Five-Year Review (FYR) is the start of the remedial action on September 14, 2006.

Interim Remedial Action Objectives

On September 29, 2005, EPA issued the interim ROD, which included an interim remedy to minimize the amount of contamination reaching Little Fork Creek through controlling contaminants released to surface water. The following interim action objectives were established for the Site:

- Meet and sustain South Carolina water quality standards for protection of human health in Little Fork Creek.
- Meet and sustain National Water Quality Criteria for human consumption of water and organisms in Little Fork Creek.

Technical Assessment

The review of documents, risk assumptions and the site inspection indicate that the remedy is functioning as intended by the interim ROD. The pump-and-treat system, which maintains water within the backfilled pits at an elevation that prohibits some seeps from discharging and permits others to be captured and treated, prevents most impacts to Little Fork Creek. Weekly effluent sampling was reduced to monthly sampling and annual macroinvertebrate sampling was discontinued in 2001 to reduce costs. Monthly and daily maximum discharge data from September 2006 to May 2011 (available in Appendix G) at Little Fork Creek showed only a single exceedance of the daily maximum for aluminum during May 2007 and a single exceedance in the monthly average (August 2007) as well as the daily maximum for selenium in May 2007. There were no other exceedances. The 2010 RI indicated that the pump-and-treat system was constructed of salvaged and jury-rigged parts in the mid-1990s and was intended to operate for only a year or two; it has now operated for over 10 years. The plant generates an iron-rich sludge that is periodically dredged from the Northwest Trend pit and air-dried prior to stockpiling; air-drying occurs on unprepared surfaces and is effective but inefficient. Operation and Maintenance (O&M) costs have also risen due to higher electricity costs. The interim remedy is progressing as expected and a final remedy is anticipated to be selected in November 2011.

Conclusion

The remedy at the Site is expected to be protective of human health and the environment upon completion. In the interim, exposure pathways that could result in unacceptable risks are being controlled. Contaminated seep water and ground water are captured, treated and discharged to Little Fork Creek.

Five-Year Review Summary Form

SITE IDENTIFICATION

Site name *(from WasteLAN)*: Brewer Gold Mine

EPA ID *(from WasteLAN)*: SCD987577913

Region: 4	**State:** SC	**City/County:** Jefferson/Chesterfield

SITE STATUS

NPL status: ☒ Final ☐ Deleted ☐ Other (specify)

Remediation status (choose all that apply): ☐ Under Construction ☒ Operating ☐ Complete

Multiple OUs?* ☒ YES ☐ NO | **Construction completion date:** N/A

Has site been put into reuse? ☐ YES ☒ NO

REVIEW STATUS

Lead agency: ☒ EPA ☐ State ☐ Tribe ☐ Other Federal Agency

Author name: Johnny Zimmerman-Ward and Sarah Alfano (Reviewed by EPA)

Author title: Associates | **Author affiliation: Skeo Solutions**

Review period**: 05/06/2011 to 09/14/2011

Date(s) of site inspection: 06/07/2011

Type of review:

☒ Post-SARA ☐ Pre-SARA ☐ NPL-Removal only
☐ Non-NPL Remedial Action Site ☐ NPL State/Tribe-lead
☐ Regional Discretion

Review number: ☒ 1 (first) ☐ 2 (second) ☐ 3 (third) ☐ Other (specify)

Triggering action:

☒ Actual RA On-site Construction at OU# 1 ☐ Actual RA Start at OU#
☐ Construction Completion ☐ Previous Five-Year Review Report
☐ Other (specify)

Triggering action date *(from WasteLAN)*: 09/14/2006

Due date *(five years after triggering action date)*: 09/14/2011

* ["OU" refers to operable unit.]

** [Review period should correspond to the actual start and end dates of the Five-Year Review in WasteLAN.]

Five-Year Review Summary Form (continued)

Issue:
1. Institutional Controls are not in place to ensure long-term protectiveness.

Recommendation:
1. As part of the selection of the final remedy, identify the Institutional Controls necessary to prevent exposure to contaminated media and to protect the integrity of the remedy in the long-term; measures to restrict access to the Site have been taken to ensure short-term protectiveness until the final remedy is selected and Institutional Controls can be implemented by a future owner.

Protectiveness Statement:
The remedy at the Site is expected to be protective of human health and the environment upon completion. In the interim, exposure pathways that could result in unacceptable risks are being controlled. Contaminated seep water and ground water are captured, treated and discharged to Little Fork Creek.

Other Comments:
None.

Environmental Indicators
- Current human exposures at the Site are under control.
- There are insufficient data to determine migration control status.

Are Necessary Institutional Controls in Place?
☐ All ☐ Some ☒ None
Institutional control requirements will be assessed when the final remedy is selected.

Has the Site Been Designated as Sitewide Ready for Anticipated Use?
☐ Yes ☒ No

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1.0 Introduction

The purpose of a Five-Year Review (FYR) is to evaluate the implementation and performance of a remedy in order to determine if the remedy will continue to be protective of human health and the environment. The methods, findings and conclusions of FYRs are documented in FYR reports. In addition, FYR reports identify issues found during the review, if any, and document recommendations to address them.

The United States Environmental Protection Agency (EPA) prepares FYRs pursuant to the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Section 121 and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). CERCLA Section 121 states:

> "If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews."

EPA interpreted this requirement further in the NCP; 40 Code of Federal Regulations (CFR) Section 300.430(f)(4)(ii), which states:

> "If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such actions no less often than every five years after the initiation of the selected remedial action."

Skeo Solutions, an EPA Region 4 contractor, conducted the FYR and prepared this report regarding the remedy implemented at the Brewer Gold Mine site (the Site) in Jefferson, Chesterfield, South Carolina. This FYR was conducted from May to September 2011. EPA is the lead agency for developing and implementing the remedy for the Superfund-financed cleanup at the Site. The South Carolina Department of Health and Environmental Control (SCDHEC), as the support agency representing the State of South Carolina, has reviewed all supporting documentation and provided input to EPA during the FYR process.

This is the first FYR for the Site. The triggering action for this statutory review is the on-site construction start date of the interim remedial action. The FYR is required due to the fact that hazardous substances, pollutants or contaminants remain at the Site above levels that allow for

unlimited use and unrestricted exposure. The Site consisted of one operable unit (OU) at the time of the interim ROD, which is addressed in this FYR.

2.0 Site Chronology

Table 1 lists the dates of important events for the Site.

Table 1: Chronology of Site Events

Event	Date
Potentially Responsible Party (PRP) caused a release of hazardous substances via on site dam failure and triggered first EPA Emergency Response Action.	November 1990
EPA issued Unilateral Administrative Order	November 11, 1990
PRP completed removal action	November 30, 1991
SCDHEC conducted preliminary investigation	April 19, 1994
EPA conducted administrative/voluntary cost recovery	September 9, 1994
SCDHEC Administrative Order on Consent (AOC)	1995
EPA initiated second emergency response	December 2, 1999
EPA began removal action	December 12, 1999
SDHEC began expanded site inspection	February 8, 2000
SDHEC completed expanded site inspection	September 25. 2001
EPA began first remedial investigation/feasibility study (RI/FS) for OU1	July 30, 2002
EPA began second RI/FS for OU1	September 29, 2003
EPA proposed Site for listing on National Priorities List (NPL)	September 23, 2004
EPA finalized Site on NPL	April 27, 2005
EPA began remedial design for OU1	September 20, 2005
EPA completed focused RI/FS for OU1 EPA issued interim ROD for OU1	September 29, 2005
EPA completed remedial design for OU1	June 16, 2006
EPA began OU1 remedial action	September 14, 2006
EPA completed removal action	November 30, 2006
EPA completed second sitewide RI	December 2010

3.0 Background

3.1 Physical Characteristics

The approximately 1,000-acre Site is located off Hilton Road in a rural area of Chesterfield County, about four miles west of the Town of Jefferson, one half-mile mile north of the intersection of SR 265 and CR 110, in north-central South Carolina (Figure 1). About 230 acres were disturbed by gold and topaz mining and processing. The Site includes two property parcels: Chesterfield County parcel #026 000 000 013 and Chesterfield County parcel #026 000 000 014.

The Site is bounded to the east by Little Fork Creek, a tributary to Lynches River, to the north and west by private land, and to the south by State Highway 265. The Site is located in a rural residential area that is mostly wooded and undeveloped. Little Fork Creek enters Lynches River approximately two miles downstream of the Site. About 25 miles downstream of the Site, an extended reach of Lynches River has been designated as a State Scenic River.

The Site is located in the Piedmont Province of South Carolina, an area characterized by rolling hills and incised rivers and streams. The boundary between the Piedmont and Coastal Plain provinces lies about one mile east of the Site. The former mine is situated atop a broadly rounded hill with an elevation of about 600 feet above mean sea level. The hilltop stands 150 to 200 feet above the surrounding terrain. Relief in the area surrounding the mine is steep, with slopes of 20 to 30 percent occurring on the northwest and east sides of the hill. Little Fork Creek is deeply incised along the eastern margin of the hill and two deeply incised, unnamed streams drain the northeast and western slopes of the mine. On-site buildings include an office building, truck shop and sheds.

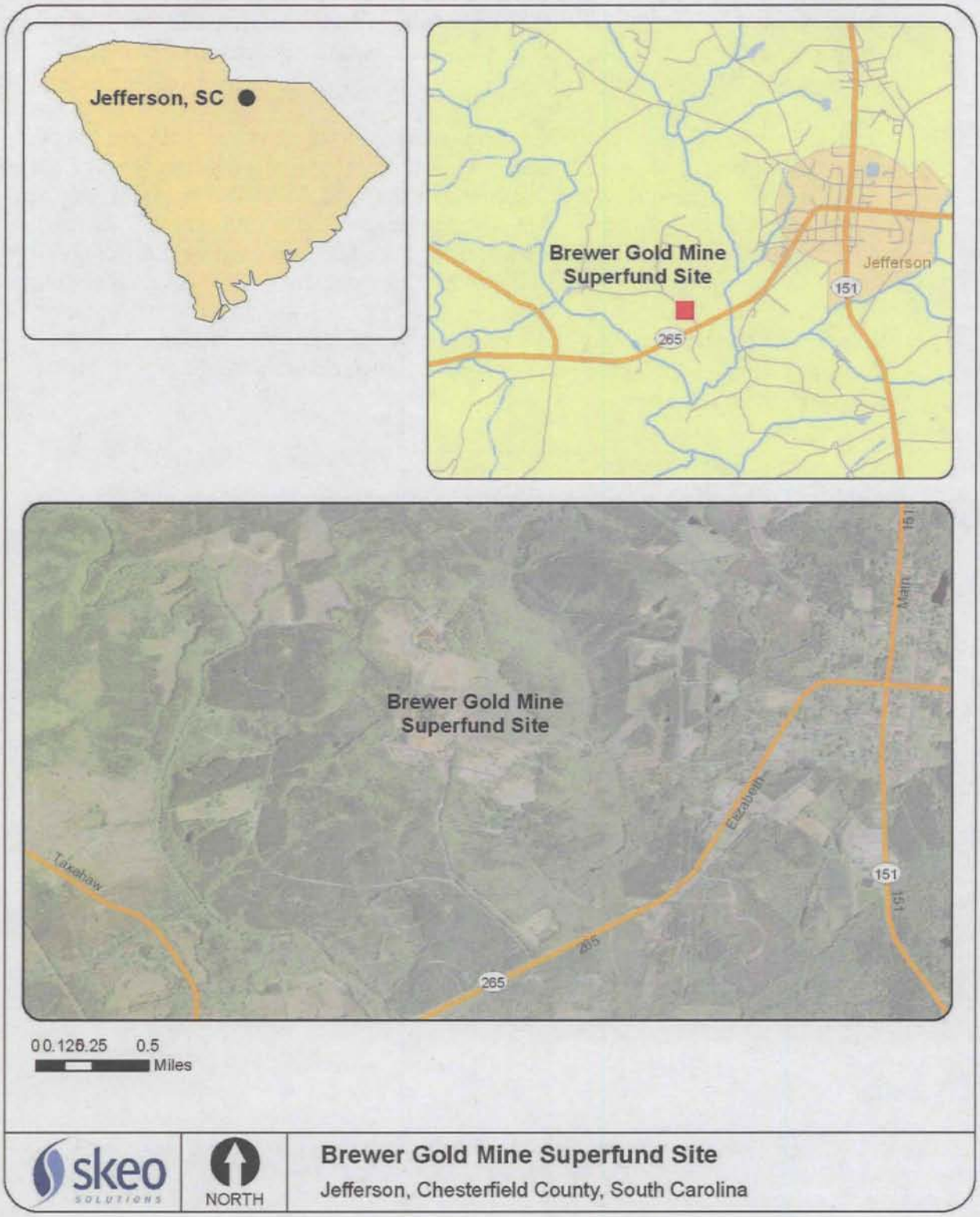
Most runoff from the Site drains east and south through unnamed gullies to Little Fork Creek, which flows into Fork Creek, a tributary of the Lynches River. The northwestern portion of the Site drains directly to Lynches River through unnamed ephemeral gullies; this part of the Site has not been mined. From the point where it receives inflow from the sediment pond tributary, Little Fork Creek flows an additional 0.65 mile to its confluence with Fork Creek. Fork Creek then flows 0.94 mile to its confluence with the Lynches River. Informal names have been given to three gullies along the eastern side of the Site: the pad 6 drainage, which flows from below the earthen dam that impounds the pad 6 overflow pond to Little Fork Creek on the northeast side of the Site; Roger's River, which flows south to Little Fork Creek along the east-central part of the Site; and the sediment pond tributary, which flows southward to Little Fork Creek from below the earthen dam that impounds the sediment pond (Figure 2).

Ground water on the Site occurs in surficial soil and saprolite (intact but decomposed bedrock) and in deeper crystalline bedrock. Ground water flow and storage at the Site have been modified by mining activities, including excavation of historic workings, construction of a drainage tunnel and recent open-pit mining and reclamation.

The shape of the water table implies that the ground water gradient is oriented radially away from Brewer hill and toward Little Fork Creek and other bounding gullies and streams. Seeps that occur on hill slopes surrounding the Site indicate that the water table locally intersects the ground surface; in many locations, these seeps are spatially associated with a resistant ledge of rock.

A seep appeared at the east end of the B-6 pit during reclamation and discharged poor quality water from the pit area. This seep, termed the "B-6 seep," discharged water at a three-year average rate of 118.8 gallons per minute (gpm). Two other seeps also drained water of poor quality from the pit area. The "upper seep" (also known as the "tunnel seep") flowed at approximately 10 gpm and originated in the area of the Brewer drainage tunnel outlet; this seep began to flow after the drainage tunnel portal was plugged during backfilling of the Brewer pit. The "lower seep" flowed at 1 to 2 gpm and was apparently active prior to reclamation activities. Consequently, ground water discharge from the Brewer and B-6 pit areas totaled approximately 130 gpm, similar to the pumping rate of the Brewer pit during mining.

Figure 1: Site Location Map



Disclaimer: This map and any boundary lines within the map are approximate and subject to change. The map is not a survey. The map is for informational purposes only regarding EPA's response actions at the Site, and is not intended for any other purpose.

Figure 2: Detailed Site Map

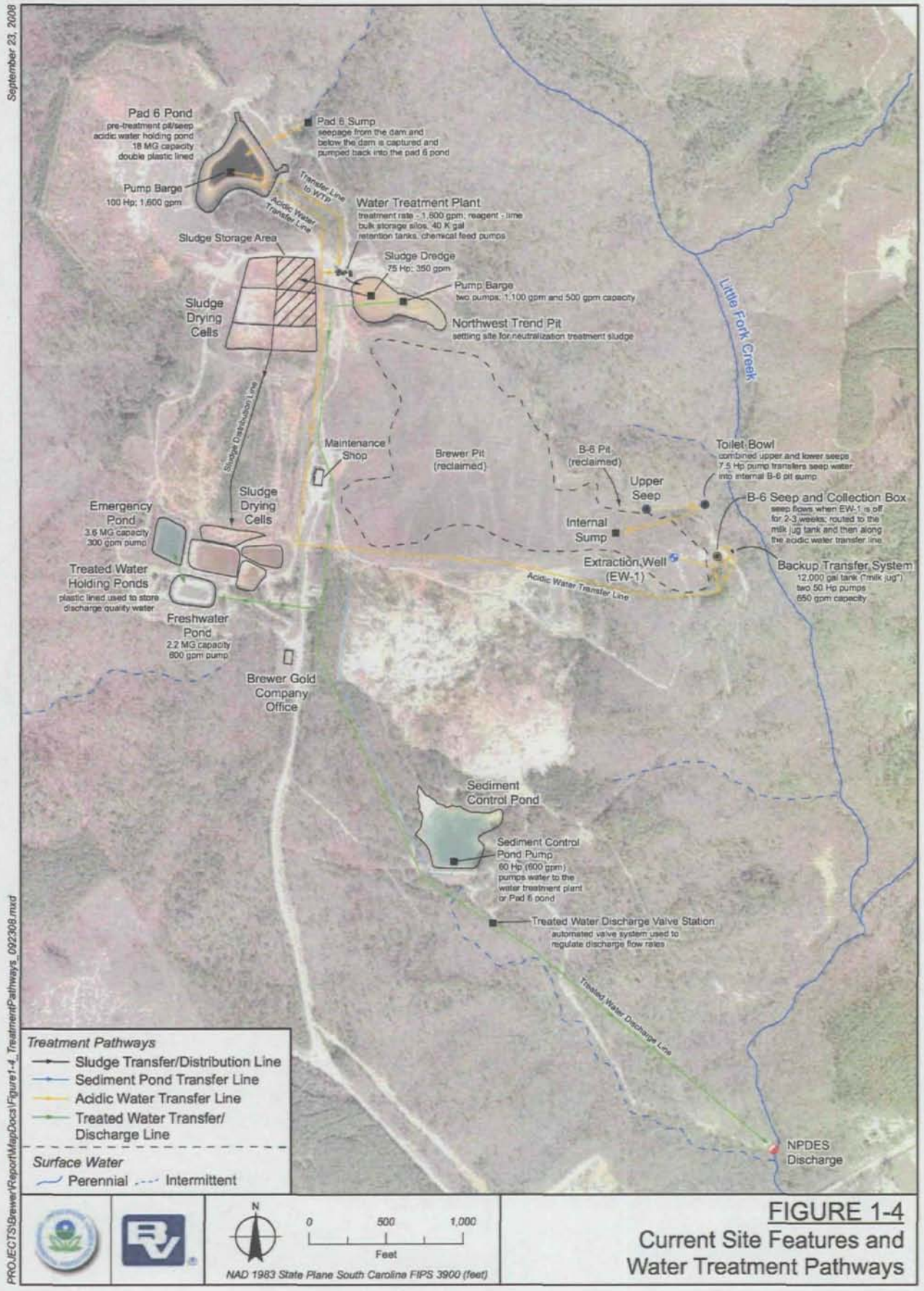


FIGURE 1-4
Current Site Features and Water Treatment Pathways

3.2 Land and Resource Use

The County is primarily rural, with a mix of forest and agricultural lands. The Site was used for gold and topaz mining operations for over a century. The Brewer Gold Mine was developed beginning in 1828. The 2005 interim Record of Decision (ROD) anticipated that the property would be used for recreation in the future. Undisturbed portions of the property might be suitable for rural residences or agriculture, but tax issues and ownership would have to be resolved before any such use could occur.

Chesterfield County covers a land area of 799 square miles and had a population of 46,734 in 2010. The Town of Jefferson, with a population of 704, is one of eight municipalities in the County. Most of the population within a four-mile radius of the Site obtains drinking water from the Jefferson Town Water System. The closest drinking water intake is on Lynches River, approximately one mile upstream of the confluence with Little Fork Creek, and therefore is unaffected by discharges from the Site. Little Fork Creek and downstream waters are not used for drinking water. However, there are an estimated 339 homes within four miles of the Site that obtain drinking water from private wells. EPA sampled private wells in 2003 and detected no metals in the water.

Little Fork Creek has an average flow of 7.7 cubic feet per second and joins Fork Creek, which has an average flow of 29 cubic feet per second, approximately 1.6 miles downstream from the Site. Fork Creek then flows into Lynches River about 0.94 mile downstream. The river provides an important fishery resource. There are limited wetlands (approximately one mile of frontage) downstream along Lynches River. Several miles downstream, the river has been designated as a State Scenic River.

3.3 History of Contamination

The Brewer Gold Mine was developed beginning in 1828. Although its early history is uncertain, it was possibly mined prior to the Revolutionary War. Early activities used placer techniques to remove ore from weathered, decomposed portions of the deposit and from deposits in the southwest margin of later workings. Gold was initially collected by washing the ore in rockers. A second period of mining activity occurred from 1879 to 1894. During this time, a pipeline was laid to draw water from Little Fork Creek for use in hydraulic mining. In 1886, a five-stamp mill was installed on the banks of Little Fork Creek and it was enlarged to 40 stamps in 1889.

At the time, a lode deposit at the old Brewer and Hartman pits was developed. The Brewer pit was mined to a diameter of 200 to 300 feet and excavated to about 140 feet in depth. Several tunnels radiated from the pit, including one extending 430 feet northward and a drainage and haulage tunnel nearly 1,050 feet long running east-southeast to convey water and ore from the pit to the Little Fork Creek. The Hartman pit was located about 500 feet southwest of the Brewer pit, had a diameter of about 150 feet, and was 100 feet deep. In addition to the pits, the area was marked by numerous raises, stopes, adits and shallow shafts in the areas of the two pits and areas north.

From the 1840s into the late 1800s, gold was recovered by amalgamating the gold with mercury, then heating the amalgam to drive off the mercury. The foundation of an amalgamation furnace is present on the banks of Little Fork Creek just north of the mill foundation. In 1892, a chlorination plant was added to the mill, but it operated for less than two years before closing due to lawsuits for damages caused by the tailings. The process used chlorine gas to remove gold from crushed, milled and roasted ore in a pressurized lead-lined barrel. The process precipitated gold chloride that was smelted to form bars. Tailings created by the process were highly acidic. In the years following, operations were intermittent and attempts to process the Brewer ore using cyanide were unsuccessful. By the early 1900s, the mill was reduced to 10 stamps and gold was recovered using mercury amalgamation. Renewed mining activity, focused in the Hartman pit, began in 1934 and continued until 1940.

Following World War II, the Site was mined for topaz, which had been earlier identified as a mineral in the deposit. Topaz was excavated from one and possibly two small pit(s) north of the Brewer pit in the 1940s and 1950s (referred to as the Hilford and Topaz pits). The Site was subsequently drilled and explored for copper reserves by several lessees without significant mining. However, Scheetz (1991) estimated that the property yielded 22,000 ounces of gold between 1844 and 1940. Gold Resources, Inc. acquired an option on the site property and the firm entered into a joint venture with Nicor Mineral Ventures in 1983 to explore and develop the deposit, ultimately completing a feasibility study in 1986.

Later in 1986, Costain Holdings acquired Nicor Mineral Ventures and established Westmont Mining, which broke ground for new facilities in March 1987. Brewer Gold Company was established in June 1987 to operate the new facilities. The company poured its first gold in August 1987. Brewer Gold Company operated the property as an open pit-heap leach operation. The pit was expanded to include the pre-existing Brewer, Hartman, Hilford and Topaz pits, as well as many of the shafts, adits and underground workings. Gold ore was mined, crushed, agglomerated with cement and placed on permanent, lined leach pads. Waste rock was stockpiled in lifts on the south side of the pit. The ore was sprayed with a dilute cyanide solution that leached gold and carried it to collection ponds.

This gold-laden solution was pumped through a carbon adsorption system to remove the gold and the barren cyanide solution was refortified and returned to the heaps. Gold was stripped from the carbon columns using a solution of caustic and cyanide and the carbon was regenerated and recycled to the stripping tanks. Gold was then electroplated onto steel wool and melted into doré bars in the facility's crucible furnace. The sodium cyanide solution was re-fortified and recirculated in a closed-loop process. Sludge from the electrowinning tanks and slag from the furnace were shipped off site for recovery of other metals. Historical site maps are available in Appendix F.

In the course of its operations, Brewer Gold Company mined an estimated 12 million tons of ore and waste rock that yielded 192,000 ounces of gold.

Following heavy rains associated with a tropical storm, a dam impounding an overflow pond at heap leach pad 6 failed on October 28, 1990. This released an estimated 10 to 12 million gallons of pregnant (gold-laden) cyanide leach solution that flowed down a small unnamed tributary to Little Fork Creek, eventually reaching Lynches River. Fish kills were reported for at least 49 miles downstream. Following the release, SCDHEC conducted an assessment of impacts to aquatic macroinvertebrates in Little Fork Creek, Fork Creek and the Lynches River, the results of which were compared to an assessment conducted in 1988. After that time, macroinvertebrate studies were conducted annually through 2001 to monitor recovery of the insect population in the affected streams. The overflow pond and dam were redesigned and reconstructed and the mine resumed normal operation in 1991.

3.4 Initial Response

SCDHEC conducted a preliminary assessment of the Site in 1993. The preliminary assessment evaluated the potential threat to human health and the environment posed by the Site to support a decision for further investigations under CERCLA. The assessment report included a review of the impacts from the 1990 dam failure and concluded that aquatic life was recovering from the event. Consequently, the assessment report recommended continued monitoring of the Site and low prioritization of the Site for further CERCLA action.

When mining ceased in 1993, the operation consisted of three pits (the Brewer, B-6 and Northwest Trend pits); six leach heaps; one waste rock disposal area; six process, sediment retention and water storage ponds; and numerous shops, offices and process facilities. Ore leaching and gold production continued until 1995. Brewer Gold Company closed and reclaimed the mine following a plan outlined under an Administrative Order on Consent (AOC) issued by the State of South Carolina (File No. 95-036-W). Reclamation activities commenced in August 1995. These actions included dewatering the Brewer and B-6 pits, rinsing leach heaps, dismantling unnecessary facilities, backfilling the Brewer and B-6 pits, installing a geosynthetic clay liner across the pit area, and continuing to operate an on-site water treatment plant.

Pit dewatering, which was completed in December 1995, removed an estimated 120 million gallons of acidic water. The water was treated in a plant constructed in 1995 for that purpose, then discharged to Little Fork Creek. Heaps were rinsed with a peroxide solution until cyanide and metals in the rinse water were below criteria set forth in the AOC. Under terms of the closure plan, acid-generating materials were placed in the bottom of the pits, where they would remain submerged beneath ground water, near the top of the backfill, and above the water table. Non-acid generating materials were placed in the area of the water table. Also disposed of in the pit were the leach pad liners, any contaminated soil existing beneath the liners, and debris from building demolition.

At the close of mining, the lower 50 feet of the B-6 pit had been backfilled with waste rock and the Brewer and B-6 pits were separated by a bedrock rib about 90 feet high that had remained relatively undisturbed during operations. The Brewer pit was originally

excavated to an elevation of 330 feet and the B-6 pit was excavated to an elevation of about 340 feet (prior to backfill). The lowest exposed benches of the Brewer pit were lined with limestone prior to backfilling to provide additional buffering alkalinity and a historic drainage tunnel was plugged with a concrete bulkhead. Rinsed material from heap 5 was placed atop limestone in the bottom of the Brewer pit and this was followed by material from heaps 1 through 4. Prior to placing the heap 1 through 4 materials, the west side of the bedrock rib (the Brewer pit side) was capped with low-permeability soil.

When the backfill reached the top of the bedrock rib, a limestone-filled subdrain was keyed into the bedrock and this feature was extended eastward for 1,393 feet across waste rock fill in the B-6 pit and westward into the Brewer pit for 237 feet. The portion of the subdrain from the eastern Brewer pit wall to the eastern B-6 pit wall was wrapped with an impermeable layer and the subdrain was set at a three percent slope from a base elevation of 425 feet at the inlet to 380 feet at the outlet. The purpose of this subdrain was to intercept and siphon ground water within the Brewer pit to a passive treatment system that would be constructed between the pits and Little Fork Creek. Washed material from heaps 1 through 4 covered the subdrain in the Brewer pit and extended to an elevation above the water table. Waste rock was placed above this as a blanket that extended from the Brewer pit across the bedrock rib to the toe of the B-6 pit. Rinsed material from heap 6 was placed atop the waste rock in the Brewer pit area. The entire backfilled area was graded for drainage and covered with a geosynthetic clay liner and vegetation layer.

As pit reclamation was taking place, a seep of acidic water began flowing at the eastern end of the B-6 pit at an elevation of about 373 feet. This elevation is approximately 10 feet below the toe of the limestone subdrain. The seep, which eventually discharged about 100 gpm, was collected and pumped to the on-site treatment plant together with two smaller seeps emanating from the area of the historic drainage tunnel outlet.

Costain Holdings constructed a plant in 1995 to treat water removed from the pits. The treatment plant was originally slated to be demolished and placed into the backfilled Brewer pit, but this plan was abandoned when the plant was needed to treat the contaminated seepage water collected from the upper seep, lower seep and B-6 seep. Water from the upper and lower seeps was collected in a concrete sump, and then returned to the B-6 pit through an internal sump that was constructed during closure. Water from the B-6 seep was collected in a sump and gravity drained to a collection tank from which it was pumped to the pad 6 overflow pond. The treatment plant used magnesium hydroxide to neutralize acidity and remove metals from the water on a batch basis, with treated water settled and clarified in the Northwest Trend pit. Treated water was discharged to Little Fork Creek under a National Pollutant Discharge Elimination System (NPDES) permit. In November 1999, Costain Holdings abandoned the Site in violation of the AOC.

During mine operations, the Brewer Gold Mine was regulated by several state agencies, including the Bureau of Water Pollution Control, the Bureau of Air Quality Control and the Land Resources Commission. These agencies issued permits to regulate surface water quality, ground water quality, air quality, facility construction and operation, and dam

construction. SCDHEC issued Brewer Gold Company an NPDES permit in 1986 that authorized discharges of process wastewater and stormwater from the sediment pond to Little Fork Creek. The permit was substantially revised and reissued in 1990. Additional revisions to the permit were made in 1993 due to the cessation of mining operations. A new permit was issued to the company in 1998 for discharges to Little Fork Creek from the wastewater treatment system. This permit required sampling and analysis of effluent and submission of monthly discharge reports to SCDHEC. In December 1999, EPA cancelled the 1998 permit when it took jurisdiction over the Site. EPA has continued to monitor effluent discharge, pH, aluminum, copper, mercury and selenium.

In December 1999, SCDHEC requested emergency response assistance from EPA Region 4 in response to Costain Holdings' abandonment of the Site. EPA initiated an emergency response on December 2, 1999, and authorized actions to continue operating the seepage collection and treatment system. An impact study that included chemical analyses of site waters was performed in January 2000. This study concluded that failure to treat wastewater would result in releases of acidic, metals-laden water that would severely degrade water quality in Little Fork Creek. An expanded site investigation report, prepared by SCDHEC in 2001, recommended that the Site be given a high priority for National Priorities List (NPL) listing.

In 2000, EPA installed four new monitoring wells in the B-6 pit area and an extraction well to pump water from the B-6 pit. The extraction well, which was installed to lower the ground water in the pit and eliminate the B-6 seep, pumped water to the pad 6 overflow pond for treatment, where it was mixed with water pumped from the sediment pond. In addition, EPA conducted a treatability study to evaluate and optimize the existing system and to evaluate other potential neutralizing agents. The report recommended a change from magnesium hydroxide to hydrated lime as a cost-saving measure and additionally recommended several other process changes. EPA converted the system to use hydrated lime in 2000 but continued to use the Northwest Trend pit to settle contaminants. Treated water was either discharged to Little Fork Creek or to one of two holding ponds prior to discharge to the Creek. Buildup of treatment sludge in the Northwest Trend pit over time began to impinge on the volume of water that could be treated in batch cycles. Consequently, EPA had to dredge lime sludge from the pit in 2002 using a rented crane. Sludge was sent to drying beds constructed in the area of the former leach pads 1 through 5, where it was air dried and stockpiled. In 2005, EPA purchased a floating dredge to allow sludge to be pumped from the Northwest Trend pit to the drying beds.

EPA placed the Site on the NPL on April 27, 2005, shifting responsibility for the Site from EPA's Emergency Response Program to the Remedial Program. EPA took several steps to conclude the emergency removal. These steps included preparation of a focused remedial investigation/feasibility study (RI/FS), which recommended continuing treatment of contaminated water as an interim action to reduce risks from the Site pending implementation of the final remedy.

The wastewater treatment system is presently operated as described above by Gemini Services Inc. under contract to EPA contractor Black & Veatch. Two batches of 3 million gallons are treated in a typical month, at a treatment rate of 1,400 to 1,600 gpm.

3.5 Basis for Taking Action

Because the focus of the interim action is to prevent the release of acidic water contaminated with high concentrations of metals to Little Fork Creek while a permanent remedy is identified and selected, the only exposure route examined in the focused RI was via surface water. Potential media/receptors included workers or recreational visitors who might ingest or come into contact with contaminated water and aquatic receptors that would be exposed to contaminated surface water.

Persons wading, swimming or fishing in Little Fork Creek, North Fork Creek or Lynches River would be the most likely human receptors. They could be exposed to contaminants in the surface water through incidental ingestion of the water, dermal contact with the water or consumption of fish.

Aquatic life, particularly macroinvertebrates and fish, are the receptors of concern in Little Fork Creek. Small mammals and deer as well as birds might be attracted to standing water on the Site, and they are the most likely terrestrial receptors. Waterfowl are not particularly attracted to the Site, although there might be casual visits of migratory waterfowl to the Northwest Trend pit, the pad 6 pond or the sediment pond. Ingestion and contact with surface water and sediments are the pathways of concern.

The uptake of metals through the water column would be the major route of exposure for aquatic invertebrates, algae and fish. Routes of benthic organism exposure include uptake from porewater in the sediments of Little Fork Creek or water at the sediment/water interface, and direct contact with or ingestion of contaminated sediments. Because mercury and selenium were contaminants of potential concern in the Creek, these chemicals could follow an indirect pathway of contamination through the food chain.

Besides the acid- and metals-contaminated seeps, other potential sources of contamination could include:

- Wastewater treatment plant sludge, which is stored on site pending identification and implementation of a permanent remedy.
- Contaminated soil near the former furnace used for mercury evaporation and other areas where mercury might have been used.
- Contaminated sediments in Little Fork Creek below where the former acid seep joined the Creek and below the old mercury amalgamation process and furnace.
- Residual mine wastes remaining on the surface of the Site.

The 2005 interim ROD indicated that although information was incomplete, these were believed to be secondary sources that did not pose an immediate threat, unlike the contaminated seeps. For purposes of the interim action, only seeps posing an immediate

threat were of concern in the focused RI/FS and the interim ROD. The other potential sources would be investigated in the RI/FS for the permanent remedy. The evaluation and, if necessary, further control of treatment plant sludge will be a priority during the RI/FS for the permanent remedy.

4.0 Remedial Actions

In accordance with CERCLA and the NCP, the overriding goals for any remedial action are protection of human health and the environment and compliance with applicable or relevant and appropriate requirements (ARARs). A number of remedial alternatives were considered for the Site, and final selection was made based on an evaluation of each alternative against nine evaluation criteria that are specified in Section 300.430(e)(9)(iii) of the NCP. The nine criteria include:

1. Overall Protectiveness of Human Health and the Environment.
2. Compliance with ARARs.
3. Long-Term Effectiveness and Permanence.
4. Reduction of Toxicity, Mobility or Volume of Contaminants through Treatment.
5. Short-term Effectiveness.
6. Implementability.
7. Cost.
8. State Acceptance.
9. Community Acceptance.

4.1 Remedy Selection

On September 29, 2005, EPA issued the Site's interim ROD, which included an interim remedy to minimize the amount of contamination reaching Little Fork Creek through controlling contaminants released to surface water. The following interim action objectives were established for the Site:

- Meet and sustain South Carolina water quality standards for protection of human health in Little Fork Creek.
- Meet and sustain National Water Quality Criteria for human consumption of water and organisms in Little Fork Creek.

These objectives were chosen to be consistent with future remedial actions. The interim remedy was designed to prevent discharges of contaminated ground water to surface waters at the Site. The major components of the interim remedy included:

- Collecting contaminated seepage from several springs downgradient of the backfilled pits and injecting it into the B-6 pit.
- Pumping contaminated water out of the B-6 pit and from the sediment pond and storing it in a lined storage pond.
- Treating all contaminated water with lime in an on-site wastewater treatment plant and discharging the treated water into the Northwest Trend pit.
- Decanting water from the Northwest Trend pit and storing it in one of two lined storage ponds or discharging it directly to Little Fork Creek.
- Periodically removing sludge from the Northwest Trend pit, drying the sludge and storing it in on-site piles.
- Evaluating the potential for contaminants to be released from sludge while it is stored. If it is determined that contaminants could be released, a sludge

management plan would be developed and implemented, pending development of a final remedy.

- Monitoring water quality of the effluent discharge and surface water in Little Fork Creek.
- Maintaining the site property and equipment as necessary to accomplish all of the foregoing activities.

The interim remedy was chosen based on its ability to meet remedial and interim action goals for the Site. These goals provided targets for selecting the appropriate remedy response alternatives and can be updated as new information becomes available. They are considered preliminary goals, and may be modified during selection of the final remedy for the Site.

The preliminary interim action goal for Little Fork Creek was for treated water that is discharged to the Creek to meet discharge limits that are equivalent to the formerly applicable NPDES permit (permit SC0040657, originally effective February 1, 1998, and modified on October 12,1998), as shown in Table 2. These limits were based in part on mass-based criteria in pounds-per-million-gallons in Little Fork Creek and in part on national discharge standards promulgated by EPA. SCDHEC established the limits based on the more stringent of several criteria, including applicable state water quality standards (see the risk evaluation in the focused RI for these standards). The interim ROD identified the effluent discharge limits in Table 2 as chemical-specific ARARs to be met during operation of the interim remedy.

Table 2: Interim Remedial Goals

Contaminant	Mass-Based Limit (pounds per million gallons, lb/MG)		Concentration-Based Limit (milligram per liters, mg/L)	
	Monthly Average	Daily Maximum	Monthly Average	Daily Maximum
total suspended solids	-	-	20	30
oil and grease	-	-	10	15
cyanide	0.0835	0.167	-	-
aluminum	0.726	6.26	-	-
arsenic	0.0417	0.0835	-	-
cadmium	0.0835	0.167	0.05	0.10
copper	0.0835	0.167	0.15	0.30
lead	0.417	0.835	0.3	0.6
mercury	0.00167	0.00334	0.001	0.002
selenium	0.0417	0.167	-	-
silver	0.250	0.500	-	-
zinc	0.492	0.542	0.75	1.5
ammonia (as nitrogen April - October)	30.5	61.0	-	-

Contaminant	Mass-Based Limit (pounds per million gallons, lb/MG)		Concentration-Based Limit (milligram per liters, mg/L)	
	Monthly Average	Daily Maximum	Monthly Average	Daily Maximum
ammonia (as nitrogen, November - March)	32.1	167	-	-
Sulfate	Monitor Only			
- No goal defined				

4.2 Remedy Implementation

The Site's interim remedial design began in September 2005 and was completed in June 2006. The interim remedial action began in September 2006. EPA's Emergency Response Program cancelled the Site's 1998 NPDES permit, which required weekly monitoring of 15 effluent contaminants, when it assumed jurisdiction over the Site in 1999. The 2005 interim ROD also required weekly monitoring of 15 effluent contaminants; however, since 2001, EPA has continued to monitor effluent discharge, pH, aluminum, copper, mercury and selenium monthly. EPA Emergency Response and Removal Branch determined over a six year period that these effluent discharge criteria were necessary for protecting human health and the environment and reduced the number of monitored weekly effluent contaminants in order to reduce expenses.

Numerous macroinvertebrate studies were conducted in Little Fork Creek, particularly after the 1990 cyanide spill that damaged aquatic life in the Creek and portions of Lynches River. In addition, SCDHEC collected macroinvertebrate data in the Creek upstream of the Site at the SR 39 bridge in 1998 and 2003. The data indicated a gradual improvement to near-full recovery of the macroinvertebrate community, to the point where conditions approximated those that existed before the 1990 cyanide spill. Though called for in the 2005 interim ROD, annual macroinvertebrate studies were discontinued in 2001 by EPA Emergency Response and Removal Branch due to the results of previous sampling and to decrease operation and maintenance (O&M) costs.

The required weekly monitoring of 15 effluent discharge contaminants as well as the annual macroinvertibrate studies in the 2005 interim ROD were based on components of the original removal action memo and Brewer Gold Company operations when EPA took over the Site in 1999. The 2005 interim ROD apparently did not take into account the cost cutting measures and changes in operational procedures at the Site that occurred under the removal program during its six year operation of the Site. The current interim remedial action is a continuance of the former removal action and continues to protect human health and the environment.

Most of the disturbed upland area at the Site have been reclaimed and revegetated with a mixture of grasses and legumes, along with loblolly pines planted in the former waste rock dump area. The former Brewer and B-6 mine pits, now backfilled, support lush grasses, while the former pad 6 area supports less robust growth. Naturally occurring pines and other trees are periodically removed so that roots will not penetrate the

geotextile liner. Loblolly pines were also planted on portions of former pads 1-5. Some areas, particularly along drainages, are naturally revegetated with several native species of deciduous trees, grasses and forbs.

The water table has been modified by pumping water from the B-6 pit via the extraction well that was installed in 2000 as part of the EPA removal action and which has been operating since August of that year. Reclamation actions that have affected ground water at the Site include placement of unconsolidated backfill within the pits and placement of an impervious liner over the pit area. Although the liner reduces precipitation infiltration, the compacted backfill stores ground water in intergranular pore space; to a varying extent, materials that compose the backfill are chemically reactive. In addition, treated mine water is currently held within the unlined Northwest Trend pit for clarification prior to discharge; this pool is maintained at an elevation higher than the water table within the Brewer pit.

Water management begins when contaminated water is pumped from the wastewater sources to the pad 6 pond, which serves as a holding pond. The pad 6 pond has a high density polyethylene-liner underlain by a French drain, and the pond has a capacity of about 18 million gallons. Untreated water is pumped from the pad 6 pond to the treatment plant, where it is mixed with lime slurry to raise the pH. This mixture is retained for a short time in the retention tanks. The neutralized wastewater is then discharged to the Northwest Trend pit, where it is retained for at least a day to allow the wastewater to stabilize and to precipitate heavy metals. This process generates lime-based sludge in the Northwest Trend pit. Clarified wastewater from the Northwest Trend pit is decanted and pumped either to the emergency pond or freshwater pond (lined treated water holding ponds), or directly discharged to the Little Fork Creek. The plant operator determines where the wastewater will be pumped based upon the current wastewater levels in the ponds, current creek flow conditions, and the overall water balance of the treatment system. Flow of wastewater discharged to the Creek is regulated by a treated wastewater discharge valve station.

Effluent must not degrade Little Fork Creek and so effluent discharge is based on flow in the Creek. The plant operator determines the rate of effluent flow by measuring the Creek flow and estimating the contaminant mass in the treated wastewater. This in turn determines the rate at which treated wastewater can be discharged. Effluent is discharged through a perforated pipe suspended over the middle of Little Fork Creek.

The Northwest Trend pit contains sludge up to 80 feet thick. Lime-based sludge constitutes the upper portion (perhaps the top 10 to 20 feet), but the lower-most sludge is magnesium-oxide-based, since that was the reactant used to neutralize acid wastewater until 2001. Sludge is pumped from the Northwest Trend pit to one of several drying beds. Dried sludge from the drying cells is periodically moved with a loader or dozer to a storage/disposal pile on site.

An RI study for the final remedy was completed in December 2010 and a final ground water remedy for OU 1 is forthcoming.

The RI found that sludge formed through lime neutralization of site water presents a slight noncancer hazard to current workers through incidental ingestion of iron and aluminum under a reasonable maximum exposure. Aluminum in the sludge might also present an unacceptable reasonable maximum exposure inhalation exposure hazard to outdoor workers operating a bulldozer in the sludge or standing nearby the operation. An unacceptable reasonable maximum exposure ingestion hazard is also predicted for the future residential child through ingestion of iron and aluminum in the sludge. The RI also discusses the future FS and recommended treatability studies that will be conducted. EPA is currently in the planning stages of recycling all of the stockpiled sludge on site.

4.3 Operation and Maintenance (O&M)

The Site's June 2006 O&M Manual describes the water treatment system as well as site O&M requirements.

Many improvements have been made to the Site since the interim 2005 ROD. The office was re-roofed and re-sided in 2011. Backup generators were installed at the B-6 seep collection area, at the upper seep collection area, and below the pad 6 pond. The extraction well pump is susceptible to lightning strikes and new systems have been installed twice since the interim ROD. O&M contractors have been working to repair old equipment as needed.

The interim 2005 ROD estimated O&M costs to be approximately $695,684 annually. Available actual annual O&M costs are presented in Table 3. High O&M costs can be attributed to increased electricity costs following a rate raise.

Table 3: Annual O&M Costs

Year	Total Cost
2006	$642,919
2007	$608,401
2008	$811,260
2009	$919,486
2010	$1,021,113

5.0 Progress Since the Last Five-Year Review

This is the first FYR for the Site.

6.0 Five-Year Review Process

6.1 Administrative Components

EPA Region 4 initiated the FYR in May 2011 and scheduled its completion for September 2011. The EPA site review team was led by EPA Remedial Project Manager (RPM) Loften Carr and also included EPA site attorney Rhelyn Finch, EPA Community Involvement Coordinator (CIC) Angela Miller, and contractor support provided to EPA by Skeo Solutions. In May 2011, EPA held a scoping call with the review team to discuss the Site and items of interest as they related to the protectiveness of the remedy currently in place. A review schedule was established that consisted of the following activities:

- Community notification.
- Document review.
- Data collection and review.
- Site inspection.
- Local interviews.
- FYR Report development and review.

6.2 Community Involvement

In July 2011, a public notice was published in the *Pageland Progressive* newspaper announcing the commencement of the FYR process for the Site, providing contact information for EPA RPM Loften Carr and CIC Angela Miller and inviting community participation. The press notice is available in Appendix B. No one contacted EPA as a result of this advertisement.

The FYR Report will be made available to the public once it has been finalized. Copies of this document will be placed in the designated site repository: Fannie D. Lowry Memorial Branch Library, located at 500 North Main Street, Jefferson, SC 29718. Upon completion of the FYR, a public notice will be placed in the *Pageland Progressive* newspaper to announce the availability of the final FYR Report in the Site's document repository.

6.3 Document Review

This FYR included a review of relevant, site-related documents including the interim ROD, RI, focused FS, and recent effluent discharge data. A complete list of the documents reviewed can be found in Appendix A.

ARARs Review

CERCLA Section 121(d)(1) requires that Superfund remedial actions attain "a degree of cleanup of hazardous substance, pollutants, and contaminants released into the environment and of control of further release at a minimum which assures protection of human health and the environment." The remedial action must achieve a level of cleanup that at least attains those requirements that are legally applicable or relevant and appropriate. Applicable requirements are those cleanup standards, standards of control and other substantive requirements, criteria or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, remedial action, location or other circumstance found at a CERCLA site. Relevant and appropriate requirements are those standards that, while not "applicable," address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. Only those state standards that are more stringent than federal requirements may be applicable or relevant and appropriate. To-Be-Considered (TBC) criteria are non-promulgated advisories and guidance that are not legally binding, but should be considered in determining the necessary remedial action. For example, TBCs may be particularly useful in determining health-based levels where no ARARs exist or in developing the appropriate method for conducting a remedial action.

Chemical-specific ARARs are health- or risk-based numerical values or methodologies which, when applied to site-specific conditions, result in the establishment of numeric values. These values establish an acceptable amount or concentration of a chemical that may remain in, or be discharged to, the ambient environment. Examples of chemical-specific ARARs include maximum contaminant levels (MCLs) under the federal Safe Drinking Water Act and ambient water quality criteria enumerated under the federal Clean Water Act.

Action-specific ARARs are technology- or activity-based requirements or limits on actions taken with respect to a particular hazardous substance. These requirements are triggered by a particular remedial activity, such as discharge of contaminated groundwater or in-situ remediation.

Location-specific ARARs are restrictions on hazardous substances or the conduct of the response activities solely based on their location in a special geographic area. Examples include restrictions on activities in wetlands, sensitive habitats and historic places.

The 2005 interim ROD identified the former NPDES permit discharge limits in Table 2 as ARARs for the Site because they are based on state water quality standards and national effluent limitations. As more specific information is developed during the site-wide RI/FS about the final remedy selection, the existing list of ARARs will be refined, modified or added to and included in the final ROD.

6.4 Data Review

During the past five years, water samples of effluent discharged into Little Fork Creek were collected weekly and analyzed monthly for mass-based levels (lb/MG) of aluminum, copper, selenium and mercury. Monthly averages were recorded as well as daily maximums within the month. Monthly composite samples were analyzed for contaminant concentrations (mg/L).

Monthly and daily maximum discharge data from September 2006 to May 2011 (available in Appendix G) at Little Fork Creek showed only a single exceedance of the daily maximum for aluminum during May 2007 and a single exceedance in the monthly average (August 2007) as well as the daily maximum for selenium in May 2007. There were no exceedances of copper or mercury compared to mass-based limits specified in the interim ROD. There were also no exceedances in the monthly average data for copper and mercury concentration-based limits specified in the interim ROD. Daily maximum concentration-based data were not available for review. The interim ROD did not specify concentration-based limits (mg/L) for aluminum or selenium. No trends were observed in the data although the magnitude of spikes appears to decrease over time.

6.5 Site Inspection

On June 7, 2011, Loften Carr, EPA; Jim McLain, Gemini Services; Van Keisler, Jason Lambert, Charles Williams, III and Kayse Jarman, SC DHEC; and Treat Suomi and Johnny Zimmerman-Ward, Skeo Solutions, met at the Site. Jim McLain of Gemini Services (O&M contractor to Black & Veatch) provided a tour of the Site. The completed site inspection checklist is available in Appendix D. Photographs were taken to record site conditions and are available in Appendix E.

The group toured the Site to observe the condition of all interim action remedial components and followed the wastewater treatment process. The Site's remedy was found to be well maintained and functioning as intended. Recent upgrades to the Site, including new backup generators at the B-6 and Upper seeps, as well as the pad 6 sump, new roofing and siding at the site office, and the repair of the liner in the pad 6 pond were also observed.

On June 6, 2011, Skeo Solutions staff visited the designated site information repository, located at the Fannie D. Lowry Memorial Branch Library. Relevant documents were available at the repository.

Contractor staff conducted research at the Chesterfield County Public Records Office and found the deed information pertaining to the Site listed in Table 4.

Table 4: Deed Documents from Chesterfield County Public Records Office

Date	Type of Document	Description	Book #	Page #
12/18/1996	Quit Claim	Transfer tract from Westmont Mining Inc. to Gold Resources Inc.	356	828
12/18/1996	Quit Claim	Transfer tract from Westmont Mining Inc. to Gold Resources Inc.	355	1393
7/1/1987	Deed	Transferred property to Westmont Mining Inc.	303	1250

Back taxes are currently owed on the property; the County of Chesterfield has not yet foreclosed on the property. Without a viable property owner, Institutional Controls cannot yet be placed on the site property parcels (026 000 000 013 and 026 000 000 014). Institutional Controls will be addressed in the forthcoming final remedy for the Site.

7.0 Technical Assessment

7.1 Question A: Is the remedy functioning as intended by the decision documents?

The review of documents, risk assumptions and the site inspection indicate that the remedy is functioning as intended by the interim ROD. The pump-and-treat system, which maintains water within the backfilled pits at an elevation that prohibits some seeps from discharging and permits others to be captured and treated, prevents most impacts to Little Fork Creek. Weekly effluent sampling was reduced to monthly sampling and annual macroinvertebrate sampling was discontinued in 2001 to reduce costs. Contaminated seepage from several springs downgradient of the backfilled pits is collected and injected into the B-6 pit. Contaminated water is pumped out of the B-6 pit and from the sediment pond and stored in a lined storage pond. Contaminated water is treated with lime in an on-site wastewater treatment plant and the treated water is discharged into the Northwest Trend pit. Decanted water from the Northwest Trend pit is stored in one of two lined storage ponds or discharged directly to Little Fork Creek. Sludge is periodically removed from the Northwest Trend pit, dried and stored in on-site piles. Water quality of the effluent discharge to Little Fork Creek is monitored monthly for aluminum, copper, selenium, mercury and pH. The Site's remedy and treatment equipment are well maintained.

The required weekly monitoring of 15 effluent discharge contaminants as well as the annual macroinvertibrate studies in the 2005 interim ROD were based on components of the original removal action memo and Brewer operations when EPA took over the Site in 1999. The 2005 interim ROD apparently did not take into account the cost cutting measures and changes in operational procedures at the site that occurred under the removal program during its 6 year operation of the Site. The 2005 interim ROD also required weekly monitoring of 15 effluent contaminants; however, since 2001, EPA has continued to monitor effluent discharge, pH, aluminum, copper, mercury and selenium monthly. EPA Emergency Response and Removal Branch determined over a 6 year period that these effluent discharge criteria were necessary for protecting human health and the environment and reduced the number of monitored weekly effluent contaminants in order to reduce expenses. The current interim remedial action is a continuance of the former removal action and continues to protect human health and the environment.

Monthly and daily maximum discharge data from September 2006 to May 2011 (available in Appendix G) at Little Fork Creek showed only a single exceedance of the daily maximum for aluminum during May 2007 and a single exceedance in the monthly average (August 2007) as well as the daily maximum for selenium in May 2007. There were no exceedances of copper or mercury compared to mass-based limits specified in the interim ROD. There were also no exceedances in the monthly average data for copper and mercury concentration-based limits specified in the interim ROD. No trends were observed in the data although the magnitude of spikes appears to decrease over time.

The 2010 RI indicated that the pump-and-treat system was constructed of salvaged and jury-rigged parts in the mid-1990s and was intended to operate for only a year or two; it

has now operated for over 10 years. The plant generates an iron-rich sludge that is periodically dredged from the Northwest Trend pit and air-dried prior to stockpiling; air-drying occurs on unprepared surfaces and is effective but inefficient. O&M costs have also risen due to higher electricity costs.

7.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels and remedial action objectives (RAOs) used at the time of remedy selection still valid?

The exposure assumptions, toxicity data, cleanup levels and RAOs used at the time of interim remedy selection are still valid. The interim remedy is progressing as expected and a final remedy is anticipated to be selected in November 2011.

7.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has come to light that could call into question the protectiveness of the remedy.

7.4 Technical Assessment Summary

The review of documents, risk assumptions and the site inspection indicate that the remedy is functioning as intended by the interim ROD. The pump-and-treat system, which maintains water within the backfilled pits at an elevation that prohibits some seeps from discharging and permits others to be captured and treated, prevents most impacts to Little Fork Creek. Weekly effluent sampling was reduced to monthly sampling and annual macroinvertebrate sampling was discontinued in 2001 to reduce costs. Monthly and daily maximum discharge data from September 2006 to May 2011 (available in Appendix G) at Little Fork Creek showed only a single exceedance of the daily maximum for aluminum during May 2007 and a single exceedance in the monthly average (August 2007) as well as the daily maximum for selenium in May 2007. There were no other exceedances. The 2010 RI indicated that the pump-and-treat system was constructed of salvaged and jury-rigged parts in the mid-1990s and was intended to operate for only a year or two; it has now operated for over 10 years. The plant generates an iron-rich sludge that is periodically dredged from the Northwest Trend pit and air-dried prior to stockpiling; air-drying occurs on unprepared surfaces and is effective but inefficient. O&M costs have also risen due to higher electricity costs. The interim remedy is progressing as expected and a final remedy is anticipated to be selected in November 2011.

8.0 Issues

Table 5 summarizes the current site issues.

Table 5: Current Site Issues

Issue	Affects Current Protectiveness (Yes or No)	Affects Future Protectiveness (Yes or No)
Institutional Controls are not in place to ensure long-term protectiveness. Measures to restrict access to the Site, such as daily on-site personnel and signage, have been taken to ensure short-term protectiveness until the final remedy is selected and Institutional Controls can be implemented by a future owner.	No	Yes

9.0 Recommendations and Follow-up Actions

Table 6 provides recommendations to address the current site issues.

Table 6: Recommendations to Address Current Site Issues

Issue	Recommendations / Follow-Up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness? (Yes or No)	
					Current	Future
Institutional Controls are not in place to ensure long-term protectiveness.	As part of the selection of the final remedy, identify the Institutional Controls necessary to prevent exposure to contaminated media and to protect the integrity of the remedy in the long-term; measures to restrict access to the Site have been taken to ensure short-term protectiveness until the final remedy is selected and Institutional Controls can be implemented by a future owner.	EPA	EPA	11/30/2011	No	Yes

10.0 Protectiveness Statement

The remedy at the Site is expected to be protective of human health and the environment upon completion. In the interim, exposure pathways that could result in unacceptable risks are being controlled. Contaminated seep water and ground water are captured, treated and discharged to Little Fork Creek.

11.0 Next Review

The Site is a statutory site that requires ongoing FYRs as long as waste is left on site that does not allow for unrestricted use and unlimited exposure. The next FYR will be due within five years of the signature/approval date of this FYR.

Appendix A: List of Documents Reviewed

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Information System (CERCLIS) Site Information accessed from website http://cfpub.epa.gov/supercpad/cursites/csitinfo.cfm?id=0405550 May-July 2011.

EPA Superfund Record of Decision, Brewer Gold Mine, EPA ID: SCD987577913, OU 1. Jefferson, South Carolina. September 29, 2005.

Focused Feasibility Study of Continuing Water Treatment, Brewer Gold Mine Site. Chesterfield County, South Carolina. Prepared by Black & Veatch for EPA Region 4. August 1, 2005.

Operations and Maintenance Manual, Brewer Gold Mine Site, Interim Action Remedial Design. Chesterfield County, South Carolina. Prepared by Black & Veatch for EPA Region 4. June 16, 2006.

Remedial Investigation Report, Brewer Gold Mine Site. Chesterfield County, South Carolina. Prepared by Black & Veatch for EPA Region 4. December 2010.

Appendix B: Press Notice

The U. S. Environmental Protection Agency, Region 4 Announces the First Five-Year Review for the Brewer Gold Mine Superfund Site, Jefferson, Chesterfield County, South Carolina

Purpose/Objective: The U.S. Environmental Protection Agency (EPA) is conducting a Five-Year Review of the remedy for the Brewer Gold Mine Superfund Site (the Site) in Jefferson, Florida. The purpose of the Five-Year Review is to ensure that the selected cleanup actions effectively protect human health and the environment.

Site Background: The 1,000-acre Brewer Gold Mine site is located on the western border of Chesterfield County, in a rural area approximately 1-mile west of Jefferson, South Carolina. The disturbed area that supported mining activities covers 230 acres in the eastern portion of the larger property. The Brewer Gold Mine operated from 1828 - 1995. From 1987 through 1995, the Brewer Gold Company mined over 12,000,000 tons of ore and waste rock from several open pits. The company crushed ore and placed it in large heaps on one of several plastic-lined surfaces called pads. A dilute solution of sodium cyanide was then applied to the surface of the heaps and it dissolved the gold and silver as it trickled through the heaps. The company then collected the solution at the bottom and recovered the gold in an on-site plant. In 1990, following large rainstorms, a dam broke and allowed over 10 million gallons of cyanide solution to escape and flow into Little Fork Creek. Fish were killed in the Creek and in Lynches River for nearly 50 miles downstream. EPA and South Carolina Department of Health and Environmental Control (SCDHEC) responded to the emergency. The dam and plastic-lined pond were repaired and the company resumed mining in 1991.

In 1995, the company notified the State of South Carolina of its intent to stop operations at the Site. At that time, there were three open pits, six heaps of spent ore, a waste rock pile, a sediment control pond to capture stormwater runoff from the waste rock pile, a large plastic-lined pond to capture and store excess runoff from the heaps, the process plant where ore was prepared and the cyanide solution processed to recover the gold, several buildings, and several miles of unpaved roads. The State required Brewer to close and reclaim the mine. Brewer placed all the rock it had mined, including both waste rock and spent ore, back into the open pits. They then had to cap the two filled pits and re-vegetate the entire site. While the company was completing its closure and reclamation activities, acid rock drainage began to emerge from several seeps a few hundred feet from Little Fork Creek. Brewer Gold constructed a plant to treat the contaminated water and received a permit from SCDHEC that allowed the treated water to be discharged to Little Fork Creek. Brewer operated the treatment plant from 1995 -1999.

In 1999, the company abandoned the Site and the wastewater treatment plant. The state requested EPA assistance at the Site and EPA took over the waste water treatment plant in 1999 under CERCLA removal authority. The wastewater treatment plant must continue to operate in order to keep acidic mine water from receptors in the Little Fork Creek and Lynches River. Once the Site was listed on the National Priorities List in 2005, EPA's Remedial Program assumed responsibility for operating the wastewater treatment plant.

Cleanup Actions: EPA designated one operable unit (OU) to address the Site's soil, sediment, seeps, ground water and sludge contamination. EPA signed the Site's Interim Record of Decision (ROD) in September 2005, selecting an interim remedy to treat contamination at the Site. The major components of the interim remedy included: pumping and treating contaminated site ground water and discharging treated ground water to Little Fork Creek; monitoring to ensure that effluent meets water quality standards; annual downstream macroinvertebrate surveys; and managing sludge by dredging the Northwest Trend Pit and drying materials for storage. Remedial actions began in September 2006 and are ongoing at the Site. The Site's December 2010 Remedial Investigation Report identifies and evaluates a permanent site-wide remedy.

Five-Year Review Schedule: The National Contingency Plan requires that remedial actions resulting in any hazardous substances, pollutants or contaminants remaining at the Site above levels that allow for unlimited use and unrestricted exposure be reviewed every five years to ensure the protection of human health and the environment. The first Five-Year Review for the Site will be completed by September 2011.

EPA invites community participation in the Five-Year Review process: EPA is conducting this Five-Year Review to evaluate the effectiveness of the Site's remedy and to ensure that the remedy remains protective of human health and the environment. As part of the process, EPA staff members are available to answer any questions about the Site. Community members who have questions about the Site or the Five-Year Review process, or who would like to participate in a community interview, are asked to contact: Loften Carr, EPA Remedial Project Manager, Phone: 404-562-8804, E-mail: carr.loften@epa.gov or Angela Miller, EPA Community Involvement Coordinator, Phone: 404-562-8561 / 1-877-718-3752, ext. 28561 (toll-free), E-mail: miller.angela@epa.gov or at mailing address: EPA Region 4, 61 Forsyth Street S.W., Atlanta, GA 30303-8960. Additional site information is also available at the Site's document repository, located at Fannie D. Lowry Memorial Branch Library, 500 N. Main Street, Jefferson, SC 29718, or online at: *http://www.epa.gov/region4/waste/npl/nplsc/brwgldsc.htm*.

Appendix C: Interview Forms

Brewer Gold Mine Superfund Site **Five-Year Review Interview Form**

Site Name: Brewer Gold Mine **EPA ID No.:** SCD987577913
Interviewer Name: Johnny Zimmerman-Ward **Affiliation:** Skeo Solutions
Subject Name: Charles Williams, III **Affiliation:** SCDHEC
Subject Contact Information: williacj@dhec.sc.gov
Time: 10:45A.M. **Date:** 06/07/2011
Interview Location: Brewer Gold Mine Site Office

Interview Format (circle one): In Person Phone Mail Other:

Interview Category: State Agency

1. What is your overall impression of the project; including cleanup, maintenance and reuse activities (as appropriate)?
   Satisfied.

2. What is your assessment of the current performance of the remedy in place at the Site?
   It seems to work well for this site.

3. Are you aware of any complaints or inquiries regarding site-related environmental issues or remedial activities from residents in the past five years?
   No.

4. Has your office conducted any site-related activities or communications in the past five years? If so, please describe the purpose and results of these activities.
   We perform site visits, but are not in touch directly with the community, as Jim McLain acts as the community liaison.

5. Are you aware of any changes to state laws that might affect the protectiveness of the Site's remedy?
   No.

6. Are you comfortable with the status of the Institutional Controls at the Site? If not, what are the associated outstanding issues?
   Yes.

7. Do you have any comments, suggestions or recommendations regarding the management or operation of the Site's remedy?
   No.

Site Name:	**Brewer Gold Mine**	**EPA ID No.:**	**SCD987577913**
Interviewer Name:	**Johnny Zimmerman-Ward**	**Affiliation:**	**Skeo Solutions**
Subject Name:	**Loften Carr**	**Affiliation:**	**EPA**
Subject Contact Information:	**carr.loften@epa.gov**		
Time:	**10:50 A.M.**	**Date:**	**06/07/2011**
Interview Location:	**Brewer Gold Mine Site Office**		

Interview Format (circle one): **In Person** **Phone** **Mail** **Other:**

Interview Category: **EPA Remedial Project Manager**

1. What is your overall impression of the project; including cleanup, maintenance and reuse activities (as appropriate)?
   Good.

2. What have been the effects of the Site on the surrounding community, if any?
   There has been little to no effect on the community, no private wells were contaminated and there have been no complaints.

3. Are you aware of any complaints or inquiries regarding site-related environmental issues or remedial activities since the implementation of the cleanup?
   No.

4. What is your assessment of the current performance of the remedy in place at the Site?
   The remedy is doing quite well.

5. Are you comfortable with the status of the Institutional Controls at the Site? If not, what are the associated outstanding issues?
   Yes because it is not possible to put Institutional Controls on an abandoned property. The county has not yet foreclosed on the site, but the Institutional Controls will be addressed in the future when the time is right.

6. Are you aware of any community concerns regarding the Site or the operation and management of its remedy? If so, please provide details.
   No.

7. Do you have any comments, suggestions or recommendations regarding the management or operation of the Site's remedy?
   No, I am in touch with Jim McLain, who sends me weekly reports on the Site. Anytime we need to buy equipment, Black & Veatch comes to me for approval.

Site Name: Brewer Gold Mine **EPA ID No.:** SCD987577913
Interviewer Name: Treat Suomi **Affiliation:** Skeo Solutions
Subject Name: Jim McLain **Affiliation:** Gemini Services
Subject Contact Information: 843-658-6700
Time: 10:45 AM **Date:** 06/07/2011
Interview Location: Brewer Gold Mine Site Office

Interview Format (circle one): In Person Phone Mail Other:

Interview Category: O&M Contractor

1. What is your overall impression of the project; including cleanup, maintenance and reuse activities (as appropriate)?
   EPA has done a good job containing the situation. The RPM has a very good handle on what needs to be done.

2. What is your assessment of the current performance of the remedy in place at the Site?
   It is fairly labor intensive but very effective with very low technology. The new ROD will improve upon the water treatment.

3. What are the findings from the monitoring data? What are the key trends in contaminant levels that are being documented over time at the Site?
   We are containing the contaminants. There is no discharge of contaminants. Without treatment, the release could be horrendous.

4. Is there a continuous on-site O&M presence? If so, please describe staff responsibilities and activities. Alternatively, please describe staff responsibilities and the frequency of site inspections and activities if there is not a continuous on-site O&M presence.
   There are three personnel here on site. Someone is here on a daily basis. We are responsible for water treatment, site integrity (e.g., tree removal), site security, general equipment upkeep and management, and sludge management. I live here in the community and I attend town meetings, conduct tours and involve the community. This prevents trespassing and vandalism and keeps the community informed.

5. Have there been any significant changes in site O&M requirements, maintenance schedules or sampling routines since start-up or in the last five years? If so, do they affect the protectiveness or effectiveness of the remedy? Please describe changes and impacts.
   As equipment ages, there have been upgrades. Vegetation and sludge management activities have been approved.

6. Have there been unexpected O&M difficulties or costs at the Site since start-up or in the last five years? If so, please provide details.
   There has been a large increase in electricity costs due to a raise in rates/loss of discount.

7. Have there been opportunities to optimize O&M activities or sampling efforts? Please describe changes and any resulting or desired cost savings or improved efficiencies.

In 2007, Black & Veatch conducted a pump test to determine how long we could go without pumping. This created helpful information about ground water and confirmed the problem is localized.

8. Do you have any comments, suggestions or recommendations regarding O&M activities and schedules at the Site?
   There are not any comments beyond what is already in "the works" with EPA. The RPM is in regular contact and works closely with Black & Veatch. Personally, I would like to see the property stay as one piece and not be broken up into smaller parcels.

Appendix D: Site Inspection Checklist

FIVE-YEAR REVIEW SITE INSPECTION CHECKLIST

I. SITE INFORMATION

Site Name: Brewer Gold Mine	**Date of Inspection: 6/7/11**
Location and Region: Region 4, Jefferson, SC	**EPA ID: SCD987577913**
Agency, Office or Company Leading the Five-Year Review: EPA Region 4	**Weather/Temperature: High 80s and sunny**

Remedy Includes: (Check all that apply)

- ☐ Landfill cover/containment
- ☐ Access controls
- ☐ Institutional controls
- ☒ Ground water pump and treatment
- ☒ Surface water collection and treatment
- ☐ Other: _____
- ☐ Monitored natural attenuation
- ☐ Ground water containment
- ☐ Vertical barrier walls

Attachments: ☒ Inspection team roster attached ☐ Site map attached

II. INTERVIEWS (check all that apply)

1. **O&M Site Manager** Jim McLain (Name) _____ (Title) 06/07/2011 (Date)
   Interviewed ☒ at site ☐ at office ☐ by phone Phone: _____
   Problems, suggestions ☒ Report attached: See Appendix C

2. **O&M Staff** _____ (Name) _____ (Title) mm/dd/yyyy (Date)
   Interviewed ☐ at site ☐ at office ☐ by phone Phone: _____
   Problems/suggestions ☐ Report attached: _____

3. **Local Regulatory Authorities and Response Agencies** (i.e., state and tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices). Fill in all that apply.

Agency SCDHEC
Contact Charles J. Williams, III (Name) | Project Manager (Title) | 06/07/2011 (Date) | 803-896-4162 (Phone No.)
Problems/suggestions ☒ Report attached: See Appendix C

Agency _____
Contact _____ Name | _____ Title | _____ Date | _____ Phone No.
Problems/suggestions ☐ Report attached: _____

Agency _____
Contact _____ Name | _____ Title | _____ Date | _____ Phone No.
Problems/suggestions ☐ Report attached: _____

Agency _____
Contact _____ Name | _____ Title | _____ Date | _____ Phone No.
Problems/suggestions ☐ Report attached: _____

Agency _____
Contact _____ Name | _____ Title | _____ Date | _____ Phone No.
Problems/suggestions ☐ Report attached: _____

4. **Other Interviews** (optional) ☒ Report attached: _____

Loften Carr, EPA RPM

III. ON-SITE DOCUMENTS AND RECORDS VERIFIED (check all that apply)

1. **O&M Documents**

☒ O&M manual	☒ Readily available	☐ Up to date	☐ N/A
☒ As-built drawings	☒ Readily available	☐ Up to date	☐ N/A
☒ Maintenance logs	☒ Readily available	☒ Up to date	☐ N/A

Remarks: Weekly reporting

2. **Site-Specific Health and Safety Plan**	☒ Readily available	☒ Up to date	☐ N/A
☒ Contingency plan/emergency response plan	☒ Readily available	☒ Up to date	☐ N/A

Remarks: _____

3. **O&M and OSHA Training Records**	☒ Readily available	☒ Up to date	☐ N/A

Remarks: Staff are Hazwoper and CPR trained

4.	**Permits and Service Agreements**			
	☐ Air discharge permit	☐ Readily available	☐ Up to date	☒ N/A
	☐ Effluent discharge	☐ Readily available	☐ Up to date	☒ N/A
	☐ Waste disposal, POTW	☐ Readily available	☐ Up to date	☒ N/A
	☐ Other permits: _____	☐ Readily available	☐ Up to date	☒ N/A
	Remarks: NPDES permit not required			
5.	**Gas Generation Records**	☐ Readily available	☐ Up to date	☒ N/A
	Remarks: _____			
6.	**Settlement Monument Records**	☐ Readily available	☐ Up to date	☒ N/A
	Remarks: _____			
7.	**Ground Water Monitoring Records**	☐ Readily available	☐ Up to date	☒ N/A
	Remarks: _____			
8.	**Leachate Extraction Records**	☐ Readily available	☐ Up to date	☒ N/A
	Remarks: _____			
9.	**Discharge Compliance Records**			
	☐ Air	☐ Readily available	☐ Up to date	☒ N/A
	☒ Water (effluent)	☒ Readily available	☒ Up to date	☐ N/A
	Remarks: _____			
10.	**Daily Access/Security Logs**	☒ Readily available	☒ Up to date	☐ N/A
	Remarks: _____			

IV. O&M COSTS

1.	**O&M Organization**	
	☐ State in-house	☐ Contractor for state
	☐ PRP in-house	☒ Contractor for PRP
	☐ Federal facility in-house	☐ Contractor for Federal facility
	☐ _____	

2. **O&M Cost Records**

☒ Readily available ☒ Up to date

☐ Funding mechanism/agreement in place ☐ Unavailable

Original O&M cost estimate: $695,684 ☐ Breakdown attached

Total annual cost by year for review period if available

From: 01/01/2006 Date	To: 12/31/2006 Date	$642,919 Total cost	☐ Breakdown attached
From: 01/01/2007 Date	To: 12/31/2007 Date	$608,401 Total cost	☐ Breakdown attached
From: 01/01/2008 Date	To: 12/31/2008 Date	$919,486 Total cost	☐ Breakdown attached
From: 01/01/2009 Date	To: 12/31/2009 Date	$1,021,113 Total cost	☐ Breakdown attached
From: 01/01/2010 Date	To: 12/31/2010 Date	_____ Total cost	☐ Breakdown attached

3. **Unanticipated or Unusually High O&M Costs during Review Period**

Describe costs and reasons: O&M costs have increased by more than 50 percent over the past five years due to utility rate increases.

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A

A. Fencing

1. **Fencing Damaged** ☐ Location shown on site map ☐ Gates secured ☒ N/A

Remarks: _____

B. Other Access Restrictions

1. **Signs and Other Security Measures** ☐ Location shown on site map ☐ N/A

Remarks: Daily presence of O&M staff on site

C. Institutional Controls (ICs)

1. **Implementation and Enforcement**

Site conditions imply ICs not properly implemented ☐ Yes ☐ No ☒ N/A

Site conditions imply ICs not being fully enforced ☐ Yes ☐ No ☒ N/A

Type of monitoring (e.g., self-reporting, drive by): _____

Frequency: _____

Responsible party/agency: _____

Contact _____ _____ mm/dd/yyyy _____

Name Title Date Phone no.

Reporting is up to date ☐ Yes ☐ No ☒ N/A

Reports are verified by the lead agency ☐ Yes ☐ No ☒ N/A

Specific requirements in deed or decision documents have been met ☐ Yes ☐ No ☒ N/A

Violations have been reported ☐ Yes ☐ No ☒ N/A

Other problems or suggestions: ☐ Report attached

2. **Adequacy** ☐ ICs are adequate ☐ ICs are inadequate ☒ N/A

Remarks: ICs will be addressed in final remedy selection

D. General

1. **Vandalism/Trespassing** ☐ Location shown on site map ☒ No vandalism evident

Remarks: _____

2. **Land Use Changes On Site** ☒ N/A

Remarks: _____

3. **Land Use Changes Off Site** ☒ N/A

Remarks: _____

VI. GENERAL SITE CONDITIONS

A. Roads ☒ Applicable ☐ N/A

1. **Roads Damaged** ☐ Location shown on site map ☒ Roads adequate ☐ N/A

Remarks: _____

B. Other Site Conditions

Remarks: Site is well maintained by O&M contractor staff

VII. LANDFILL COVERS ☒ Applicable ☐ N/A

A. Landfill Surface

1. **Settlement** (low spots) ☐ Location shown on site map ☒ Settlement not evident

Arial extent: _____ Depth: _____

Remarks: _____

2.	**Cracks**	☐ Location shown on site map	☒ Cracking not evident
	Lengths: _____	Widths: _____	Depths: _____
	Remarks: _____		
3.	**Erosion**	☐ Location shown on site map	☒ Erosion not evident
	Arial extent: _____		Depth: _____
	Remarks: _____		
4.	**Holes**	☐ Location shown on site □ap	☒ Holes not evident
	Arial extent: _____		Depth: _____
	Remarks: _____		
5.	**Vegetative Cover**	☒ Grass	☒ Cover properly established
	☐ No signs of s□ress	☐ Trees/shrubs (indicate size and locations on a diagram)	
	Remarks: _____		
6.	**Alternative Cover** (e.g., armored rock, concrete)		☒ N/A
	Remarks: _____		
7.	**Bulges**	☐ Location□shown on site map	☒ Bulges not evident
	Arial extent: _____		Height: _____
	Remarks: _____		
8.	**Wet Areas/Water Damage**	☒ Wet areas/water damage not evident	
	☐ Wet a□eas	☐ Location shown on site map	Arial extent: _____
	☐ Ponding	☐ Location shown on site map	Arial extent: _____
	☐ Seeps	☐ Location shown on site □ap	Arial extent: _____
	☐ Soft subgrade	☐ Location shown on site map	Arial extent: _____
	Remarks: _____		
9.	**Slope Instability**	☐ Slides	☐ Location □hown on site map
	☒ No evidence of slope instability		
	Arial extent: _____		
	Remarks: _____		
B. Benches		☐ Applicable	☒ N/A
	(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)		
1.	**Flows Bypass Bench**	☐ Location shown on site map	☐ N/A or okay
	Remarks: _____		
2.	**Bench Breached**	☐ Location shown on site map	☐ N/A or okay
	Remarks: _____		

3.	**Bench Overtopped**	☐ Location shown on site map	☐ N/A or okay
	Remarks: _____		
C. Letdown Channels		☐ Applicable	☒ N/A
	(Channel lined with erosion control mats, riprap, grout bags or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)		
1.	**Settlement** (Low spots)	☐ Location shown on site map	☐ No evidence of settlement
	Arial extent: _____		Depth: _____
	Remarks: _____		
2.	**Material Degradation**	☐ Location shown on site map	☐ No evidence of degradation
	Material type:_____		Arial extent: _____
	Remarks: _____		
3.	**Erosion**	☐ Location shown on site map	☐ No evidence of erosion
	Arial extent: _____		Depth: _____
	Remarks: _____		
4.	**Undercutting**	☐ Location shown on site map	☐ No evidence of undercutting
	Arial extent: _____		Depth: _____
	Remarks: _____		
5.	**Obstructions**	Type: _____	☐ No obstructions
	☐ Location shown on site map	Arial extent: _____	
	Size: _____		
	Remarks: _____		
6.	**Excessive Vegetative Growth**	Type: _____	
	☐ No evidence of excessive growth		
	☐ Vegetation in channels does not obstruct flow		
	☐ Location shown on site map	Arial extent: _____	
	Remarks: _____		
D. Cover Penetrations		☐ Applicable	☒ N/A
1.	**Gas Vents**	☐ Active	☐ Passive
	☐ Properly secured/locked	☐ Functioning	☐ Routinely sampled	☐ Good condition
	☐ Evidence of leakage at penetration		☐ Needs maintenance	☐ N/A
	Remarks: _____		

2. **Gas Monitoring Probes**

☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition

☐ Evidence of leakage at penetration ☐ Needs maintenance ☐ N/A

Remarks: _____

3. **Monitoring Wells** (within surface area of landfill)

☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition

☐ Evidence of leakage at penetration ☐ Needs maintenance ☐ N/A

Remarks: _____

4. **Extraction Wells Leachate**

☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition

☐ Evidence of leakage at penetration ☐ Needs maintenance ☐ N/A

Remarks: _____

5. **Settlement Monuments** ☐ Located ☐ Routinely surveyed ☐ N/A

Remarks: _____

E. Gas Collection and Treatment ☐ Applicable ☒ N/A

1. **Gas Treatment Facilities**

☐ Flaring ☐ Thermal destruction ☐ Collection for reuse

☐ Good condition ☐ Needs maintenance

Remarks: _____

2. **Gas Collection Wells, Manifolds and Piping**

☐ Good condition ☐ Needs maintenance

Remarks: _____

3. **Gas Monitoring Facilities** (e.g., gas monitoring of adjacent homes or buildings)

☐ Good condition ☐ Needs maintenance ☐ N/A

Remarks: _____

F. Cover Drainage Layer ☐ Applicable ☒ N/A

1. **Outlet Pipes Inspected** ☐ Functioning ☐ N/A

Remarks: _____

2. **Outlet Rock Inspected** ☐ Functioning ☐ N/A

Remarks: _____

G. Detention/Sedimentation Ponds ☐ Applicable ☒ N/A

1. **Siltation** Area extent: _____ Depth: _____ ☐ N/A

☐ Siltation not evident

Remarks: _____

2. **Erosion** Area extent: _____ Depth: _____

☐ Erosion not evident

Remarks: _____

3. **Outlet Works** ☐ Functioning ☐ N/A

Remarks: _____

4. **Dam** ☐ Functioning ☐ N/A

Remarks: _____

H. Retaining Walls ☐ Applicable ☒ N/A

1. **Deformations** ☐ Location shown on site map ☐ Deformation not evident

Horizontal displacement: _____ Vertical displacement: _____

Rotational displacement: _____

Remarks: _____

2. **Degradation** ☐ Location shown on site map ☐ Degradation not evident

Remarks: _____

I. Perimeter Ditches/Off-Site Discharge ☐ Applicable ☒ N/A

1. **Siltation** ☐ Location shown on site map ☐ Siltation not evident

Area extent: _____ Depth: _____

Remarks: _____

2. **Vegetative Growth** ☐ Location shown on site map ☐ N/A

☐ Veget□□ion does not impede flow

Area extent: _____ Type: _____

Remarks: _____

3. **Erosion** ☐ Location shown on site map ☐ Erosion not evident

Area extent: _____ Depth: _____

Remarks: _____

4. **Discharge Structure** ☐ Functioning ☐ N/A

Remarks: _____

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ N/A

1. **Settlement** ☐ Location shown on site map ☐ Settlement not evident

Area extent: _____ Depth: _____

Remarks: _____

2. **Performance Monitoring** Type of monitoring: _____

☐ Performance not monitored

Frequency: _____ ☐ Evidence of breaching

Head differential: _____

Remarks: _____

IX. GROUND WATER/SURFACE WATER REMEDIES ☒ Applicable ☐ N/A

A. Ground Water Extraction Wells, Pumps and Pipelines ☒ Applicable ☐ N/A

1. **Pumps, Wellhead Plumbing and Electrical**

☒ Good condition ☒ All required wells properly operating ☐ Needs maintenance ☐ N/A

Remarks: _____

2. **Extraction System Pipelines, Valves, Valve Boxes and Other Appurtenances**

☒ Good condition ☐ Needs maintenance

Remarks: _____

3. **Spare Parts and Equipment**

☒ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided

Remarks: _____

B. Surface Water Collection Structures, Pumps and Pipelines ☒ Applicable ☐ N/A

1. **Collection Structures, Pumps and Electrical**

☒ Good condition ☐ Needs maintenance

Remarks: _____

2. **Surface Water Collection System Pipelines, Valves, Valve Boxes and Other Appurtenances**

☒ Good condition ☐ Needs maintenance

Remarks: _____

3. **Spare Parts and Equipment**

☒ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provide

Remarks: _____

C. Treatment System ☒ Applicable ☐ N/A

1. **Treatment Train** (check components that apply)

☒ Metals removal ☐ Oil/water separation ☐ Bioremediation

☐ Air stripping ☐ Carbon adsorbers

☐ Filters: _____

☒ Additive (e.g., chelation agent, flocculent): lime

☐ Others: _____

☒ Good condition ☐ Needs maintenance

☐ Sampling ports properly marked and functional

☐ Sampling/maintenance log displayed and up to date

☐ Equipment properly identified

☐ Quantity of ground water treated annually: _____

☐ Quantity of surface water treated annually: _____

Remarks: _____

2. **Electrical Enclosures and Panels** (properly rated and functional)

☐ N/A ☒ Good condition ☐ Needs maintenance

Remarks: _____

3. **Tanks, Vaults, Storage Vessels**

☐ N/A ☒ Good condition ☐ Proper secondary containment ☐ Needs maintenance

Remarks: _____

4. **Discharge Structure and Appurtenances**

☐ N/A ☒ Good condition ☐ Needs maintenance

Remarks: _____

5. **Treatment Building(s)**

☒ N/A ☐ Good condition (esp. roof and doorways) ☐ Needs repair

☐ Chemicals and equipment properly stored

Remarks: _____

6. **Monitoring Wells** (pump and treatment remedy)

☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition

☐ All required wells located ☐ Needs maintenance ☒ N/A

Remarks: _____

D. Monitoring Data

1. **Monitoring Data**

☒ Is routinely submitted on time ☒ Is of acceptable quality

2. **Monitoring Data Suggests:**

☐ Ground water plume is effectively contained ☐ Contaminant concentrations are declining

E. Monitored Natural Attenuation				
1. **Monitoring Wells** (natural attenuation remedy)				
☐ Properly secured/locked	☐ Functioning	☐ Routinely sampled	☐ Good condition	
☐ All required wells located	☐ Needs maintenance		☐ N/A	
Remarks: _____				

X. OTHER REMEDIES

If there are remedies applied at the site and not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is designed to accomplish (e.g., to contain contaminant plume, minimize infiltration and gas emissions).
The intention of the interim remedy is to continue treatment of contaminated wastewater and discharge to the Creek. An RI was completed in 2010 and a final remedy will address any remaining issues.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.
O&M is performed regularly.

C. Early Indicators of Potential Remedy Problems

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future.
None.

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.
_____

Site Inspection Participants:
Loften Carr, EPA Region 4
Jim McLain, Gemini Services
Van Keisler, SCDHEC
Jason Lambert, SCDHEC
Charles Williams III, SC DHEC
Kayse Jarman, SC DHEC
Treat Suomi, Skeo Solutions
Johnny Zimmerman-Ward, Skeo Solutions

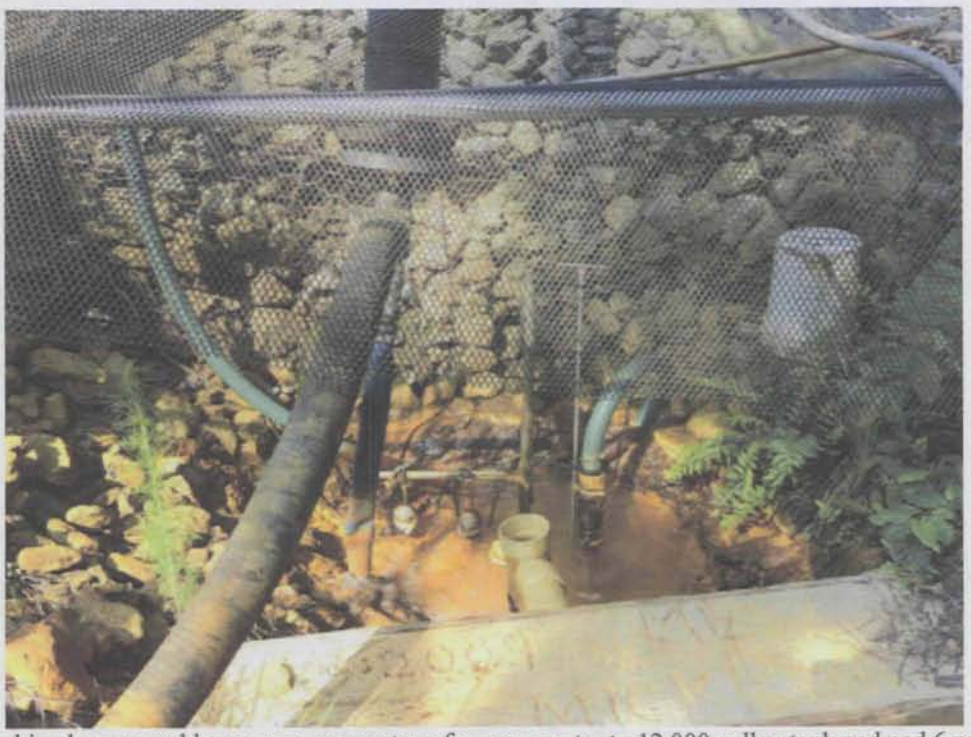
Appendix E: Photographs from Site Inspection Visit

Looking northwest at capped Brewer pit

Extraction well 1

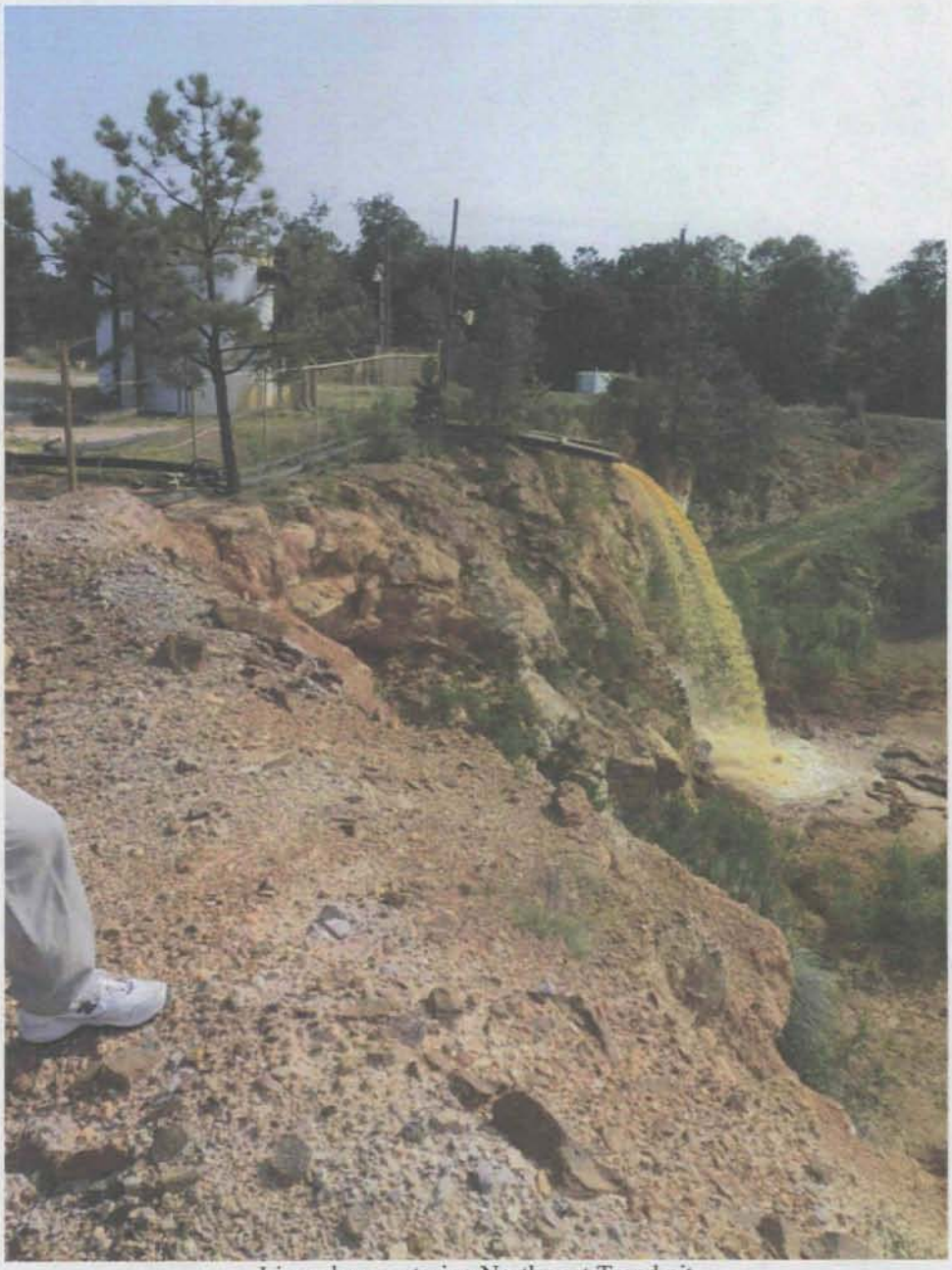
Toe of B6 pit and seep collection box

Backup transfer system (12,000-gallon tank and two pumps)

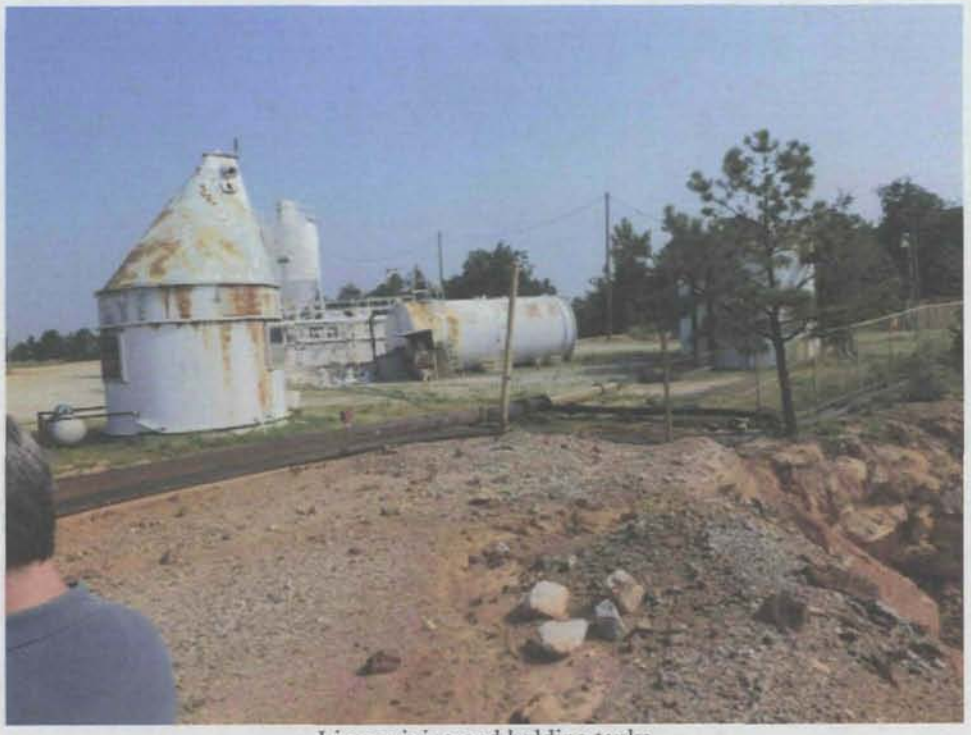


Combined upper and lower seeps pump transfers seep water to 12,000 gallon tank and pad 6 pond

Northwest Trend pit (settling site for neutralization treatment sludge)



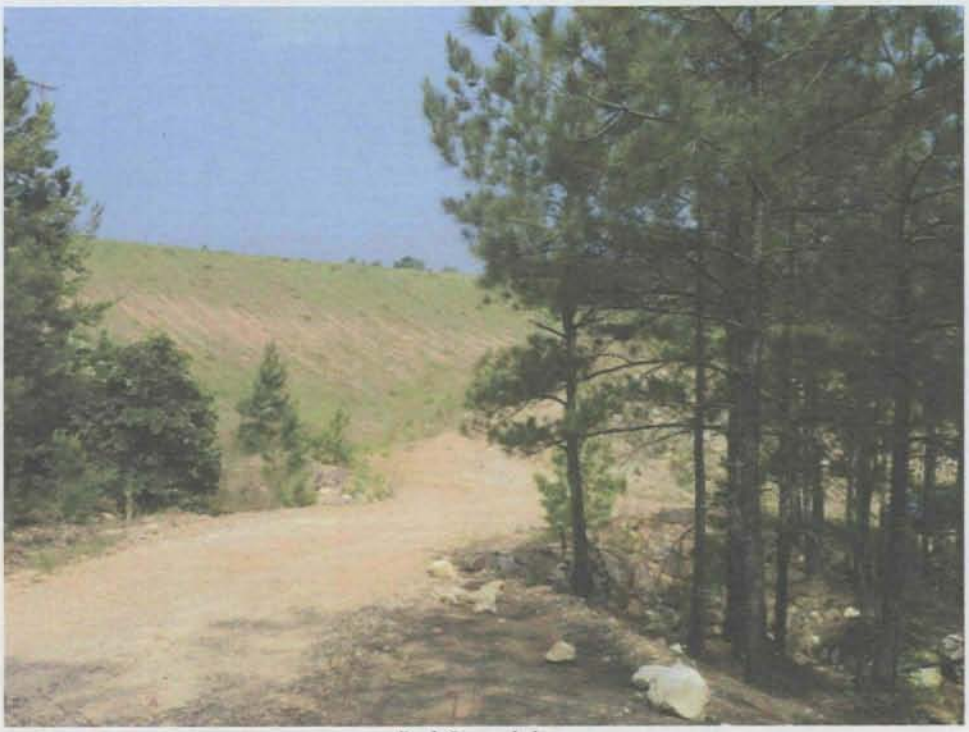
Lime slurry entering Northwest Trend pit



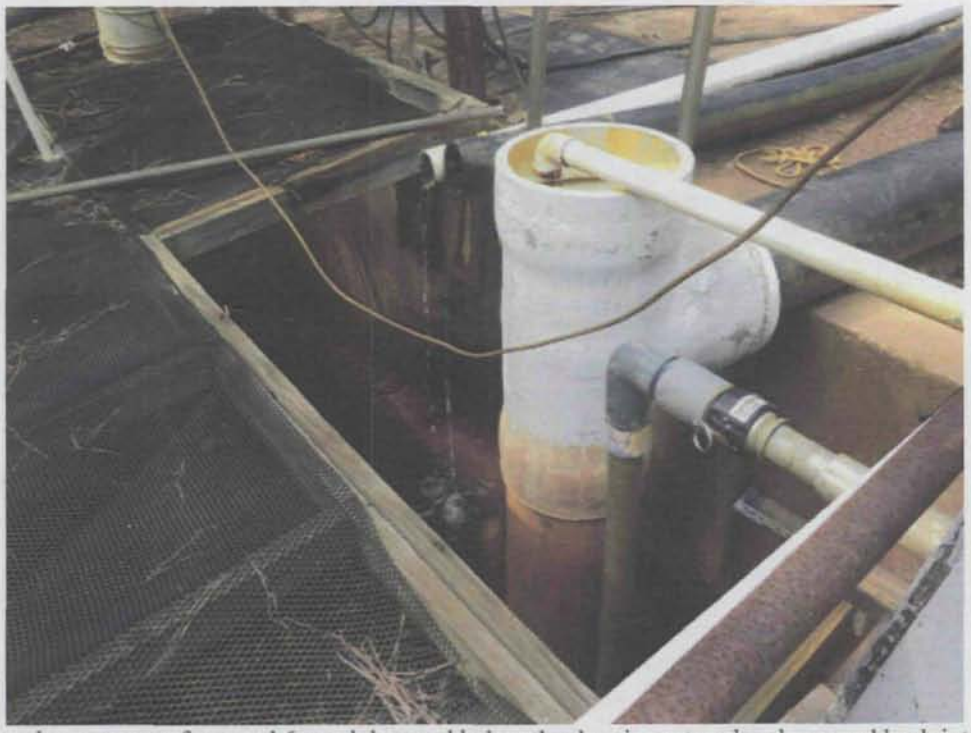
Lime mixing and holding tanks

Sludge drying cell

Lined pad 6 pond.



Pad 6 pond dam



Pad 6 pump where seepage from pad 6 pond dam and below the dam is captured and pumped back into the pad 6 pond

Treated water holding pond (plastic liner used to store discharge-quality water)

Treated effluent discharge to Little Fork Creek

Treated effluent discharge to Little Fork Creek

Appendix F: Historical Site Maps

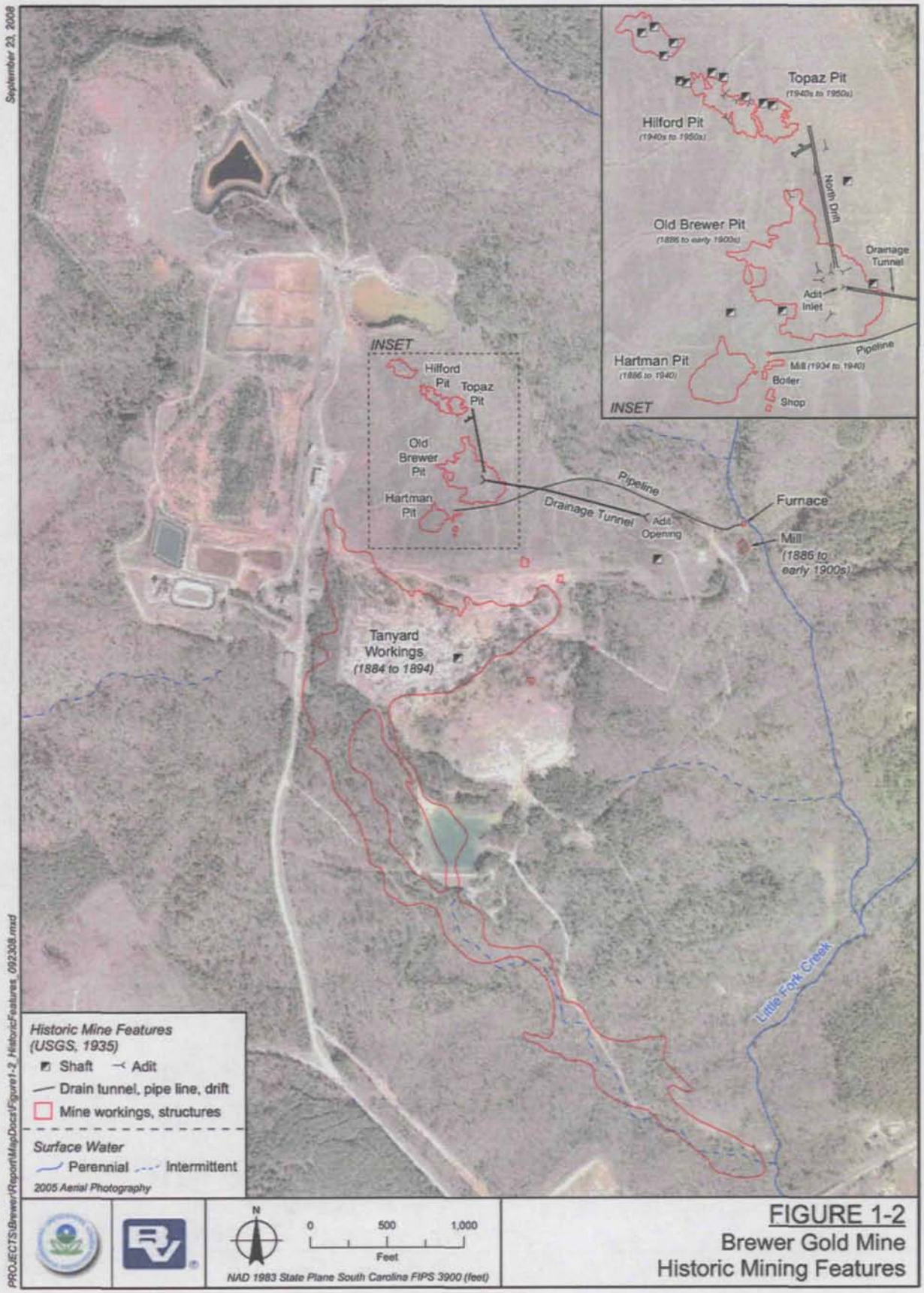


FIGURE 1-2
Brewer Gold Mine
Historic Mining Features

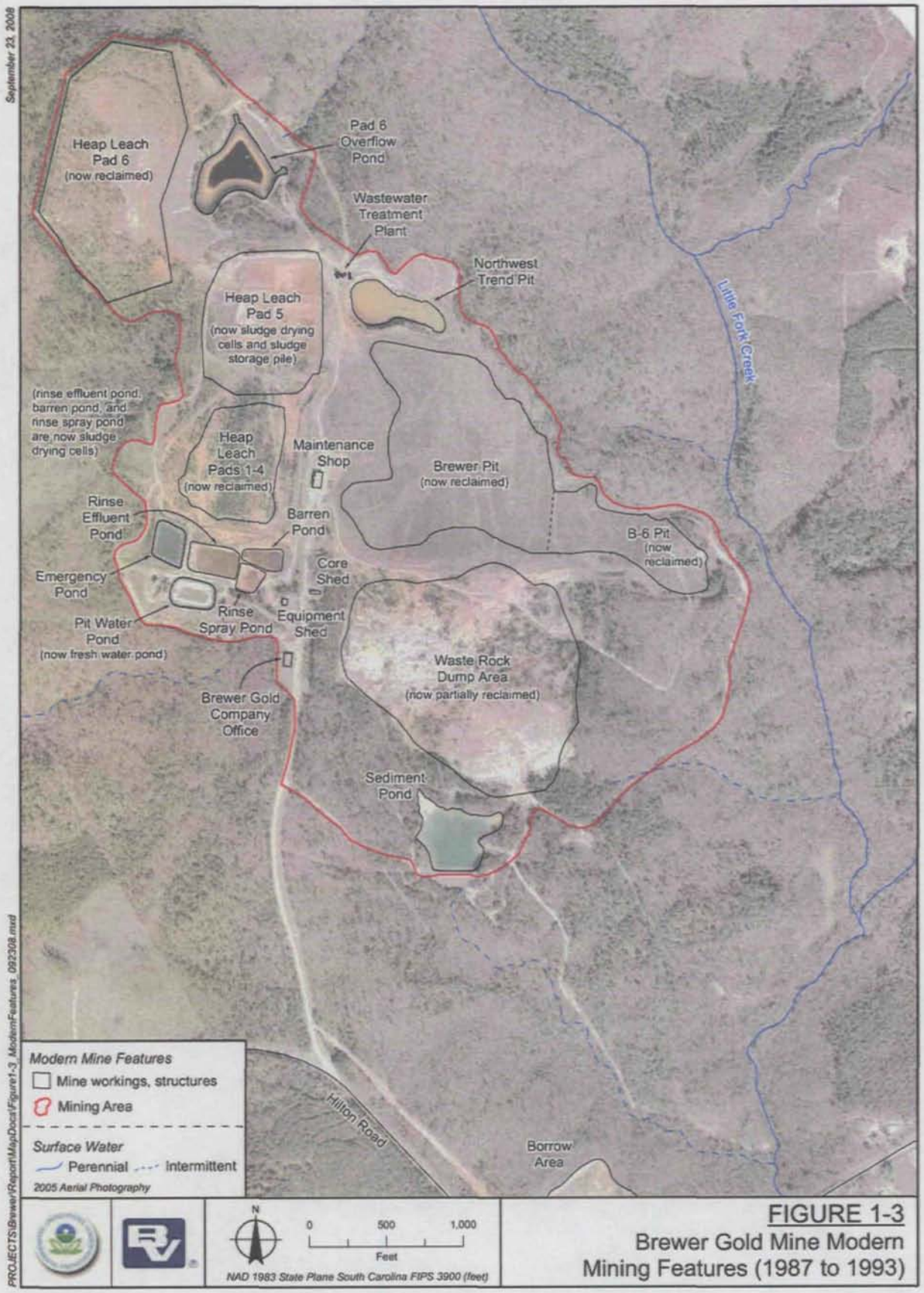


FIGURE 1-3
Brewer Gold Mine Modern Mining Features (1987 to 1993)

Appendix G: Effluent Sampling Data Results, September 2006 - May 2011

	Aluminum (lbs/MG)		Aluminum (mg/L)		Copper (lbs/MG)		Copper (mg/L)		Selenium (lbs/MG)		Selenium (mg/L)		Mercury (lbs/MG)		Mercury (mg/L)	
	Monthly Average	Daily Max	Monthly Average	Daily Max	Monthly Average	Daily Max	Monthly Average	Daily Max	Monthly Average	Daily Max	Monthly Average	Daily Max	Monthly Average	Daily Max	Monthly Average	Daily Max
Interim ROD Limits	*0.726*	*6.26*	*NA*	*NA*	*0.0835*	*0.167*	*0.15*	*0.3*	*0.0417*	*0.167*	*NA*	*NA*	*0.00167*	*0.00334*	*0.001*	*0.002*
SEPT2006	0.134978	0.218697	0.19	NA	0.0071041	0.01151	0.01	NA	0.0220228	0.035682	0.031	NA	0.00014	0.00023	0.0002	NA
OCT2006	0.150018	0.287759	0.2	NA	0.0075009	0.014388	0.01	NA	0.0292534	0.056113	0.039	NA	0.00015	0.00029	0.0002	NA
NOV2006	0.037992	0.173332	0.1	NA	0.0037992	0.017333	0.01	NA	0.009498	0.043333	0.025	NA	0.00008	0.00035	0.0002	NA
DEC2006	0.020059	0.057414	0.1	NA	0.0020059	0.005741	0.01	NA	0.0076225	0.021817	0.038	NA	0.00004	0.00011	0.0002	NA
JAN2007	0.013139	0.038044	0.11	NA	0.0013139	0.003804	0.011	NA	0.0037027	0.010722	0.031	NA	0.00002	0.00007	0.0002	NA
FEB2007	0.023333	0.042562	0.19	NA	0.0024561	0.00448	0.02	NA	0.0042981	0.00784	0.035	NA	0.00002	0.00004	0.0002	NA
MAR2007	0.019283	0.04225	0.21	NA	0.0011019	0.002414	0.012	NA	0.002112	0.004627	0.023	NA	0.00002	0.00004	0.0002	NA
APR2007	0.045253	0.175421	0.5	NA	0.0015386	0.005964	0.017	NA	0.0022627	0.008771	0.025	NA	0.0000	0.0001	0.0002	NA
MAY2007	0.382298	**7.145497**	0.86	NA	0.0062235	0.116322	0.014	NA	0.0164477	**0.307423**	0.037	NA	0.0001	0.0017	0.0002	NA
JUN2007	0.073293	0.147241	0.62	NA	0.0023643	0.00475	0.02	NA	0.0039011	0.007837	0.033	NA	0.0000	0.0000	0.0002	NA
JUL2007	0.271962	0.706597	0.76	NA	0.0050098	0.013016	0.014	NA	0.022902	0.059503	0.064	NA	0.0001	0.0002	0.0002	NA
AUG2007	0.239484	0.460821	0.39	NA	0.009825	0.018905	0.016	NA	**0.0485108**	0.093346	0.079	NA	0.0001	0.0002	0.0002	NA
SEPT2007	0.169355	0.300698	0.27	NA	0.0106631	0.018933	0.017	NA	0.0282258	0.050116	0.045	NA	0.0001	0.0002	0.0002	NA
OCT2007	0.039313	0.070069	0.12	NA	0.0049141	0.008759	0.015	NA	0.01507	0.02686	0.046	NA	0.0001	0.0001	0.0002	NA
NOV2007	0.036119	0.053757	0.13	NA	0.0050011	0.007443	0.018	NA	0.0141698	0.021089	0.051	NA	0.0001	0.0001	0.0002	NA
DEC2007	0.02748	0.071225	0.1	NA	0.0049464	0.012821	0.018	NA	0.0115416	0.029915	0.042	NA	0.0001	0.0002	0.00028	NA
JAN2008	0.218138	0.45742	0.32	NA	0.0381742	0.080048	0.056	NA	0.0204504	0.042883	0.03	NA	0.0002	0.0010	0.00068	NA
FEB2008	0.038262	0.06813	0.14	NA	0.0076523	0.013626	0.028	NA	0.0117518	0.020926	0.043	NA	0.0001	0.0001	0.0002	NA
MAR2008	0.030924	0.092323	0.17	NA	0.0018191	0.005431	0.01	NA	0.0034562	0.010318	0.019	NA	0.0000	0.0001	0.0002	NA
APR2008	0.176226	0.60024	1	NA	0.0029958	0.010204	0.017	NA	0.0075777	0.02581	0.043	NA	0.0000	0.0001	0.0002	NA
MAY2008	0.370544	0.73503	0.65	NA	0.0091211	0.018093	0.016	NA	0.0267932	0.053148	0.047	NA	0.0001	0.0002	0.0002	NA
JUN2008	0.717094	1.03431	2.2	NA	0.0042374	0.006112	0.013	NA	0.0185793	0.026798	0.057	NA	0.0001	0.0001	0.0002	NA
JUL2008	0.343785	0.549098	0.52	NA	0.0079335	0.012671	0.012	NA	0.0343785	0.05491	0.052	NA	0.0001	0.0002	0.0002	NA
AUG2008	0.509216	0.825667	0.74	NA	0.0123863	0.020084	0.018	NA	0.031654	0.051325	0.046	NA	0.0001	0.0002	0.0002	NA
SEPT2008	0.176054	0.476437	0.27	NA	0.0065205	0.017646	0.01	NA	0.0312984	0.0847	0.048	NA	0.0001	0.0004	0.0002	NA
OCT2008	0.117029	0.301247	0.19	NA	0.0061594	0.015855	0.01	NA	0.0277174	0.071348	0.045	NA	0.0001	0.0004	0.00025	NA
NOV2008	0.055955	0.125995	0.12	NA	0.0046629	0.0105	0.01	NA	0.0186518	0.041998	0.04	NA	0.0001	0.0003	0.00032	NA
DEC2008	0.043284	0.122456	0.2	NA	0.0021642	0.006123	0.01	NA	0.0077912	0.022042	0.036	NA	0.0000	0.0001	0.0002	NA
JAN2009	0.036735	0.073151	0.19	NA	0.0019334	0.00385	0.01	NA	0.0075403	0.015015	0.039	NA	0.0000	0.0001	0.0002	NA
FEB2009	0.028323	0.058638	0.15	NA	0.0013218	0.005082	0.013	NA	0.0081194	0.016809	0.043	NA	0.0000	0.0001	0.0002	NA

MAR2009	0.041689	0.179543	0.48	NA	0.000608	0.004863	0.013	NA	0.0026056	0.011221	0.03	NA	0.0000	0.0001	0.0002	NA
APR2009	0.050008	0.103688	0.44	NA	0.000918	0.003535	0.015	NA	0.0042052	0.008719	0.037	NA	0.0000	0.0000	0.0002	NA
MAY2009	0.087998	0.334078	1	NA	0.00088	0.003341	0.01	NA	0.0036959	0.014031	0.042	NA	0.0000	0.0001	0.0002	NA
JUN2009	0.097371	0.239397	0.51	NA	0.0019092	0.004694	0.01	NA	0.0055368	0.013613	0.029	NA	0.0000	0.0001	0.0002	NA
JUL2009	0.057305	0.337286	0.43	NA	0.0014659	0.008628	0.011	NA	0.0065301	0.038435	0.049	NA	0.0000	0.0002	0.0002	NA
AUG2009	0.070326	0.131781	0.16	NA	0.0043954	0.008236	0.01	NA	0.0162629	0.030474	0.037	NA	0.0001	0.0002	0.0002	NA
SEPT2009	0.495088	0.892779	0.75	NA	0.0066012	0.011904	0.01	NA	0.0297053	0.053567	0.045	NA	0.0001	0.0002	0.0002	NA
OCT2009	0.118718	0.282748	0.2	NA	0.010228	0.04524	0.032	NA	0.026118	0.062205	0.044	NA	0.0001	0.0003	0.0002	NA
NOV2009	0.133596	0.234024	0.44	NA	0.0053952	0.017552	0.033	NA	0.007287	0.012765	0.024	NA	0.0001	0.0001	0.0002	NA
DEC2009	0.071578	0.282225	0.34	NA	0.0018138	0.013281	0.016	NA	0.004421	0.017432	0.021	NA	0.0000	0.0002	0.0002	NA
JAN2010	0.02398	0.106829	0.15	NA	0.0012912	0.010683	0.015	NA	0.0039966	0.017805	0.025	NA	0.0000	0.0001	0.0002	NA
FEB2010	0.011224	0.039093	0.1	NA	0.0041531	0.014465	0.037	NA	0.0025816	0.008991	0.023	NA	0.0000	0.0001	0.0002	NA
MAR2010	0.006907	0.022607	0.13	NA	0.0004577	0.002782	0.016	NA	0.0021252	0.006956	0.04	NA	0.0000	0.0000	0.0002	NA
APR2010	0.020757	0.028933	0.12	NA	0.0024217	0.003376	0.014	NA	0.007784	0.01085	0.045	NA	0.0000	0.0000	0.0002	NA
MAY2010	0.049504	0.077498	0.17	NA	0.0037856	0.005926	0.013	NA	0.0136864	0.021426	0.047	NA	0.0001	0.0001	0.0002	NA
JUN2010	0.270378	0.400123	0.61	NA	0.0053189	0.007871	0.012	NA	0.0168432	0.024926	0.038	NA	0.0001	0.0001	0.0002	NA
JUL2010	0.12631	0.182626	0.25	NA	0.0085891	0.012419	0.017	NA	0.0181886	0.026298	0.036	NA	0.0001	0.0001	0.0002	NA
AUG2010	0.105025	0.173946	0.24	NA	0.004376	0.007248	0.01	NA	0.0113777	0.018844	0.026	NA	0.0001	0.0001	0.0002	NA
SEPT2010	0.096304	0.17318	0.18	NA	0.0053502	0.009621	0.01	NA	0.0149806	0.026939	0.028	NA	0.0001	0.0002	0.0002	NA
OCT2010	0.119407	0.320885	0.17	NA	0.0105359	0.028313	0.015	NA	0.0280958	0.075502	0.04	NA	0.0001	0.0004	0.0002	NA
NOV2010	0.090444	0.330462	0.11	NA	0.0443999	0.162227	0.054	NA	0.0337111	0.123172	0.041	NA	0.0002	0.0006	0.0002	NA
DEC2010	0.060084	0.060084	0.1	NA	0.0294412	0.029441	0.049	NA	0.0318445	0.031845	0.053	NA	0.0001	0.0001	0.0002	NA
JAN2011	0.060084	0.060084	0.1	NA	0.0108151	0.010815	0.018	NA	0.0330462	0.033046	0.055	NA	0.0001	0.0001	0.0002	NA
FEB2011	0.082401	0.144202	0.12	NA	0.0082401	0.01442	0.012	NA	0.0322737	0.056479	0.047	NA	0.0002	0.0003	0.00029	NA
MAR2011	0.017864	0.033749	0.17	NA	0.0016813	0.003176	0.016	NA	0.0040981	0.007743	0.039	NA	0.0000	0.0000	0.0002	NA
APR2011	0.106221	0.473779	0.5	NA	0.0025493	0.011371	0.012	NA	0.0080728	0.036007	0.038	NA	0.0000	0.0002	0.0002	NA
MAY2011	0.24871	0.706909	0.7	NA	0.0241604	0.068671	0.068	NA	0.0092378	0.026257	0.026	NA	0.0001	0.0002	0.0002	NA

NA = Not Available
Bolded/Red = exceedance of interim ROD goals